MODELS FOR GROWTH CHARACTERISTICS AND THEIR APPLICATIONS IN YIELD STUDIES FOR *Pinus caribaea* Morelet 1851 IN SOUTHWESTERN NIGERIA

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ABSTRACT

Development of empirical models provides ample prospects of exploring established mathematical theories and relationships among tree growth variables for sustainable forest management options. However, there is inadequate information on modelling growth characteristics and productivity potentials of *Pinus caribaea*, a pulpwood species which is now being proposed for timber production in Nigeria. Hence, models for growth characteristics and their applications in yield studies for *Pinus caribaea* in southwestern Nigeria were investigated.

Sixty Temporary Sample Plots (TSPs) of size 20m x 20m each and of different Age (A) series based on stocking density were sampled from Omo Forest Reserve (n=16 TSPs -15 and 21 years), Oluwa Forest Reserve (n=36 TSPs-18, 20, 35, 36 and 37 years) and Shasha Forest Reserve (n=8TSPs-27years) in Ogun, Ondo and Osun States respectively using stratified random sampling method. Growth variables: Diameter at Breast Height (DBH), Stem Quality (SQ) and Total Height (THT) were measured in each plot and Basal Area (BA), Stem Volume (SV), Tree Slenderness Coefficient (TSC), Crown Ratio (CR), Crown Projection Area (CPA) and Site Index (SI) estimated. A total of 1,592 trees were enumerated and each tree per plot classified into four canopy layers as dominant, co-dominant, intermediate and suppressed. Data obtained were used for modelling and categorized into individual tree level, size class level and whole stand level with Maximum Likelihood Estimation (MLE) technique adopted in 3-parameter Weibull Probability Distribution Functions (WPDF). Data were analysed using descriptive statistics, ANOVA, correlation and regression analyses at $\alpha_{0.05}$.

Growth variables exhibited significant variations among the canopy layers with the dominant canopy layer having the highest mean THT of 14.9±0.2m and intermediate canopy layer lowest with 7.8±0.1m. Stem volume (1.4±0.04m^3) and BA (0.1±0.002m^2) were also highest in the dominant canopy layer. Slenderness coefficient however was highest (80.6±1.1) within the suppressed canopy layer while crown ratio was highest (0.27±0.001) in intermediate canopy layer. There were positive relationships between the growth variables across the stands with coefficients of correlation (*r*) ranging from 0.01-0.98 for individual tree level and 0.41-0.91 for whole stand level. Similar results of correlation between Weibull parameters and other growth variables at the size class level were significant with *r* ranging between -0.72 and 0.92 with location parameter ‘a’ of the WPDF having the highest positive association of r = 0.92 with DBH. The growth-yield models were of the forms $\ln CR = -3.5507+0.6263\ln THT+0.1558CPA+10.2339A^{1}$, $R^2 = 0.98$ for dominant layer, $\ln CR = -3.1922+0.6363CPA+7.6876A^{-1}$, $R^2 = 0.994$ for intermediate layer, $\ln THT = 0.4547+0.0032\ln SQ+0.6757CPA+0.1052A^{-1}$, $R^2=0.989$ for suppressed layer and $\ln THT=0.5872+0.5348CPA+0.0567A^{-1}$ with $R^2= 0.996$ for co-dominant layer respectively. The overall best model among individual, size and whole stand categories was found within the whole stand level with $R^2=0.999$ and of exponential form: $\ln SV=-0.7759+0.0001SI+0.0005A^{-1}+0.9532\ln BA$.

The best adjudged growth-yield model among the canopy layers was found within the co-dominant layer. The selected whole stand growth-yield model was suitable for both current and future prediction of major growth characteristics and productivity potentials of *Pinus caribaea* in southwestern Nigeria.

Keywords: *Pinus caribaea*, Growth variables, Yield models, Tree canopy layers

Word count: 489

DEDICATION

This work is dedicated to Him; who has the final saying. Him; with who's LIFE the universe consists. He is the Fountain of all knowledge; who speaks and come to pass. He is the God Almighty, the Most High who lives and abides forever.

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Bukola Amoo OYEBADE
July, 2014

CERTIFICATION

I certify that this work was carried out by Mr. Bukola Amoo Oyebade in the Department of Forest Resources Management, Faculty of Agriculture and Forestry, University of Ibadan, Ibadan, Nigeria.

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ACRONYMS AND ABBREVIATIONS

BA	Basal area
DBH	Diameter at breast height
THT	Total height
SQ	Stem quality
SV	Stem volume
CR	Crown ratio
CD	Crown diameter
TSC	Tree slenderness coefficient
DT	Diameter at the top
DB	Diameter at the base
TSPs	Temporary Sample Plots
A	Age
MSE	Mean Square Error
RMSE	Root Mean Square Error
RSS	Residual Sum Square
TSS	Total Square Error
SI	Site index
MHT	Merchantable height
CAI	Current Annual Increment
PAI	Period Annual Increment
MAI	Mean Annual Increment
LN	Natural logarithm

CHAPTER ONE

1.0 INTRODUCTION

1.1.1 BACKGROUND

Forest growth models have provided forest managers with an abundance of tools for simulating stand dynamics. Modeling the growth of trees of forest stands is of great importance for development of a sustainable forest management system for multiple-use forestry. In general, the actual application of forest policies in the tropics and many parts of the world is based on future projections of the available data on extensive forest areas for sustainable forest management (Fenger, 1996; Euler and Epp, 2000).In recent years, models had been developed to explore the interaction between the ecological integrity of the forest and its timber management under different possible scenarios (Gustafson *et al.*, 2000; Kurz *et al.,* 2000).Predictive models that are used for volume estimation in sustainable forest management have to be dynamic and must capture forest attributes such as diameters at breast height (dbh), height, basal area, regeneration, mortality and some silvicultural operations such as thinning and partial harvest.

Forest biophysical parameters have changed continuously both by the external and internal factors. Thus, information on forest status obtained from traditional inventory is pertinent and may be a significant pointer in a certain length of time for plantation forest where there is evenness in structure and optimized management advantages. In achieving plausible feats in sustainable forest management in many Sub-Saharan countries, there is urgent need for critical evaluation of growth characteristics from forest mensuration; where there is pragmatic approach to determining the forest variables such age, volume, biomass, basal density and height periodically (Husch *et al.* 2003). Such evaluation will pertinently utilize simulation methods that are system based and such that constitute empirical principles from growth parameters.

Onyekwelu *et al.* (2003) reported that to achieve positive and substantial response of residual trees to thinning, formulation of management strategies must be based on good understanding of individual trees and stand growth processes. He however stated in his study that silvicultural interventions have been administered without a good knowledge of growth characteristics, thus leading to a bad management decision that had had some adverse effects on stand productivity and end products.

There are positive and increasing trends of plantation development in the tropics in the last two decades with annual rate of establishment falling between 2 to 3 million hectares (Evans, 1998). Majority of these plantation species are managed to optimize yield of wood products within the possible short period, and thus amounting to their general acceptance of domestication in Nigeria (Onyekwelu *et al.,* 2003). In most forested region of earth, people have recently and historically cleared forests for pasture and crops. In retrospect, many such cleared sites have been too erosive for continued pasturage or cropping; or have proved to be (or been degraded to become) marginal or submarginal for their intended human activities. Conversely, many of such degraded sites are now being proved as best sites for forest plantations with plausible varieties of important primary purposes other than supplying wood (Palmberg, 1989; Laarman and Sedjo, 1992). Abayomi (1984) supported the tremendous need for plantation establishments; particularly for meeting the rapid growing demand for wood and wood products in Nigeria. According to him, there were annual increments of timber volume above 40cm diameter at breast height (dbh) between 1.14 m^3 ha^{-1} $year^{-1}$ and 8.30 m^3 ha^{-1} $year^{-1}$ in the sample plots with plantation species against the annual increments of between 2.0m^3 ha^{-1} $year^{-1}$ to 3.0 m^3 ha^{-1} $year^{-1}$ of the natural forest stands.

Among the less dominant exotic species is the *Pinus caribaea* of which records showed that it was originally confined to high altitudes of northern savannah of Nigeria's ecological delineation (Figure 1) to check desertification, but now been widely planted in Nigeria because of its long fibers suitable for manufacture of high quality paper and other pulpwood products (Iyamabo *et al.*, 1972; Emerhi *et al.*, 2008).

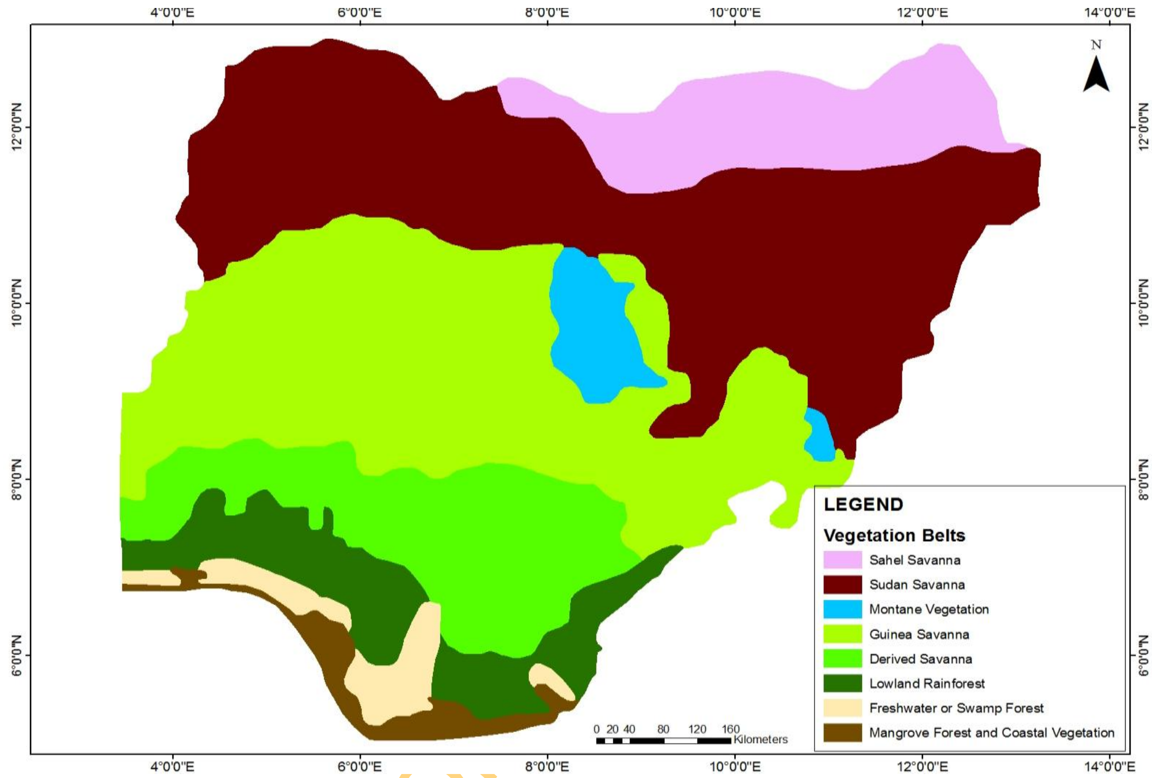


Fig. 1: Map of Nigeria showing the ecological regions

1.1.2 APPLICATIONS OF GROWTH MODELS

Growth models have been identified as having a broader role in forest management and in the formulation of forest policy, and have been very essential when used in conjunction with other resource and environmental data for growth predictions and prescriptions that will eventually be used as guidelines for forest policy. With suitable inventory and other resource data, growth models provide a reliable way to examine silvicultural and harvesting options, to determine the sustainable timber yield, and examine the impacts of forest management and harvesting on other values of the forest.

Forest managers may require information on the present status of the resource (e.g. numbers of trees by species and sizes for selected strata), forecasts of the nature and timing of future harvests, and estimates of the maximum sustainable harvest. This information can be compiled from three sources: (i) area estimates of the existing forest (ii) stand level inventory of the present forest, and (iii) growth and harvesting models based on dynamic inventory data. A growth model is a synthesis of dynamic inventory data indicating growth and change in the forest. These data may be obtained from permanent sample plots. Growth models may also have a broader role in forest management and in the formulation of forest policy.

A model is an abstraction, or a simplified representation, of some aspect of reality (and should not be confused with the normative meaning of the word, something worthy of being imitated). We frequently use models unconsciously, e.g. making mental models to visualize cause-effect relationships to help explain and anticipate the behaviour of systems. Models may be stated in verbal (e.g. a description) or material forms (e.g. a scale model). A mathematical model is like a verbal model, but uses mathematical language which is more concise and less ambiguous than natural language. Computers have become indispensable as tools to assist modeling, but are not central to the process of modeling. Modeling is about making a good representation, and the computer is merely a convenient way to realize it. García (1994) likened "computer modeling" to "typewriter poetry". There are so many growth models in existence that it is impossible to examine the methodology used in each. Thus it is necessary to identify some commonality, and to consider just a few examples for each class of model.

It is useful to distinguish between models for understanding and models for prediction (Bunnell, -+`1989). Models for understanding (e.g. process models) are useful to comprehend and link previously isolated bits of knowledge and may help to identify gaps where more work is needed. The benefits come from the insights gained while developing and exploring the model, and future uses (if any), are less important. Conversely, models for prediction may sacrifice specific details of growth processes to achieve greater efficiency and accuracy in providing information for forest management.

Therefore, this study has explored the concept of growth characteristics and their applications to timber yield of *Pinus caribaea* in Southwestern Nigeria. The study equally provided best predictive models that would proffer sustainable management options for *Pinus caribaea* in Southwestern and many other ecological regions of Nigeria.

1.1.3 FOREST MODELING: MODERN TREND

A *stand growth model* is an abstraction of the natural dynamics of a forest stand, and may encompass growth, mortality, and other changes in stand composition and structure. Common usage of the term "growth model" generally refers to a system of equations which can predict the growth and yield of a forest stand under a wide variety of conditions. Thus a growth model may comprise a series of mathematical equations, the numerical values embedded in those equations, the logic necessary to link these equations in a meaningful way, and the computer code required to implement the model on a computer. In its broadest sense, the term may also embrace yield tables and curves, which are analogous to equations, but which have been stated in a tabular or graphical form, rather than a mathematical form.

1.1.4 ***Pinus Caribaea***

Pinus caribaea is a medium-growing tree that reaches 45 m in height and more than 1m diameter at breast height (d.b.h). The shafts are generally straight and free of branches. The bark is thick with wide fissures and is reddish brown to ashy brown. This variety has fascicles of three, and in the young trees these fascicles have four to six acicular leaves.

The acicular leaves are 15 to 25 cm long and 1.5 mm wide; they are stiff and finely serrated, dark green to yellowish green, and covered with white stripes of stomata. The tree has a pivot root in deep soils, and superficial roots in slightly deep soils. It adapts very well to a wide variety of environments, including degraded, poor, lixiviated, rather low soils with good drainage. The species grows well in acid sandy soils (pH 4.3 to 6.5) and, to a lesser degree, sandy-clayey soils. Generally, moisture in the soil determines development more than the availability of nutrients. The tree grows well in oxisol soils that are not very deep, are saturated with water during the rainy season, and are very dry in the rainless season. In wet climates of the Tropics the species tends to form foxtail. It can tolerate drought for up to 6 months and sporadic floods. However, drought can also cause large losses in young stands (Lamprecht, 1986). *Pinus caribaea* grows well where temperatures range from 20 to 27 °C and annual precipitation is between 1000 and 1800 mm. Some trees grow where precipitation is 600 to 3900 mm. In its native region the tree grows from sea level to 850 m; it is occasionally found at 1000 m.

The hard wood of *P. caribaea* is appropriate for floors and all types of construction. Treated with a preservative, the wood is used in mines, pilings, and railroad ties. Primarily used in construction and carpentry, the wood is also dried and turned (Centro Agronómico Tropical de Investigación Enseñza, 1994). In Villanueva, Casanare, Colombia, pine wood obtained by precommercial thinning at 8 to 10 years is used in tongue and groove boards and cabinet making such as portable crates, doors, windows, desks, and bookcases (Koenig and Venegas, 1978; Venegas, 1982). It is used for pulp even though its resin content is high. It is traditionally used as firewood and in the manufacture of charcoal. The trees are used as windbreaks and to control erosion and recover soils.

Resins are also extracted to produce colophony and turpentine. The seeds of this species have a high commercial value. The cones are 6 to 14 cm long. The dark grayish seeds are ovoid and winged and sometimes have light brown speckles. Most of the seeds lose their wings. Fire is always allowed in its plantation for natural regeneration; however, the young plantules are damaged or killed by fire. Outside its native area, the species rarely regenerates naturally. Seeds can be stored up to 10 years if placed in hermetic containers at 3 to 4 °C and 6 to 9 percent humidity. A pre-germination treatment is unnecessary; however, seeds sub-merged in water for 12 hours will germinate more uniformly (Nieto and Rodriguez, 2002).

Germination percentage of this species reaches 80 percent (Wong 1983; Trujillo, 1984). The species can be propagated in nurseries by seeds or bare roots. Seeds are sowed in germinators and transferred to bags; seeds with a high germination percentage can be planted directly in bags. The planting site should be thoroughly cleared; burning the site produces the best results. In deep soils, holes must be 20 cm deep and 20 cm in diameter. In shallow, compacted soils, holes must be 30 cm in depth and diameter. Up to 80 percent of the roots will remain when outplanting by lifting the plantules with clods of earth on the roots. Silvicultural treatments during the first 2 years in reforestation of savannas provide fire protection for this species while removal of underbrush by trampling is also essential.

1.1.4.1 Ecology and distribution

The species *P. caribaea* is native to Central America and the Caribbean but widely planted throughout the American, Asian and African tropics and subtropics. *P. caribaea* (var.)*;* which is of caribaea variety is confined to Cuba and the Isla de la Juventud, *P. caribaea* var. *bahamensis* is indigenous to certain Islands of the Bahamas and the Caicos groups and *P. caribaea* var. *hondurensis* can be found in the eastern half of Central America south-east from the Yucatán peninsula. The tree grows best in frost-free areas up to 700 m altitude on more fertile sites with good drainage and annual rainfall of 1000 - 3000 mm.

1.1.4.2 Propagation and Management

The cones mature at the onset of the rainy season but there is often variation between trees and stands. In general, cones tend to mature during the same period, despite variation in flowering times. Seed production in exotic plantations is often poor due to either cool temperature preventing the formation of flowers or humid conditions during flowering preventing pollination (Londo and Stephen, 2006). When the tree is 3-4 years old, it begins to produce female cones but seed setting is low unless there are mature pollinating trees close by. The cones are mature when: (i) more than half of the cone has turned brown, (ii) when cut in two, the cone axis is dark brown, (iii) the apex of the cone feels firm when pressed with the thumb (iv) the seed coat is darkening in colour and (v) the inside of the seed is white and firm and filling the cavity. Collection is done directly from the tree. Care must be taken not to break the fragile branchlets as this can seriously reduce crop size for several years. Once the cones have become brown and are still moist, the scales may start to open and the pre-germination occur.

1.2 STATEMENT OF PROBLEM

Modelling growth characteristics of *Pinus caribaea*; an exotic species is of great importance in quantitative forestry for ascertaining sustainable evaluation and production of its timber in Nigeria. Though the species was primarily introduced to Nigeria in the early 60 (Sixty); with a goal of exploring its pulp production potential for the then pulp and paper industries. This objective was however abandoned and jettisoned, and the pine plantations in the three major forest reserves in the southwestern Nigeria have overgrown its pulping production capability and now fully grown for apparent timber production. The pine plantation stands within the forests are threatened, and annually being exposed to incidence of fire attack as a result of bush burning around the reserves.

Since no quantitative study exist on *Pinus caribaea* in Nigeria; mensurational information about this all-important tree species is significant for its reasonable growth characteristics evaluation, its yield production and valuation and plausible volume prediction that could project its sustainable management in Nigeria.

It is therefore imperative to carry out this quantitative investigation to reconnoiter models for growth characteristics of *Pinus caribaea* with the objective of developing empirical models and determining the models’ application to its yield (timber volume production) in southwestern Nigeria.

According to Onyekwelu (2001), over 80% of total plantations in Nigeria are exotic, and their dominance is attributed to their ease of establishment, rapid growth rate and consequently short rotation length. Although, this assertion was factual, there has been little effort in modeling growth characteristics of plantation species such as Pine in Nigeria that can be significantly used to facilitate sustainable management and adequate policy making. It is therefore pertinent to develop growth models that are flexible and robust for multi-ecological diversity and comparison. The development of growth characteristics models for predicting growth, yield and other stem quality is therefore concomitant to attaining sustainable management of pine plantations in this ecological zone; which can be a model for reasonable management and planning in other ecological zone of the country.

1.3 OBJECTIVES OF THE STUDY

The main objective of this study is to explore models for growth characteristics of *Pinus caribaea* with a goal to determine their applications to pine's timber yield in southwestern Nigeria. The specific objectives of the study include:

1. to develop appropriate growth characteristics models at canopy layers, individual tree, size class and whole stand levels for the *Pinus caribaea* plantations in the study area.

2. to determine the best model for predicting and forecasting the yield of *Pinus caribaea* in the study area.

3. to determine the optimal rotation age for pine timber production

1.4 JUSTIFICATION OF THE STUDY

In forest management, information on both current forest resources and future yields is needed. The future development of forest resources can be predicted with growth and yield models (Sironen *et al.*, 2001). The main uses of growth and yield predictions are updating forest inventories, comparing silvicultural treatments by simulating them and predicting their outcomes, harvest scheduling, stand and forest level decision support and management planning (Short III and Burkhart, 1992; Hynynen, 1995).

Development of growth characteristics models remain significant aspect of research in growth and yield studies. According to Okojie (1981), it is essentially important in providing relevant information that are applied for predicting happenstances in forest industries, individual trees and stands in response to investments, silvicultural treatments and management alternatives. Consequently, the accumulation of pertinent information on tree and stand growth ensures development of simulation and growth models which are primarily aimed at modeling long-term effects of management options, cultural treatments and for yield predictions. It is therefore crucial to carry out this all important study on the development of growth characteristics models and explore their applications in ensuring sustainable management for *Pinus caribaea* in some selected plantations in Southwestern, Nigeria.

Growth-yield models require site-specific knowledge about individual trees and environmental conditions. The data usually come from periodic growth yield censuses of marked individual trees in a large number of plots (Liu and Ashton, 1995). Most models are developed from growth variables simply because they are much easier to measure than other variables and for instance height and basal area information can be derived from functions which describe diameter-height and diameter-basal area relationships of individual species (Ker and Smith, 1957; Hilt and Teck, 1988). This study thus explored and investigated several growth models simulated from common growth characteristics within the *Pinus caribaea* in the study area.

The growth functions vary in terms of types of functions and variables in the functions. For example, Hilt and Teck (1988) developed and simulated basal area estimates to establish a predictive model for diameter growth. The potential basal area growth model is a modified version of the Chapman-Richards function (Richards, 1959; as cited by Liu and Ashton, 1995). This quantitative study threw more light on several growth models as well as simulating variables of interest in *Pinus caribaea* plantations at the three forest reserves of the study area.

1.5 SCOPE OF THE STUDY

This study primarily was restricted to development of growth characteristics models of pine plantations in Omo Forest Reserve (Ogun State), Oluwa Forest Reserve (Ondo State) and Shasha Forest Reserve (Osun State); all in South western Nigeria. The study also explored the applications of these growth characteristics to timber yield potential of *Pinus caribaea* in the study areas. The choice of these three forest reserves is based on availability of the species and possibility of obtaining reasonable age series data from the three Plantations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 MODELING APPLICATION IN FORESTRY

Model may be defined as the representation of some existing structure showing the proportions and arrangements of its component parts. It may also refer to a formal expression of a theory (Ford-Robertson, 1977). Common usage encompasses the mathematical equations, the numerical values embedded in those equations, the logic necessary to link these equations in a meaningful way, and the computer code required to implement the model on a computer.

Model development involves exploring data to provide new insights into forest dynamics and reveal gaps in present knowledge. Once implemented, the model may be used to study forest dynamics, to explore silvicultural and management options, and to forecast future harvests and stand conditions. These applications indicate directions for model development. Modelers should critically explore available data and existing knowledge, and design models that are robust in extrapolation. Implementation should encourage both exploratory and operational use of the model. Although apparently obvious, these principles are not reflected in many models.

It is necessary to emphasize the nature and detail of growth models by discussing whole stand, stand class and single tree models. Whole stand models draw on stand-level parameters such as stocking (trees/hectare), stand basal area and standing volume to predict stand growth or yield. Size distributions may be inferred, but few details of individual trees are available. Stand class models provide more details by simulating several classes within the stand (e.g. stand table projection). The approach is a compromise between whole stand models and single tree models. If the class is infinitely large and only one class exists, it is a whole stand approach. When the class width is considerably small and each tree is a single class, then it becomes a single tree model, in which the individual tree is the basic unit of modeling. The minimum input required for a single tree model is a list containing the size of every tree in the stand.

Other models draw on different foundations to help understand growth and stand dynamics exist, but have not yet successfully been used for predicting timber yields. Succession models (West *et al.*, 1981; Shugart, 1984) attempt to model species succession, but are generally unable to provide reliable information on timber yields.

Process models attempt to model the processes of growth, taking as input light, temperature and soil nutrient levels, and modeling photosynthesis and the allocation of photosynthates to roots, stems and leaves (Landsberg, 1986; Sievanen *et al.*, 1988; McMurtrie *et al.*, 1990). The challenge is to provide sufficient physiological and ecological basis to ensure realistic predictions under a variety of site and stand conditions, even when empirical data for calibration are limited.

2.2 MODEL TYPES

There are so many growth models in existence that it is impossible to examine the methodology used in each. Thus it is necessary to identify some commonality, and to consider just a few examples for each class of model. It is important to classify models on the level of detail they provide. A model may be considered a whole stand model, a size class model, or a single-tree model, depending on the detail required, provided and utilized by the model.

2.2.1 Whole stand models

Whole stand models are often simple and robust, but may involve complexities not possible in other approaches. Population parameters such as stocking (number of trees per unit area), stand basal area and standing volume are used to predict the growth or yield of the forest. No details of the individual trees in the stand are determined. Stem size distributions may be inferred from existing or predicted distributions.

2.2.2 Size class models

Provide some information regarding the structure of the stand. Several techniques are available to model stand structure, but one of the most widely used is the method of stand table projection which essentially produces a histogram of stem diameters. This approach is a compromise between whole stand models and single-tree models. When the class size is infinitely large and only one class exists, then the method is a whole stand approach. When the class width is infinitely small and each tree is considered a single class, then the method is the single-tree approach.

2.2.3 Single-tree models

This type of model is the most detailed and has an approach that uses the individual tree as the basic unit of modeling. The minimum input required is a list specifying the size of every tree in the stand. Some models also require the spatial position of the tree, or tree height and crown class. Single-tree models may be very complex, modeling branches and internal stem characteristics, and may be linked to harvesting and conversion simulators (Mitchell, 1988; Vanclay, 1988).

2.2.4 Process models

These are also known as mechanistic of physiological models. These models help to provide a better understanding of growth and stand dynamics, but have not yet successfully been used for predicting timber yields for forest management. Attempt to model the processes of growth and taking light, temperature, soil nutrient levels and modeling photosynthesis, respiration and the allocation of photosynthates to roots, stems and leaves as inputs of the models define the central principle of process modeling (Landsberg, 1986; Mäkelä, 1992).

2.3 DATA FOR GROWTH MODELS

Growth models rely on data for calibration. Too often, the model is dictated by limitations of the data rather than the needs of the application. Most models have similar data requirements and standard procedures have been established (Campbell, 1989; Vanclay, 1991; Alder and Synnot, 1992). Since few tropical tree species are amenable to stem analysis (Mariaux, 1981), data must be obtained from re-measurements on permanent sample plots (PSPs). Re-measurements must span a sufficient period to average anomalous weather patterns and ensure that growth is not obscured by measurement error. Graphical (Beetson *et al.*, 1992) and computer algorithms (Gertner,

1987) may guide sampling schemes. Both passive monitoring and treatment response data from designed experiments are necessary. Extreme treatments need not applied in practice, but remain essential to define the response surface for growth models.

The accuracy of growth predictions depends largely on the stratification of site; but there are few techniques for site productivity assessment in tropical moist forests (Smith and Burkhart, 1984). The average height of dominant and co-dominant trees remaining after logging has been used to indicate site productivity in dipterocarp forests (Mendoza and Gumpal, 1987). Vanclay (1992) favored a growth index based on permanent plot data, but estimated for temporary plots from presence or absence of several indicator species. Further research is necessary to develop efficient methods for site evaluation in tropical forests, and this will require comparisons with long term permanent plot records to ensure reproducible and consistent estimates which are not unduly influenced by stand condition or management history.

2.4 TREE GROWTH

Tree growth is an intermittent process characterized by change in stem form and dimension over a period of time. This change, according to Avery and Burkhart (1994), manifest itself as an increase (increment) in size over a given period of time and in terms of diameter, height, basal area or pubic volume.

Climate, soil and biotic factors contribute tremendously to the growth of a plant. Deficiency or excess of any of these environmental factors can become limiting and thus cause trees to grow at different rates. The ability to absorb and assimilate carbon dioxide for the purpose of growth (photosynthesis) is controlled by such factors as wind speed, available moisture and competition with other plants (Nwoboshi, 1982).

Although, the exact form of the cumulative growth curve will differ with variable used and the fluctuations, the elongated S-shaped (sigmoid) pattern is a characteristic that can be invariably expected. Wood production in the central stem can be predicted by measuring past rates of diameter and height growth. Indeed, the primary objective of most tree growth studies is the reliable prediction of future wood yield.

2.5 RELATIONSHIP BETWEEN GROWTH AND YIELD

Growth is the increase (increment) over a given period of time (Avery and Burkhart, 1994). Growth is a complicated process embracing a multitude of factors such as soil climate and tree properties (Fries *et al.*, 1978).

On the other hand, yield is the total amount available for harvest at a given time (Avery and Burkhart, 1994). Yield, can thus be regarded as the summation of the annual increments. To be meaningful, Leuschner (1984) emphasized the need for growth and yield values to be quantified with regard to the part of the tree and the position of the stand being considered, and one must be certain of the unit of measure being used and for growth, the time period involved.

Clutter *et al.* (1983), Avery and Burkhart (1994), identified three factors that determine the growth and yield for stands of given species or species composition. These factors are:

i) age of stand (the point in time in stand development)
ii) the innate productive capacity of the land area involved (site quality) and
iii) the cultural treatments applied (thinning, fertilization, competing vegetation control).

For even-aged stands, the first three factors can be expressed quantitatively through the variables of stand age, site index and stand density respectively. The measure of stand density most commonly used in growth and yield models for natural stands has been Basal Area (BA) per unit area whereas most models for planted stands have employed number of trees per unit area. For a given site index and initial stand density level, volume per unit area (yield) can be plotted over stand age which result in a sigmoid curve.

The growth curve often referred to as current annual growth or current annual increment (CAI) increases up to the inflection point of the yield curve and decreases thereafter. Another important quantity is the mean annual increment (MAI) defined as the yield at any given age divided by the total number of year (age) required for achieving that yield. Early work did not attempt to relate growth analysis to yield analysis, although the biological relationship can be readily expressed mathematically. Clutter (1963) derived compatible and yield models for loblolly pine by ensuring that the algebraic form of the yield model could be obtained by mathematical integration of the growth model. Sullivan and Clutter (1972) extended Clutter's model by estimating yield and cumulative growth as a function of initial stand age, initial basal area, site index and future age. When the future age equals the current age (i.e. when the projection period is zero), the projection model is reduced to a conventional current yield model.

2.6 USES OF MODELS

2.6.1 Valuation of stands

If the growth functions have been developed for any tree species in a certain area, then it becomes possible to estimate the standing volume of trees in that area at any age (Adegbehin, 1985). Thus, economic rotation age of the stand can be determined, and the current value of the stand can be compared with its potential value. Such comparison aids the forest owner in estimating the profit to be made in holding his timber for cutting at a future date as against sale at present time.

2.6.2 Production Forecasting

In forestry, growth models are used to predict the increment of individual trees and of stands. They are also used to obtain the estimates of potential cut from the forest. This provides guidelines for the forest manager to adopt the principle of sustained yield. The concept of sustained yield when implemented keeps the volume of the growing stock constant and regulates exploitation in the forest (Okojie, 1981), watershed protection and eco-tourism have also been solved through modeling (Buonogiorno and Gilles, 1987).

2.6.3 Decision on Rotation age and Harvesting

Rotation age is the normal period of years required to grow and harvest an even aged of crop of trees on a given land area. Rotation age is usually not an easy thing to decide in forest management. It is sometimes determined based on the age of maximum mean annual increment, stumpage value, and tree size specifications for various products and other management considerations. Other factors include urgent need for money, anticipated price increase. The economic optimum production point (EOPP) is another useful approach to deciding rotation age. Growth and yield data are required for deciding age irrespective of the criteria considered.

Given a minimum exploitable diameter or girth, it is possible to calculate from distribution models the percentage of the stand that meets this requirement. This will assist the forest manager to decide if the proportion of the stand meeting the diameter or girth requirement is reasonable enough.

2.7 MODELING APPROACHES IN FORETRY

2.7.1 Volume or Yield table Approach

Foresters in the 18th and 19th centuries assembled their data in the form of tables, which were based on graphically produced relationships between the crop characteristics (Omiyale and Joyce, 1982). Two types were prominent: Volume and yield tables.

Volume table according to Husch *et al*. (1982) is a tabular presentation of the volume of a tree of some specified dimensions. Depending on the number of independent variables and area covered, volume table could be divided into two types; (i) Local or single entry volume tables (only Dbh) and; (ii) Standard or multiple entry tables (Dbh, merchantable or total height and some measure of form included).

The introduction of regression analysis and advent of computers have made possible the establishment of various objective relationship (Volume equations) between tree volume and other measured parameters such as height, tree diameter at breast height (Dbh) or basal area (BA) from which such tables can be constructed. Multiple regression procedures (usually stepwise) are often used to select the best combination of independent variables from a series of equations, which may take the following forms:

(i) Simple Linear regression model

$$V = b_o + b_1 D^2 \quad \text{……eqn. 1}$$

$$V = b_o + b_1 D^3 \quad \text{……eqn.2}$$

(ii) Multiple Linear regression models

$$V = b_o + b_1 D^2 + b_2 H \quad \text{…….eqn.3}$$

$$V = b_o + b_1 D^2 + b_2 D^2 H \quad \text{……..eqn.4}$$

$$V = b_o + b_1 D^2 H + b_2 H \quad \text{…….eqn.5}$$

(iii) Quadratic model

$$V = b_o + b_1 D + b_2 D^2 \quad \text{…… eqn.6}$$

(iv) Logarithmic transformed Model

According to Osho (1988), most yield table methodologies were first developed in Europe in the 1920s and later in the limited usefulness of yield tables in comparing silvicultural alternatives since the methodologies were only intended to describe undisturbed development of natural stands.

2.7.2 Statistical distributions: Models Approach

Forest management systems are becoming increasingly intensive and many decisions are dependent on knowledge of forest stand dynamics. Several studies have been carried out to describe the distribution patterns of forest data particularly tree diameters, basal areas and volumes. Actual diameter distribution may be calculated from data derived from forest inventories. In many cases, more useful predictions may be based on models that generalize and portray the expected distributions.

Most of these studies appear to concentrate more on diameter distribution pattern which characterizes the structure of a stand, and is one of the growth parameters that is most accurately measured and can also be used to predict basal area or volume.

Diameter distribution represents the number of trees in specific size classes. The observed diameter distribution results from the natural development of the trees in relation to age, site index and total number of stems per hectare. Diameter distribution models help to provide answers to such questions as when, how and where to cut timber? They are therefore very important in forest management.

According to Okojie (1981) citing other workers, efforts to describe stem diameter distribution from empirical data date back to many years. He referenced that in 1899, DeLioncourt constructed a model using geometric progression for diameter distribution in uneven aged forests which was also found satisfactory in describing diameter distribution in old growth forests in Indiana by Shmelz and Lindsey (1965). Several distribution models have now been in use although only some of these are flexible enough to describe the growth curves. These models include: normal, lognormal, beta, gamma, negative or double exponential and Weibull probability distribution functions (Gadow, 1983; Philip 1994).

2.7.2.1 Normal Distribution

A random variable x, assuming all real values from $-\infty < x < \infty$ has a normal distribution if its probability density function is of the form:

$$f(x) = \frac{1}{\delta\sqrt{2\pi}} exp\left[\frac{-(x-\mu)^2}{2\delta^2}\right] \qquad \text{…………eqn..7}$$

Where,

μ = means

x = random variable and

δ^2 = variance.

For a normally distributed population; it is expected that 68.27% of the cases will fall between $\mu - \sigma$ and $\mu + \sigma$ and 95.45%.between μ -2σ and μ +2σ while 99.73% of the cases are found between μ - 3a and $\mu + 3\sigma$.

The standardized normal distribution in most cases does not meet the flexibility desired in growth studies. However, its importance is due to the fact that it is tabulated hence facilitating practical tests of a data set for normality. A standardized form is obtained by transformation of original x values with unit standard deviation and zero mean.

Among the few others who obtained some promising results in the application of distribution to growth studies is Gringrich (1967); he used the distribution to describe composition and diameter data in upland hardwood forests.

2.7.2.2 Lognormal Distribution

A lognormal distribution occurs in practice whenever a random variable X has its logarithm showing a normal distribution. Its probability density function is expressed as:

$$f(x) = \frac{1}{x\delta\sqrt{2\pi}} exp \left[\frac{-\{lnx-\mu\}^2}{2\delta^2}\right] \qquad \text{……………eqn.8}$$

Where

x σ> 0; ln x = natural logarithm of x.

This distribution is positively skewed with:

Mean = exp (u+σ^2) and

Variance = exp (2u- σ^2) (exp σ^2-1)

Bliss and Reinker (1964) found this suitable in describing diameter distribution in some even-aged stand. However, the lognormal distributions are of limited use in growth studies as they generate only positively skewed curves.

2.7.2.3 Gamma Distribution

A continuous random variable x has a gamma distribution if its probability density function is given by:

F(x) = $\frac{\beta^{\alpha} e^{-\beta x} x^{\alpha-1}}{\gamma(x)}$, x > 0 ……………eqn. 9

= 0 elsewhere

Where α > 0, β > 0 and γ(x) = (α-1)!

Otherwise

γ (n) = gamma function with parameter n

Mean, $\mu = \frac{\alpha}{\beta}$

Variance $\sigma^2 = \frac{\alpha}{\beta^2}$

Gamma distribution is generally noted for generating positively skewed Curves. Nelson (1964) found this appropriate for describing diameter distribution in a loblolly pine stand.

2.7.2.4 Beta Distribution

If a random variable x has a probability density function

f (x) = $\frac{x^{\alpha-1}(1-x)^{\beta-1}}{\beta(\alpha,\beta)}$ …………………..……...eqn.10

= 0 elsewhere

Where α > 0, β > and β (α, β) = $\frac{r(\alpha)r(\beta)}{r(\alpha+\beta)}$

The mean of the distribution is given by

$\mu = \frac{\alpha}{\alpha+\beta}$ ……………..….eqn.11

And its variance

$\sigma^2 = \frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$ …………..….eqn.12

Because of its ability to ensure a wide variety of shapes, beta distribution has been used in describing diameter distribution in stands of different specialty and many studies abound on such premises (Burkhart and Strut, 1974; Jayarman and Rugruini, 1988).

The Beta distribution reduces to uniform (rectangular) distribution so called because its density is uniform or constant over a certain interval say (a, b). Its probability density function is given by:

$f(x) = \frac{1}{b-a}$ ……………eqn.13

$0 < a < b < \infty$ = elsewhere

and, means, $\mu = \frac{a+b}{2}$ ……………………..……eqn.14

variance, $\sigma^2 = \frac{(b-a)(b+a)}{2}$ ………………………eqn.15

for $a = 0$, $b = 1$, $f(x) = 1$, $\mu = ½$, $\sigma^2 = 1/12$

The gamma and beta functions have their density highly flexible in shape and are therefore promising for adaptation in growth studies.

2.7.2.5 Weibull distribution

The Weibull function is equally flexible in terms of the ability to assume various shapes (both positive and negative skewness) and have become increasingly popular for characterizing stand diameter distributions. Weibull distribution was developed in an entirely different context from its application in forestry. Weibull was Swedish physicist who derived and used the function in his experiments. It has since been recognized as a useful and most appropriate model in reliability studied and life lasting experiments in forestry (Osho, 1989).

A random variable ‘x’ is side to have a two-parameter Weibull density function

if $f(x) = (\alpha/\beta)(x/\beta)^{\alpha-1} \exp\left[-\left({}^{x}/_{\beta}\right)^{\alpha}\right]$ ……………………… eqn.16

Where,

α = shape parameter

β = scale parameters.

The cumulative distribution function of the two-parameter Weibull function is given by:

$f(x) = 1\text{-}\exp\left[-\left({}^{x}/_{\beta}\right)^{\alpha}\right]$ ……………….…………….eqn.17

When the location parameter ‘c’ is included, we have a 3-parameter density function given by:

$f(x) = c/b\,(x\text{-}a/b)^{c-1}\ \exp\left[-(x-a/b)^{c}\right]$ ………………….……..…eqn.18

For x, b, c> 0 (in general, ‘a’ can be positive, zero or negative, but for diameter distribution, a must be non-negative).

The parameter ‘a’ is known as the location parameter, ‘b’ as the scale parameter and ‘c’ as the shape parameter.

The expected class probability (P_i) of the ith diameter class with limited L_i and upper limited U_i is given as:

$$P_i = \exp\left[-\left(L_i - a/b\right)^c\right] - \exp\left[-\left(U_i - a/b\right)^c\right] \quad \text{………………… eqn.19}$$

A number of works had been done on the application of Weibull distribution in quantitative forestry. Weibull distributions that have used to characterize stem diameter distribution include Bailey and Dell (1973), Bailey and Clutter (1974), who used it to predict development of *Pinus radiata* in New Zealand. In Nigeria, Okojie (1981) and Adegbehin (1985) have used Weibull functions to characterize the stem diameter distributions for plantation of indigenous *Meliaceae* and exotic tree species respectively.

2.7.3 MATRIX ALGEBRA FORMULATIONS

Weibull equation can be reformulated using matrix algebra in a way that is both concise, and allows growth of trees through several diameter classes in one time period. The basic matrix formulation can be stated as:

$$N_{t+1} = \mathbf{G.N_t} \quad \text{………………………………… eqn.20}$$

Where:

N_t is a column vector whose elements are the stem numbers in each diameter class at time t. It may be written as:

$\mathbf{N_t} = [n_1\ n_2\ n \ldots n_k \ldots n_{m]'}$

The elements n_k are identical to the scalar values N_k in equation (20). There are m diameter classes altogether.

N_{t+1} is a column vector of stem numbers by diameter classes one time period later, its definition is as in (20).

G is a square matrix of order m known as the transition matrix. Each element g_{ij} defines the proportion of stems, which grow from the ith diameter class to the jth diameter class during a time period.

> The elements of G correspond to components of equation (20) for trees, which move exactly one class or remain in the same class. However, they can also allow growth of trees across several classes, or even shrinkage of trees.

Similarly, Weibull equation works because of the way the operation of matrix multiplication is defined. Each element of N_{t+1}, will be given as:

$$n_{j,t+1} = \Sigma^{m}_{k=1} n_{k,t} . g_{kj} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{eqn.21}$$

This is implicit in the definition of matrix multiplication (Green, 1976). The application of matrix algebra to growth modeling in uneven-aged forest stands appears to have evolved from three distinct lines of thought. The models developed by Usher (1966) were derived from animal demographic methods applied to plant populations. Bruner and Moser (1973) used the general technique of Markov modeling, whilst other authors (Mengin-Lecreuix, 1990) simply adapt matrix algebra to the 'classical' diameter class projection model defined in equation (20) above.

The use of matrix models in forestry appears to have originated with Usher (1966). He noted that Leslie (Leslie, 1945, 1948) had described a matrix model of animal populations with the following form:

$$\begin{vmatrix} a_{t+1,1} \\ \vdots \\ a_{t+1,i} \\ \vdots \\ a_{t+1,n} \end{vmatrix} = \begin{bmatrix} f_o & \cdots & f_1 & \cdots & f_{n-1} & f_n \\ p_o & \cdots & \cdots & \cdots & . & . \\ . & \cdots & p_1 & \cdots & . & . \\ . & \cdots & \cdots & \cdots & p_{n-1} & . \end{bmatrix} . \begin{bmatrix} a_{t,1} \\ \vdots \\ a_{t \cdot i} \\ \vdots \\ a_{t,n} \end{bmatrix} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad \text{eqn.22}$$

which can be expressed more compactly in matrix notation as:

$$\mathbf{a}_{t+1} = \mathbf{A.a}_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \text{eqn.23}$$

The column vectors a_t and a_{t+1} are the numbers of animals in each age class at time t and t+1 respectively. The square matrix **A** contains a top row of elements f_0 to f_n which are the fecundities of each age class. In other words, f_1 is the number of offspring that will be born to the i’th class during one time interval.

The off-diagonal elements p_1 are the probabilities that any individual will survive over a time period.

Usher adapted this model from the context of animal demography to tree growth and regeneration, reformulating equation (21) as:

$$\mathbf{q}_{t+1} = \mathbf{Q}.\mathbf{q}_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad \text{eqn.24}$$

Instead of the population vector **a** with elements representing age classes, we have the vector **q** whose elements correspond to tree diameter classes. The transition matrix **Q** in equation (21) is analogous to A in) (20), but with some differences of interpretation. It is constructed of zero elements except for a top row k_1 diagonal elements a_i and off-diagonal elements b_1 as shown in equation (22). The interpretation of these elements in forestry terms is as follows:

- The a_1 terms are the proportion of static trees that remain in a given class during any growth period.

- The b_1 terms are the proportion of trees in the i’th size class that will grow into the next class up (i + 1) during the period.

$$Q = \begin{bmatrix} a_0 & k_1 & k_2 & \cdots & k_{n-1} & k_n \\ b_0 & a_1 & . & \cdots & . & . \\ . & b_1 & a_2 & \cdots & . & . \\ . & . & \ddots & \ddots & . & . \\ . & . & . & \ddots & a_{n-1} & . \\ . & . & . & \cdots & b_{n-1} & a_n \end{bmatrix} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{eqn.25}$$

- The k_1 terms are the total numbers of ingrowths, or plants added to size class 0, during a period, as a result of trees being harvested from the i’th class. For classes 0 to n-1, these terms can be defined as:

$k_1 = C_1 (\alpha-1)$ …………………….. eqn.26

and for the n'th class as:

$Kn = C_n(\alpha-a_n)$ ……….……………eqn.27

where *n* is the proportion of trees left after harvesting, and c is the number of ingrowths trees expected to arise in the gap left by a single tree in that class.

Bruner and Moser (1973) developed a model of stand growth for uneven-aged mixed hardwood forest in Wisconsin that is purely Markovian' in its design. The basic model is identical in formulation to equation (21). The elements of the state vector consisted of the size classes from 8" to 29", 29" +, dead trees, and harvested trees. Permanent sample plot data was used to calculate the transition probabilities, which aggregated for all species. The work does not indicate either the species mix or the number of plots used to derive the data, but the original transition matrix is reproduced, it appears that annual measurements existed over a 19-year period; the first nine measurements were used to define the transition matrix, which thus had a 9-year time step. The subsequent measurements were used for validation.

This shows that trees can grow one or more 1" class during the time step. Mortality is small but positive for the smallest and largest classes; and zero for the mid-sized trees 19-25". Harvesting also occurs at all sizes, but principally above 22" diameter, where it is about 20% of the class stocking.

The model was used to make forecasts of stand structure over an 18-year period (2 time steps) by squaring the transition matrix. In general with a Markov model, the state of the system after n steps, $\mathbf{t_n}$ can be determined analytically from the initial state $\mathbf{t_0}$ by the matrix equation:

$$t_n = P^n.t_0$$ eqn.28

Bruner and Moser (1973) reported a comparison between the model's projection over 9 years and the observed growth and mortality. The fit appears good with respect to both tree numbers and diameter distribution. However, their study appeared to have been unaware of Ushers (1966) work, in spite of the close similarities of the approach. Usher's method concentrated to some extent on regeneration, and allowed harvesting only as the same constant proportion in each size class (the a factor in equation {24}). Usher also allowed growth over only a single diameter class. Bruner and Moser's work, on the other hand, explicitly neglected regeneration, but included a flexible method of defining the harvest and mortality rates.

Buongiorno and Michie (1980) extended Ushers formulation of the matrix model by including a separate vector of harvested trees, and by allowing ingrowths to be a density-dependent function of basal area at the previous time period. In matrix notation, the model is:

$$\mathbf{y}_{t+1} = G(y_t - h_t) + c \quad \text{..................................eqn.29}$$

where:

$\mathbf{y}_t$ is a column vector of tree numbers by size classes in the current growth period.

$\mathbf{y}_{t+1}$ is a column vector of tree numbers by size classes at the next growth period.

G is the transition matrix, comprising the following non-zero elements:

$$G = \begin{bmatrix} d_1 & d_2 & d_3 & \cdots & d_n \\ b_2 & a_2 & . & \cdots & . \\ . & b_3 & a_3 & \cdots & . \\ . & . & \ddots & \ddots & . \\ . & . & . & b_n & a_n \end{bmatrix} \quad \text{.......................................} \quad \text{eqn.30}$$

$\mathbf{h}_t$ is a column vector of tree numbers harvested during the period.

c is a column vector comprising only a single non zero element:

$$= \begin{bmatrix} \beta_0 \\ 0 \\ 0 \\ \vdots \\ 0 \end{bmatrix} \qquad \text{..................................eqn.31}$$

The a_1 terms define, as in the other matrix models, the proportion of trees that remain in the i'th class. The b_1 elements likewise define the proportion of trees in i'th class that will move into the (1 + l)'th class during a growth period. The d_1 and β_0 elements relate to the formulation of the ingrowth function. It is assumed that the number of trees in the smallest class at the next growth period can be predicted from the equation:

$$y_{1,t+1} = \beta_0 + d_1 \left(y_{1,t} - h_{1,t}\right) + \cdots + d_n \left(y_{n,t} - h_{n,t}\right) \quad \text{................} \quad \text{eqn.32}$$

where:

$$d_1 = a_1 + \beta_1 \beta_1 + \beta_2 \quad \text{................................} \quad \text{eqn.33}$$

$$d_1 = \beta_1 \beta_1 + \beta_2 \quad \text{...................................} \quad \text{eqn.34}$$

The β_1 are the mean basal areas of each size class, whilst the β_1 are empirical coefficients. When the matrix multiplication is worked out, equation {32} resolves to an equation to predict ingrowth into the smallest class with the form:

$$1_t = \beta_0 + \beta_1 \sum \left(\beta_1 (Y_{1,t} - h_{1,t})\right) + \beta_2 \sum \left(y_{1,t} - h_{1,t}\right) \quad \text{.................} \quad \text{eqn.35}$$

In other words, ingrowth is a linear function of stand basal area and the total number of trees. The β_1 term is likely to be negative, with lower ingrowth at higher stand densities due to shading; the β_2 term should be positive, indicating that that there will be more seedlings developing as more gaps are formed from dead or felled trees.

Buongiorno and Michie (1980) tested this model with data from mixed hardwood forests in Wisconsin and Michigan, dominated by Sugar Maple. They found that over long periods of simulated time, the stocking tended to oscillate in long cycles of some 200 years, with the diameter distribution tending to be U-shaped, with abundant large trees and a deficit of Intermediate sizes. This is interesting as such diameter distributions may be observed in undisturbed tropical high forest (Alder, 1991).

The work also explored the conditions and effects for a sustainable yield defined such that the stand vector *y* at the end of a felling cycle is the same as at the beginning. It is possible to solve for the yield that will satisfy this condition using linear algebra. The result is a vector of tree numbers to be removed, with each element being a size class.

In later works on the same theme, Michie and Buongiorno (1984) gave more details of how the elements of the transition matrix and the empirical coefficients could be calculated from permanent sample plot data. Buongiorno and Hsien-Chi (1990) discussed how the basic model in equation {2.26} can be used in a linear program that maximizes the value of the harvest, subject to the sustained yield condition that the stand vector should be constant at the end of successive felling cycles. From this, both the optimum harvest and th

e cutting cycle can be determined using the modeling approach which had been applied to forest sector projections in Nigeria (World Bank, 1992).

Mengin-Lecreuix (1990) reports on a matrix model developed for mixed tropical forest in Yapo, Cote d'lvoire. The basic model is:

$$x_{t+2} = v.p.x_t + R \qquad \text{.......................................eqn.36}$$

where:

x_t is a column vector of diameter classes in year t. Each class is 5 cm wide, and the model had 25 classes in all. The basic time period was 2 years, hence the vector x_{t+2} gives the stand 2 years later, after a single growth step in the model.

v is the survival over each growth step, given as a constant fraction irrespective of size class.

P	is a growth matrix giving the transition probabilities. As with the matrix Q in equation (36), only the a_1 diagonal elements and b_1 sub- diagonal elements are non-zero, and define the proportions of static trees and those which move into the next higher class in each 2-year step.

R	is a column vector whose elements are zero except for the first, after the manner of the c vector in equation (36). This first element represents a constant rate of recruitment into the smallest diameter class.

The data for the plots was derived from experimental plots at Irobo, cote d'ivoire. Different growth, mortality and recruitment functions were established for 30 species and for thinned and unthinned forest, and used to project the growth of the forest at Yapo.

These examples illustrate some of the various formulations of matrix models of stand growth. All are essentially related to the simpler diameter class projection model of equation (35). Matrix algebra provides a compact notation for discussing the basis of a model. However, in practice, as will be seen, there are significant difficulties in applying matrix models to tropical mixed forests due to the large number of species. Even with grouping of data for species of similar habit, there may be 40-50 groups, each of which requires its own transition matrix, all of whose elements have to be defined as model parameters from data. With the inefficiency of a matrix representation in the examples discussed, most of the elements of the transition matrix are zero and if this algebraic approach is translated directly into a computer program, then the majority of the memory is used storing zeroes, and most of the computer time looping through empty portions of matrices.

Matrix models also suffer from the general deficiency of diameter class projection models, arising from the lack of sensitivity to density-dependent interactions.

2.7.4 CONSTRUCTION OF DIAMETER CLASS PROJECTION MODELS USING A SIMPLE TRANSITION MATRIX MODEL

Transition matrix models based on equation (30) are simple to construct if a large amount of data is available. They are difficult to build with sparse data, when the transition matrix will have many zero elements and will be poorly defined.

The matrix model can be defined as:

$$N_{t-1} = R + G.N_t \qquad \text{......................................eqn.37}$$

This is identical to the definition of equation (31) but with an additional column vector, R. Each element of R gives the numbers of trees growing into the corresponding diameter class as recruitment over a fixed period. G is the matrix of transitions, with each element g_{ij} defining the number of trees which move to class i from class j. The column totals will normally be less than one. In other words:

$$\sum_{I=1}^{m} g_{ij} \leq 1 \qquad \text{..eqn.38}$$

The summation gives the total survival over the period. This type of formulation differs from a pure Markov model such as that of Bruner and Moser (1973) discussed earlier. In a Markov model, states would need to be defined for dead and harvested trees, so that column totals would always equals 1.

2.8 CROWN COMPETITION INDEX

In general modeling, there is a need to quantify the effects of competition when plants or trees grow in communities. The effect of intensity of competition depends to a large extent upon whether the competition is intra-specific on inter-specific. Tree to tree interaction may result in reduction of growth of weak competitive trees. So the extent of this growth reduction is of main concern for the modelers to incorporate in their models for the realistic prediction of stand productivity, which is of real interest to the forest managers for making silvicultural, management and economic decisions for their estates.

A competition index characterizes the degree to which the growing space of an individual plant is shared by other plants (Deluis *et al.*, 1997). It is difficult to define a zone of influence for use in a competition index for individual tree that includes all competition and sources of competition for scarce resources. Two major classes of competition indices have been developed: distance-independent and distance-dependent (Munro, 1974). Distance- independent indices don't require spatial data whereas the distance-dependent indices use spatial data to stimulate individual trees or their parts (crowns, branches, etc.). Single tree spatial models use information about the distances and sizes of neighbouring trees. The distance-dependent competition indices can further be divided into size-ratio, crown or influence-zone overlap and growing space or area potentially available indices. However the size ratio index is the mostly used method which calculates sums of ratio of subject tree dimensions to competitive tree dimensions. These ratios are often weighted by distances of the subject tree to its competitors. The most common tree dimensions used are diameter at breast height (DBH), total height and basal area (the sum of individual tree cross-sectional areas).

Hegyi (1974) competition index is the most widely used size-ratio index which is calculated as in function:

$$CI = \sum \left[\frac{DBH_j}{DBH_i} \times \frac{1}{d} \right] \qquad \text{……………..………eqn.39}$$

Where CI is overall competition index of ith subject tree, DBH_j is diameter at breast height of jth competitor, DBH_i is the diameter at breast height of subject tree and d is distance between jth competitor and ith subject tree. Size-ratio indices are useful for situations where there is uncertainty about the radius of the influence zone.

2.8.1 Crown Competition Factor (CCF)

Crown competition factor was used in the study as a measure of stand density from predetermined relationship. The index enabled the development of model that expresses relationship between crown width (CW) and diameter (D) for open-grown trees with the general form:

$$CW = b_o + b_1 D \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{eqn.40}$$

Where β_o and β_1 are regression model coefficients. However, Lemay and Marshall (1990) reported that CCF is dependent on the horizontal projection of crown areas of stand-grown trees of a given diameter relative to the maximum crown area that would be associated with open-grown trees of the same diameter and that if CW is measured in meters, crown area (CA) is expressed in square meters as:

$$CA = \frac{\pi}{4} X (CW)^2 = \frac{\pi}{4} X (b_o + b_1 D)^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{eqn.41}$$

Similarly, the maximum crown area (MCA) of the study was computed from whence the CCF of the stand was estimated. The MCA is the crown area of an open-grown tree of diameter D, expressed as percentage of a hectare as in the form:

$$MCA = \frac{100 \; X \left(\frac{\pi}{4}\right) X (\beta o + \beta 1D)2}{10000} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{eqn.42}$$

The MCA was then computed for every tree in the stand, and the summation of these values on the basis of hectare is the crown competition factor (CCF).

2.9 MODELS COMPARISON: STOCHASTIC AND DETERMINISTIC MODELS

Acharjee (2006) reported that deterministic growth model produces an estimate of the expected growth in the equivalent such that the estimate of the mean indicates the expected trend for a population with the ample possibility of the model types being effective for determining the expected yield which are tremendously applicable and useful in indicating the optimum stand condition of a forest estate. On the contrary, stochastic models attempt to exemplify the natural disparity which always gives the provision of different predictions, each with a specific probability of occurrence (Frange, 2005; Haugh, 2010).For example, Huang *et al.* (1992) compared 20 published non-linear height-diameter functions including S-shaped and concave-shaped curves for 16 different species in Alberta, Canada. Fang and Bailey (2001) also investigated 33 height-diameter equations including S-shaped and concave-shaped curves for tropical forests in Hainan Island of Southern China.

Lei and Zhang (2006) reported that when a large number of models are compared, much longer time is needed besides mixing up the conceptions and properties of different mathematical models in the process of computation and selection for a given data set. Apparently, such a process based on model selection may have at least two drawbacks. First, the model forms are subjectively constrained to a given data set, and consequently some biases may be introduced in some competing models, and some may not even achieve convergence due to the use of an inappropriate functional form to start with. Secondly, it takes a considerable amount of time to complete the model selection process because of too many candidate models. For example, the curve forms of the competing models are often assigned a priori by restrictions on the S-shape, the concave shape or the parabolic shape at a given database. Instead, the form of a function selected to represent forest growth process must be sufficiently flexible and versatile to allow the curves to vary with different data sets (Lei and Zhang, 2006).

The functional forms suggested by Richards (1959) and Schnute (1981) can describe both S-shape and concave shape relationships depending on the estimated coefficients in a given data set. Both models have this useful feature, as they allow for a test of different curve shapes and thus do not make it necessary to assume an S-shape or a concave shape a priori and to use so many candidate models before the best model in a given data set is selected. However, this feature has not yet been used to conduct real data analysis with various outcomes that might be of interest to forest biometricians involved in similar model problems in forestry despite wide uses in growth models (Cieszewski and Bella, 1992, 1993; Cieszewski and Bailey, 2000; Cieszewski, 2001). This may lead to a commonly used and recommended approach that includes different curve shapes for a given database from sample plot information. The two models possess similar capabilities or basically similarity, but the deterministic model is more flexible and versatile than the stochastic model (Bredenkamp and Gregoire, 1988). The deterministic model is much easier to fit and quicker to achieve convergence for any populations (Lei, 1998).

Significantly, deterministic models produce a characteristic curve that peculiarly shows an initial period of decelerating growth and, passed the inflection point, continues with an indefinite period of accelerating growth. Such a curve might not occur very often in forest growth modelling. It occurs only when competition mortality leads thinned stands to an accelerated growth in mean diameter at breast height-dbh; which is an integral part of forest growth characteristics (Bredenkamp and Gregoire 1988).

2.10 GROWTH MODELS' DEVELOPMENT, EVALUATION AND VALIDATION

2.10.1 Models development

Growth modelers need data to develop models, to test models, and to use models, and each of these three activities may require data of a different nature. The initial and obvious requirement in model development most especially when data are used to fit the basic functions comprising the model is thoroughness of the data for the model testing. Interpolations are always safer that extrapolations, so permanent plot system should be designed to sample the widest possible range of site and stand conditions. Limited but reliable data at each extreme and at the mean are more useful than copious data clustered about the mean. Re-measurements are necessary to detect growth and change, and must span a sufficient time period to incorporate climate variation. The measurement interval should be long enough to ensure that growth patterns are not obscured by measurement error. Some statistical difficulties may arise if there are many re-measures of each plot, unless the number of plots should is large relative to the number of plot re-measurements.

2.10.2 Model Validation and Application

The validation of a model or computer program is the process of checking inputs and corresponding outputs to determine accuracy. In the case of a forest growth model, this means comparing the projected growth of stands over various periods of time and under various management regimes with the observed growth, as determined from PSPs, experimental plots, and stands of known age since logging.

The data used to test or validate a model may be completely independent of the data used to construct it, or it may be the same data. These two situations can be referred to as Independent or self-validation. Self-validation is a normal procedure with simple regression models, where statistics such as residual standard deviation provide indicators of regression accuracy. Residual plots are used in regression analysis to determine undesirable features such as lack of fit, heteroscedacity, or bias (Draper and Smith, 1966). Independent validation is more rigorous than self- validation, but when data is limited, may be an unachievable ideal. As an example, Alder (1979) used both self and Independent validation to test the VYTL growth model. Self-validation was based on the same PSPs as were used to develop the model. Independent validation was performed by simulating a number of thinning experiments whose data had not been used in the model.

It may be the case that no suitable data exists to fully validate a model. This case arose in the work of Alder (1995), for example, with the GHAFOSIM study. GHAFOSIM was based on individual tree growth data, from which whole stand yields were estimated. There was no data available on whole stand growth that could be used to check the model. Validation in such cases is limited to determining that model outputs are reasonable, conforming to general expectations and published results from similar forest types.

Formal documentation of the validation process is important to the acceptance of a model as a management tool. Introduction of growth modeling techniques into forest management implies and requires the evolution of a forest management information system. This in turn imposes a need for organizational change. Such changes will tend to be resisted by individuals who are threatened or challenged by them. If no formal validation has been performed, it will be relatively easy to oppose the introduction of modeling techniques on the grounds that the model is unproven and of doubtful accuracy (Alder, 1995).

Conversely, there may be a tendency to an over-enthusiastic and uncritical adoption of computer methods without thorough testing, in such cases, programming errors ('bugs') and model weaknesses could lead to grossly erroneous management decisions. Apart from the direct environmental and fiscal damage that might ensue, this would have the effect of discrediting modelling techniques, and retarding their wise and proper use (Alder, 1995).

Although a model should be formally validated as a terminal component of its development and documentation, validation is also an ongoing process during its composition. It is applied to check individual growth functions and also complete program modules. This internal validation will generate changes and adjustments to functions used, especially with respect to bias, validation thus becomes a component of function and program development.

2.10.3 Model Evaluation

Model evaluation is an important part of model building, and some examination of the model should be made at every stage of model design, fitting and implementation. It should not merely be an afterthought or an acceptance trial. A thorough evaluation of a model involves several steps, including two which are often called verification and validation. In forest growth modeling, these usually denote qualitative and quantitative tests of the model, respectively. However, there are some objections to these terms (Oreskes *et al*., 1994):

1. They are value-loaded, and it is preferable to use neutral language to assess model performance.

2. The same terms are used in other branches of mathematics and logic to denote other meanings: a model is valid if the logic is correct, and verified if it is “true”.

3. Verity implies truth, but it is impossible to prove a model “true” (except in the special case of a closed system). The only truth that can be established in a growth model according to Goulding (1979) is that the model is a faithful representation of what the modeler intended. Similarly, the only sense of validity that can be demonstrated for an empirical model is the “reasonableness” of the statistical assumptions. Thus it is appropriate to avoid these terms, and to use alternatives. We use the term model evaluation to encompass both these aspects. Thorough model evaluation comprises

several steps, each of which may involve qualitative and quantitative aspects. Some steps involve examination of the structure and properties of a model, with or without supplementary data, to confirm that it has no internal inconsistencies and is biologically realistic. Others require comparisons with empirical data to quantify the performance of the model, and have become known in some forestry literature as benchmarking. Ideally, benchmark tests should involve data which are in some sense unlike the data used to fit the model, but useful insights can also be obtained with the calibration data. These tests cannot prove a model to be "correct", but may be used in attempts to falsify inferences made from the model. The quality of a model can only be evaluated in relative terms, and its predictive ability always remains open to question. However, the failure of several attempts to falsify a model should increase its credibility and build user confidence. This is the role of model evaluation. Thus model evaluation should be an on-going procedure which commences during model design and continues throughout model construction and for as long as the model remains in use.

Vanclay (1994) and Soares *et al.* (1995) recently reviewed ways to evaluate forest growth models. It can be stressed that model evaluation should not be a mere mechanical procedure to examine a model's technical credentials, but should also involve philosophical considerations by modellers and model users.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 THE STUDY AREAS

3.1.1 Omo (J4) Forest reserve

3.1.1.1 Location

The Omo Forest Reserve is located between latitudes 6^{o} 42^{1} and 7^{o} 00^{1} N and longitude 4^{o} 17^{1} and 4^{o} 25^{1} E (Figure 2). The reserve has to its northern boundary Osun and Ago Owu forest reserves in Osun State and Oluwa forest reserve in Ondo State. The Omo and Oni rivers delineate the southern and eastern boundaries, while the western frontier of the reserve is demarcated by surveyed lines and trails. The reserve had a total area of approximately 130,550ha which includes a 460 ha Strict Natural Reserve (Okali and Ola-Adams, 1987), with about 65km^{2} of enclave and cut out areas with a total of about 20,000 inhabitants (Dike, 1992); is roughly triangular in shape, and tapers southwards with its southernmost tip about 20 km from the Atlantic coast.

3.1.1.2 Topography, Geology and Soils

Topographically, the reserve has a general terrain that is undulating with maximum elevation of 150 m above sea level is towards the west while the lowest parts of the Reserve are in the south where the River Omo joins River Oni before flowing into the Lekki Peninsular on the Atlantic coast. The Lagos-Ore-Benin Highway passes through the southern tip of the Reserve. The main study area is generally lowland with fair undulation towards the Ajebandele community of the reserve. Geologically the Reserve lies on crystalline rocks of the undifferentiated basement complex which in the southern parts is overlain by Eocene deposits of sand, clay and gravel. The majorities of soil representatives are found similar to the Ondo Association as contained in the Smyth and Montgomery (1962) soil classification pattern. This characteristically comprises of well-drained, mature, red, rocky and gravelly soils in the upper component of the order, which result into hill wash overlying original parent materials deposits in valley floors. Chijioke (1988) reported that the texture of the reserve varies from coarse sandy clay at the upper slopes to loamy sand at the bottom with generally acidic soil reaction.

3.1.1.3 Climate and Vegetation

The climatic description of Omo forest reserve is that of humid tropics with distinctive high temperature and high annual rainfall. The report of Chijioke (1988) showed that an annual rainfall of about 2362mm is common with highest rainfall occurring between April and October. Similarly, the driest months in the reserve is reported to occur between November and February (Lowe 1993; as cited by Isichei, 1995). The forest vegetation present in the reserve is that associated with Ferruginous Tropical soil with abundance in species including *Hunteria umbellata, Lanneawelwitschii, Terminalia superba, Triplochiton scleroxylon, Bridelia atroviridis, Celtis mildbraedii, Discoglypremna caloneura, Erythrophleum ivorensis, Khaya ivorensis, Mitragyna ciliata, Pausynstalia macroceras, P. talbotii,* and *Scottellia coriacea* (Isichei, 1995).

3.1.2. Oluwa Forest reserve

3.1.2..1 Location

Similarly, Oluwa Forest reserve (mainly OA6, OA2 and OA1) is a pet project of Ondo State Afforestation (OSAP), Lisagbede, Ondo State of Nigeria; co-established by the World Bank, Federal Government and the Ondo State Government in 1979 in furtherance Iwopin Paper Mill Industry in Ogun State. The Oluwa forest reserve geographically lies within latitude 6°55' and 7°20'N and longitude 3°45' and 4°32'E; and it is situate ted between the Oni River and the Omo Forest Reserve (Figure 2). The reserve has boundaries with Ogun State to the West of the reserve; Ore-Sagamu/Lagos-Benin expressway to the South; River Oluwa to the East and sparsely bounded in the North by some communities in Ondo State. The operation base of OSAP within the forest covers an area of about 56,110 hectares with the major activities centred at Lisagbede.

3.1.2.2. Topography, Geology and Soil

Oluwa Forest Reserve has a gently undulating steeply slopes with occasional hilly outcrops. The soil present within the forest reserve is of Precambrian period with soil composition dominantly ferralitic with usual sandy loamy overlaid with slightly clay gravel. The area of the reserve has mean attitude of about 100m above the sea level.

3.1.2. 3. Climate and Vegetation

As a true replica of tropical Climate, Oluwa Forest reserve has the two predominant seasons- Dry and the Wet sessions with annual rainfall varying between 1,500mm to 2,200mm; and the mean daily temperature is noted to range between 20.7^{o}C to 27.5^{o}C while the mean annual daily humidity finds its range between 81% and 84%; with the mean elevations of 100m above sea level. Oluwa forest reserve is a typical of rainforest type with diverse species and distinct canopies. The notable structure and physiognomy of the reserve is with a peculiar stratification yet highly heterogenous floristic composition of the following recognizable indigenous tree species- *Alstonia boonei, Afzelia africana, Buchholzia coriacea, Ceiba pentandra, Celtis zenkeri, Cleistopholis patens, Cola gigantea, Pterygota macrocarpa and Triplochiton scleroxylon.*

3.1.3 Shasha Forest Reserve

3.1.3.1. Location, Topography, Geology and Soil

Shasha Forest Reserve is situated in the Ife South Local Government Area of Osun State, Nigeria. It has landed area coverage of about 310.798 km^{2} or 31079.857 ha and geographically located on 70 and 70 10' N and 40 20' and 40 40'E (Figure 2). It shares boundaries with Omo Forest Reserve in the west. The northern and eastern boundaries are with Ife Native Authority Reserve (No. 2) and Oluwa Forest Reserve Ondo State respectively. According to Bada (1977) and Kio (1978), the geology and soils of Shasha Forest Reserve is composed of undifferentiated crystalline rocks (basement complex). The rocks components are made up of granites, gnesis and schists with occasional rock out - crops on riverbeds; while the soil belongs to the Ferruginous tropical group, which varies in depth from a few centimeters near rock out crops and one to two meters in areas occupied by large trees.

3.1.3.2. Climate and Vegetation

The annual rainfall is between 1000 and 1500 mm while the mean annual temperature is 26.5^{0}C with the annual range between 19.5^{0}C and 32.5^{0}C (Kio, 1978).The vegetation according to Keay (1959) and Keay (1989) was classified as tropical lowland rainforest with three distinct canopy stories with scattered emergents. The vegetation of Shasha Forest Reserve can be classified as mixed/moist semi evergreen forest. There is however a mixed deciduous forest in the northern part and a wet evergreen forest in the larger percentage of the southern area of the reserve as it was been identified by Okali and Ola Adams (1987) with several individual stems of about 95 species reported. Dauda *et al.*, (2004) submitted also that the indigenous species encountered during the study were mostly *Strombosia pustulata, Tabernaemontana pachysiphon, Anthostema aubreyanum* and *Diospyros iturensis.* There are also patches of exotic species plantations such as *Tectona grandis, Gmelina arborea* and *Pinus caribaea* among others.

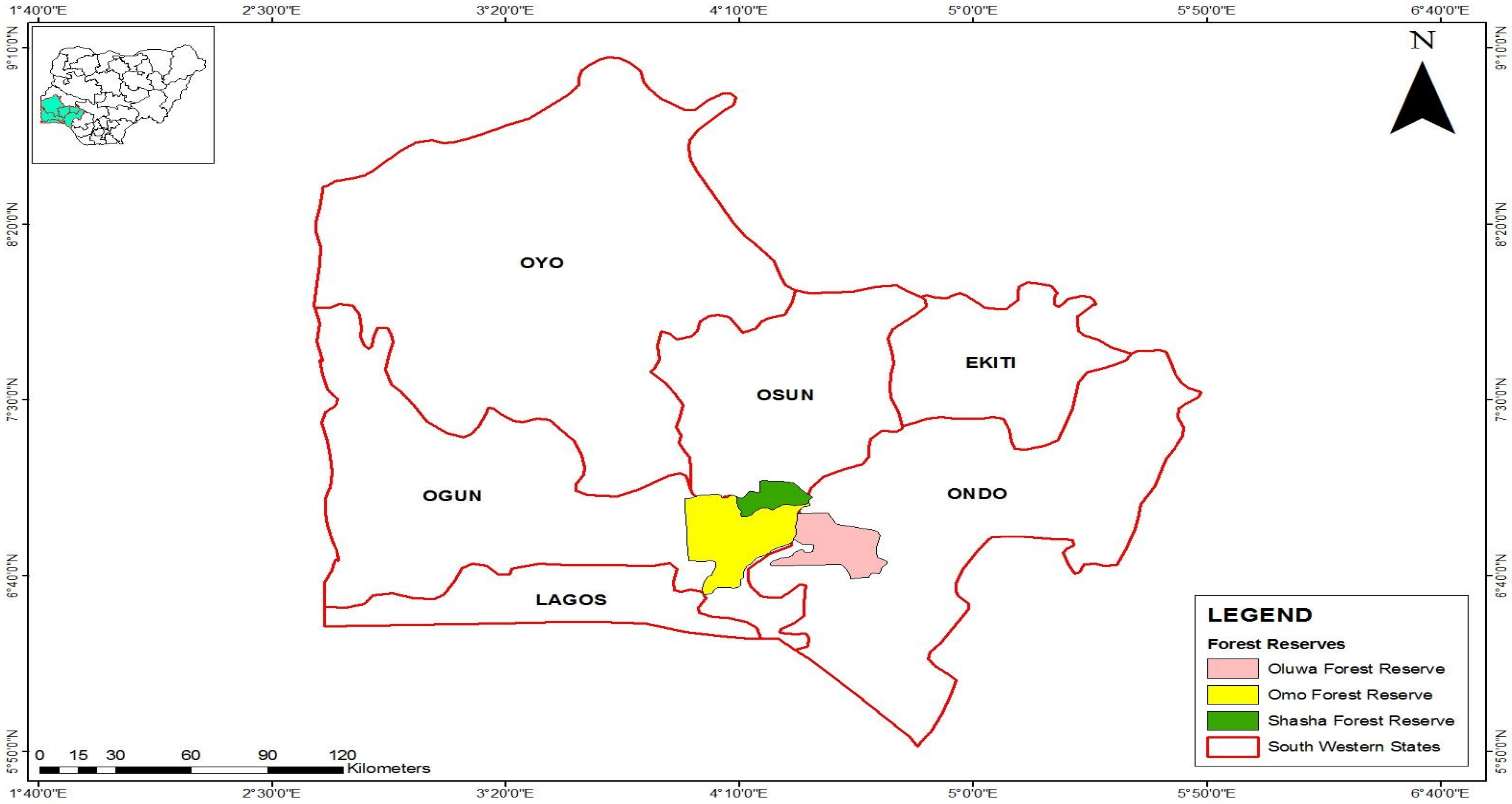


Figure 2: Map of Southwestern Nigeria showing location of Oluwa, Omo and Shasha Forest Reserves of the study area

3.2 Data collection

3.2.1 Reconnaissance survey and sites selection

A reconnaissance survey was carried out to ascertain the accessibility and suitability of the study areas. The visual assessment of the stands made enabled the proper planning of the sampling techniques. The selection of sites for this study was based on the availability of existing *Pinus caribaea* stands in the study areas with uniform growth differences and sufficient planting density suitable to get information needed for the study (Table 1)

Table 1: Extent of hectage distribution of Age series of *Pinus caribaea* plantations in the study areas

Year of planting	Location	Age	Density per Ha
1974	Oluwa Forest	37	2500
1975	Oluwa Forest	36	2050
1976	Oluwa Forest	35	4575
1984	Shasha Forest	27	5900
1990	J4 Area	21	6050
1991	Oluwa Forest	20	5925
1993	Oluwa Forest	18	1425
1996	J4 Area	15	11575

3.2.2 Sampling Technique

Sampling techniques are paramount necessary in quantitative forestry to obtain estimates that are representative of the entire population. In this study, stratified sampling technique was used with the three Forest Reserves (J4-Omo, Oluwa and Shasha Forest Reserves) representing the strata and from where Twenty (20) Temporary Sampling Plots (TSPs) were randomly chosen from each stratum and the estimates of the mean and the total population were obtained without element of biasness.

3.2.3 Measurement of Tree parameters

Tree growth characteristics measured and estimated during this study period included diameter at breast height over bark of all trees (cm), diameter at the base, at the middle and at the top of all trees in each of the sampling plots (cm), total height of all the trees (m), crown length of all the trees (m), crown diameter of the entire tree (m), merchantable height of all the trees (m) as well as the record of the age of each plot. Also determined from each of the temporary sampling plot are stem quality and canopy layer in all the study areas using mensurational instruments such as Relascope and Girth Tape for diameter measurement, Clinometer (height related attributes), a Measuring Tape for distance or land measurement and Compass and GPS for locating the coordinates within the study area.

3.3 Data Analyses

3.3.1 Computation of models variables

3.3.1.1 Stand Basal Area Estimation

The estimations of basal area in this study were both computed for every tree in each plot and for eventual mean of tree per plot. For individual trees within the plot, the basal area was estimated using the formula:

$$g = \pi \frac{D^2}{4} \quad \text{.....................................} \text{ eqn.43}$$

where

g = basal area (m^2)

D = diameter at breast height

π = 3.142 (a constant)

Similarly, the mean basal area per plot was estimated using the formula

$$d_g = \sqrt{\frac{\sum d^2}{n}} \quad \text{...................................} \text{eqn. 44}$$

where

d_g= mean basal area

d = dbh (diameter at breast height)
n = number of trees per plot

Correspondingly in every plot, the total basal area of all trees was computed and used to estimate the basal area per hectare by simply multiplying the plot basal area by 25 (being the number of 0.04 ha sample plots in a hectare. Likewise, the annual tree basal area growth and stand basal area growth per hectare were obtained by dividing individual tree basal area and basal area per hectare by the plot equivalent age respectively.

3.3.1.2 Stem volume estimation

The stem volume of each *P. caribaea* tree in each plot was estimated using Newton's formula:

$$V = (A_b + 4A_m + A_u) \times \frac{h}{6} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{eqn.45}$$

where, V= stem volume (m^3), h = total height of the section of the tree, $A_{b,}$ $A_{m,}A_{u,}$ are cross sectional areas at the base, middle and top of the tree respectively.

The formula for this estimation was based on the work of Husch *et al.* (1982). Volume per hectare (m^3/ha) was also estimated by multiplying each plot stem volume per tree by 25. Similarly, annual stem volume increments for individual trees and on stand basis were computed by dividing both tree volume and stem volume per hectare by comparable plot age.

3.3.1.3 Tree Slenderness Coefficient

The slenderness coefficient of a tree is defined as the ratio of total height (h) to diameter at 1.3 m above ground (d). For the stand level, the slenderness coefficient is calculated using the quadratic mean diameter and the height of the mean tree as (hg/dg). There is well known that a straight relationship exist between the slenderness coefficient of the stands and the risk of stem breakage or tree fall due to abiotic factors such as the wind or snow (Nunes, 2010).

The tree slenderness coefficient of each *P. caribaea* tree in each plot was computed using the formula:

$$TSC = \frac{THT}{D} \qquad \text{……………………………. eqn. 46}$$

where TSC = tree slenderness coefficient, THT = tree total height (m) and D = diameter at breast height (m)

3.3.1.4 Site quality assessment

3.3.1.4.1 Site index

The importance of site assessment remains concomitant in quantitative forestry; simply for its possibility of allowing a measure of site quality. Though several methods have been developed and applied, the method used by Akindele (1990) was adopted in this study following the procedures of development of site index equation for estimating the site indices of the sample plots, the computation of site index values of the corresponding sample plots, and fitting of the linear regression model for predicting site index from the growth characteristics variables.

Similarly, there is need for consideration of an index age for developing equations for site index estimation for each plot under the *Pinus caribaea* plantation. Twenty Five (25) years was therefore used as an index age for this study, being a nominated age within the range of the plantation in the study area. Additionally, the linearized regression of Schumacher (1939) was adopted for the estimation of site index for each plot and it is of order:

$Hd = exp\ (b_o + b_1(A^{-1})$ ……………………………eqn. 47

Where,

Hd = average dominant height

A = Stand Age

$b_o - b_1$= Regression coefficients

Taking the logarithm of the equation, the equation becomes:

$lnHd = b_o + b_1A^{-1}$ ………………………….eqn.48

Fitting the equation to dominant height data when A equals the index age (25 years); Hd will be equal to site index (SI).

Thus

$b_o = lnHd - b_1A^{-1}$ ……………………………..eqn.49

$b_o = ln(SI) – b_1(25^{-1})$ ……………………………..eqn.50

Note that $(25^{-1}) = 0.04$

$lnHd = ln(SI) - b_1(0.04) + b_1(A^{-1})$ ……………………………...eqn.51

$lnHd = ln(SI) + b_1(A^{-1} - 0.04)$ ………………………………eqn.52

Making the SI the subject of the formula

$Ln(SI) = lnHd - b_1(A^{-1} - 0.04)$ ……………………………………..eqn.53

Therefore,

$SI = exp^{[lnHd - b_1(A-1 - 0.04)]}$ …………………………….. eqn.54

The above equation was conveniently used for site index estimation and curves within the individual stand and the three stands with known values of age and dominant heights.

3.4 Crown variables estimation

3.4.1 Crown Projection Area (CPA)

The Crown projection area for each tree in the study area was estimated from the formula:

$$CPA = \frac{\pi(CD^2)}{4} \qquad \text{……………………………….. eqn. 55}$$

where CPA = crown projection area and CD = crown diameter.

3.4.2 Crown ratio

Crown ratio was also computed for each tree in this study using the formula

$$CR = \frac{CL}{THT} \qquad \text{………...……………………………………eqn. 56}$$

where CR = crown ratio, CL = crown height and THT = total height.

3.5 Development of Growth and Yield Characteristics Models

Different regimes of growth and yield characteristics models were developed at various levels of measurements (i.e individual tree, size class and whole stand). At the individual tree level, diameter growth per year, basal area growth per year, stem growth per year and stem volume growth per year were used in modeling process. Stem volume (m^3) and basal area (m^2) were used for yield models development while stem quality modeling utilized the merchantable height (m) as an indication of stem quality in the study area. Modeling from size class level used diameter stem quality distributions for modeling processes. Similarly, growth and yield variables per hectare per year and per hectare respectively were explored for whole stand levels such that stem volume (m^3/ha/year), basal area (m^2/ha/year) and stem quality (m/ha/year) for growth models while stem volume ((m^3/ha) and basal area (m^2/ha) were used for individual growth models. The models developed essentially were combination of deterministic and stochastic models and their comparison in terms of performance was evaluated accordingly.

3.5.1 Chapman-Richards Functions

Allometric relationships were used in this approach to derive height and diameter increment from volume increment. Allometry is based on the fundamental finding that the relative increment of one growth quantity is proportional to another growth quantity of one and the same organism and was being used by 19th century foresters to estimate the growth of one part of a tree by the growth of a different part of the same tree. The allometric coefficient describing the height growth depending on volume growth of each tree was derived from the growth parameter by applying a Chapman-Richards growth function. This function was a common sigmoidal relationship that is often used to fit yield equations and it was of the form:

$$Y = b_1 (1 - e^{-b_2 A})^{b_3} \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{ eqn. 57}$$

Where Y is the variable of interest, b_1, b_2, b_3 are parameters estimated using non-linear regression, and A was the age of the stand. The b_1 parameters indicated the asymptotic value for Y and b_2 and b_3 parameters control the shape of the curve. Subsequently, the allometric coefficient was estimated assuming its dependence on the spatial arrangement of the trees under study.

3.5.2 Weibull distribution Functions

Probability density function using Weibull distribution functions was adopted to establish the diameter and stem quality distribution models for *Pinus caribaea* in the study areas. The general probability density function for a 3-parameter weibull function is given as:

f (x) = $\lambda/_{\beta}\left(\frac{x-\alpha}{\beta}\right)^{\lambda-1} exp\left[-\left(\frac{x-\alpha}{\beta}\right)^{\lambda}\right]$ ………………..eqn.58

when x, β, λ >0; α ≥ 0;

This will thereafter be simulated in to diameter and stem quality distribution functions; such that

i) Diameter distribution function used was given as:

f (dbh) = $^{c}/_{b}\left(\frac{dbh-\alpha}{b}\right)^{c-1} exp\left[-\left(\frac{dbh-\alpha}{b}\right)^{c}\right]$ ………..eqn.59

ii) Stem Quality distribution function was expressed as:

f (SQ) = $^{\lambda}/_{b}\left(\frac{SQ-\alpha}{b}\right)^{c-1} exp\left[-\left(\frac{SQ-\alpha}{b}\right)^{c}\right]$ ……………….eqn.60

3.6 Model Verification and Validation

All the models developed in this study were evaluated using quantitative or statistical procedures. The commonest methods that were adopted in this study are given below:

i) The Mean Square Error (MSE): This was used in measuring the extent of the empirical data used for the primary purpose of ensuring optimum precision of the predicted response. This is expressed as:

MSE= $^{RSS}/_{n} - p$ ………………………………….. eqn. 61

ii) The Square Multiple Correlation Coefficient (R^2)

This was used in measuring the proportion of variation in the dependent variable following the significant relationship to the independent variable. This is also called coefficient of determination (R^2) and is expressed as:

R^2 = $1 - {}^{RSS}/_{TSS}$ ………………..………. eqn. 62

iii) The Adjusted Square Multiple Correlation Coefficient (R^2_{ad}) was also adopted in evaluating the models to be developed. The R^2_{ad} is given as:

$$R^2_{ad} = 1 - (1-R^2)\left[\frac{n-1}{n-p}\right] \qquad \text{……………………….eqn.63}$$

$$= 1 - MSE\left[\frac{n-1}{TSS}\right] \qquad \text{……………………….eqn.64}$$

where, p = number of parameter in the model
n = number of observation
RSS = Residual sum of square
TSS = Total sum of square (corrected)

Similarly, the series of growth characteristics models developed were validated using Student's T-Test mean comparison method between the observed and predicted values of all the parameters being evaluated. The validation ensured the suitability and robustness of the models for futuristic predictions.

CHAPTER FOUR

4.0 RESULTS

4.1 GENERAL ESTIMATES IN *PINUS CARIBAEA* GROWTH CHARACTERISTICS

The general estimates of growth characteristics across the eight forest stands of the study area are shown in Table 2. Oluwa Forest Reserve 1974 (OFR-74) had the highest diameter at breast height (DBH) estimate with 34.99±1.085 cm while J4 1996 (J4-06) had the least DBH of 18.69±0.371 cm. The highest estimate of tree total height, merchantable height and stem quality were found in Oluwa Forest Reserve 1975 (OFR-75) with estimates of 17.23±0.218 m, 15.22±0.221 m and 13.27±0.225 m respectively; while their corresponding minimum values are found within J4-1999 with estimates of total height being 9.09±0.056 m, merchantable height of 8.54±0.059 m and stem quality having 6.71±0.063m. The highest estimate (0.23±0.04 m^2) of basal area (BA) was found in Oluwa Forest Reserve 1991 while its least estimate (0.03±0.001 m^2) was found in J4-1996. Highest stem volume estimate (1.38±0.101m^3) was observed within Oluwa Forest Reserve 1975 (OFR-75) and J4-1996 had the least stem volume estimate (0.22±0.007 m^3). Similarly, the highest estimate (0.272±0.002) of crown ratio (CR) was found within J4-1990 *Pinus caribaea* stand and the least estimates of 0.15±0.001 and 0.15±0.002 were found within OFR 1974 and OFR 1975 respectively. The crown projection area (CPA) had its highest estimate (6.93±0.087) found within J4-1990 and the least estimates (6.03±0.04 and 6.03±0.05) are contained within Shasha Forest Reserve (SFR) and OFR-1993 respectively. The highest estimate (82.88±1.085) of slenderness coefficient was found within OFR-1991 of *Pinus caribaea* while the least estimate (47.62±0.719) of slenderness coefficient was found within J4-1990.

Table 2: Individual tree growth characteristics according to the study locations

Study Location	N	AGE	DBH(cm)	THT(m)	MHT(m)	SQ(m)	CL(m)	CD(m)	BA(m^2)	SV(m^3)	CR	SC	CPA
OFR-1974	100	37	34.99±1.085	17.13±0.194	15.20±0.216	13.34±0.219	2.55±0.005	2.88±0.016	0.11±0.006	1.14±0.094	0.15±0.001	52.51±1.219	6.54±0.072
OFR-1975	82	36	34.50±1.240	17.23±0.218	15.22±0.221	13.27±0.225	2.55±0.008	2.93±0.020	0.10±0.007	1.38±0.101	0.15±0.002	54.04±1.481	6.78±0.094
SFA-1984	236	27	24.41±0.530	14.16±0.139	12.17±0.145	10.03±0.142	2.49±0.004	2.77±0.009	0.05±0.002	0.56±0.030	0.18±0.002	62.33±0.956	6.03±0.040
J4-1990	241	21	22.51±0.439	10.09±0.104	8.87±0.105	7.39±0.111	2.64±0.013	2.96±0.018	0.04±0.002	0.32±0.015	0.27±0.002	47.62±0.717	6.93±0.087
OFR-1991	237	20	18.69±0.371	14.63±0.124	12.88±0.287	10.94±0.439	2.47±0.004	2.74±0.007	0.23±0.001	0.35±0.18	0.17±0.002	82.88±1.085	5.90±0.031
OFR-1993	57	18	21.06±0.704	14.82±0.202	12.90±0.193	10.93±0.191	2.49±0.007	2.77±0.012	0.04±0.002	0.44±0.036	0.17±0.002	73.40±1.459	6.03±0.050
J4-1996	464	15	18.76±0.242	9.90±0.056	8.54±0.059	6.71±0.063	2.49±0.005	2.77±0.008	0.03±0.001	0.22±0.007	0.25±0.001	55.70±0.565	6.06±0.037
OFR-1976	175	35	25.24±0.66	15.32±0.168	13.26±0.165	11.90±0.178	2.51±0.006	2.80±0.010	0.06±0.003	0.67±0.040	0.17±0.002	66.17±1.405	6.19±0.046

* **Mean± S.E**

4.2 CANOPY LAYERS GROWTH CHARACTERISTICS AND AGE SERIES ESTIMATES

Estimates of growth characteristics within the crown canopy layer are shown in Table 3. Four crown canopy layers were identified across the *Pinus caribaea* stands in the study areas; namely dominant, co-dominant, intermediate and suppressed crown canopy layers (Fig.3). Diameter at breast height (DBH) were significantly different at $P<0.05$ among the crown canopy layer with dominant canopy having the highest estimate of 36.21±0.461 cm. The highest tree total height and merchantable height were found in the dominant crown canopy layer and the suppressed being the least. The stem volume estimates of suppressed and intermediate crown canopy layer were not significantly different from each other but the highest stem volume estimate (1.36±0.046 m^3) was found in the dominant crown canopy layer. Similarly, there existed sameness in the estimates of slenderness coefficient of intermediate (57.90±0.757) and co-dominant (59.21±0.512) crown canopy layer at $P>0.05$ level of significance. The estimates of diameter at the top to the diameter at breast height (DBH) were not significantly different between suppressed and intermediate crown canopy layer but highest estimate (0.063±0.004 cm) was found among the co-dominant crown canopy layer (Table 3).

Test of significance among both individual and whole stand growth characteristics across the age series are shown in Tables 4 and 5. Stem volume, total height, merchantable height, diameter at breast height (DBH) and slenderness coefficient are the growth characteristics evaluated for the individual tree level while the variables evaluated for whole stand included averages per hectare of stem volume, tree total height, slenderness coefficient, merchantable height, diameter at breast height (DBH) and crown projection area (CPA). There were general significant differences among the growth characteristics across the age series in the individual growth variables. The mean stem volume ranges from 0.22m^3 to 1.42 m^3 with distinct significance in ages 15 and 35. The stem volume among ages 18, 20 and 21 are not significantly different from one another at $P>0.05$ level of significance. Similarly, stem volume among ages 18 and 27 as well as ages 36 and 37 are not significantly different at $P>0.05$ level of significance. Comparably, similar trends were observed among the same growth characteristics at the whole stand level, which indicates obvious variations among the growth characteristics across the age series of the *Pinus caribaea* stands across the study area. This observation was in consonant with many studies on growth characteristics of tropical rain forest area plantation grown (Akindele and Abayomi, 1993; Dupuy and Mille, 1993; Onyekwelu *et al*., 2003).

Table 3: Growth characteristics among individual canopy layer and Age

Growth characteristics	CROWN LAYER			
Growth characteristics	Suppressed	Intermediate	Codominant	Dominant
DBH(cm)	14.14±0.1998^{a}	16.49±0.209^{b}	22.77±0.1609^{c}	36.21±0.4607^{d}
THT(m)	9.27±0.1339^{a}	7.78±0.0534^{b}	11.46±0.1079^{c}	14.86±0.1459^{d}
BA(m^2)	0.02±0.0006^{a}	0.022±0.0005^{b}	0.04±0.0006^{c}	0.11±0.0028^{d}
SQ(m)	7.61±0.3543^{a}	6.13±0.0621^{b}	9.47±0.0730^{c}	12.90±0.1396^{d}
SV(m^3)	0.13±0.0045^{a}	0.14±0.0041^{a}	0.41±0.079^{b}	1.36±0.0447^{c}
CR	0.23±0.0035^{a}	0.27±0.0015^{b}	0.20±0.0015^{c}	0.16±0.0022^{d}
SC	80.56±1.1042^{a}	57.90±0.7566^{b}	59.21±0.5191^{b}	47.28±0.5373^{c}
CPA	5.41±0.235^{a}	5.71±0.0361^{b}	6.28±0.0161^{c}	7.38±0.0637^{d}
DT/DB	0.57±0.0037^{a}	0.56±0.0049^{a}	0.63±0.0036^{b}	0.61±0.0070^{c}

Means with same superscript along the rows are not significantly different at $P > 0.05$ level of significant

Table 4: Growth characteristics among individual different Stand Ages

Growth characteristic	Stand age							
	15years	18years	20years	21years	27years	35years	36years	37years
SV(m^3)	0.22 ± 0.0069^{a}	0.44 ± 0.0359^{bc}	0.35 ± 0.0181^{b}	0.32 ± 0.0153^{b}	0.56 ± 0.0304^{c}	0.67 ± 0.0404^{d}	1.38 ± 0.1008^{e}	1.42 ± 0.0935^{e}
THT(m)	9.90 ± 0.0562^{a}	14.82 ± 0.2024^{b}	14.63 ± 0.1244^{b}	10.09 ± 0.1049^{a}	14.16 ± 0.1390^{c}	15.32 ± 0.1677^{b}	17.23 ± 0.2176^{d}	17.13 ± 0.1942^{d}
TSC	55.70 ± 0.5648^{a}	73.40 ± 1.7567^{e}	82.88 ± 1.0953^{f}	47.62 ± 0.7174^{c}	62.33 ± 0.95656^{d}	66.17 ± 1.4053^{g}	54.04 ± 1.4809^{ab}	52.51 ± 1.2195^{b}
MHT(m)	8.54 ± 0.0594^{a}	12.92 ± 0.1929^{b}	12.88 ± 0.2871^{b}	8.87 ± 0.1059^{a}	12.17 ± 0.5548^{c}	13.26 ± 0.1649^{b}	15.22 ± -0.5398^{d}	15.20 ± 0.2163^{d}
DBH(cm)	18.76 ± 0.2417^{a}	21.06 ± 0.7043^{b}	18.69 ± 0.3708^{a}	22.51 ± 0.4396^{b}	24.41 ± 0.5300c	25.24 ± 0.6634^{c}	34.50 ± 1.2400^{d}	34.99 ± 1.0855^{d}

Means with same superscript along the rows are not significantly different at $P > 0.05$ level of significant

Table 5: Growth characteristics among different whole stand Ages

Whole stand Growth characteristic	Whole Stand age							
	15years	18years	20years	21years	27years	35years	36years	37years
SV/ha(m^3ha^{-1})	306.54±16.78^{bc}	195.60±46.23^{a}	255.63±24.11^{ab}	242.22±16.81^{ab}	413.53±49.17^{c}	365.34±28.05^{c}	352.53±23.52^{c}	443.41±36.17^{c}
AVTHT(m)	9.99±0.18^{a}	13.82±1.01^{b}	14.65±0.24^{bc}	10.14±0.15^{a}	14.15±0.23^{b}	15.57±0.39^{c}	17.36±0.28^{d}	17.27±0.25^{d}
AVSC	55.56±1.06^{a}	69.74±4.29^{d}	82.89±1.81^{e}	46.98±1.52^{b}	62.37±1.74^{c}	64.92±1.85^{cd}	51.96±2.95^{ab}	51.33±1.69^{ab}
AVMHT((m)	8.58±0.11^{a}	12.02±0.89^{b}	12.93±0.46^{bc}	8.97±0.19^{a}	12.19±0.20^{b}	13.51±0.38^{c}	15.35±0.28^{d}	15.35±0.27^{d}
AVDBH(cm)	18.96±0.49^{a}	20.62±0.99^{ab}	18.70±0.59^{a}	22.86±0.75^{bc}	24.08±0.67^{bc}	26.08±0.87^{c}	35.92±1.55^{d}	36.19±2.45^{d}
CPA/ha	8294.08±545.19 ac	3653.3±1510.12$_{ab}$ c	9090.50±4690.01^{c}	5218.59±581.76^{abc}	4449.06±520.26^{abc}	3385.03±441.51^{ab}	1736.41±160.25^{b}	1774.03±345.03^{b}

Means with same superscript along the rows are not significantly different at P > 0.05 level of significant

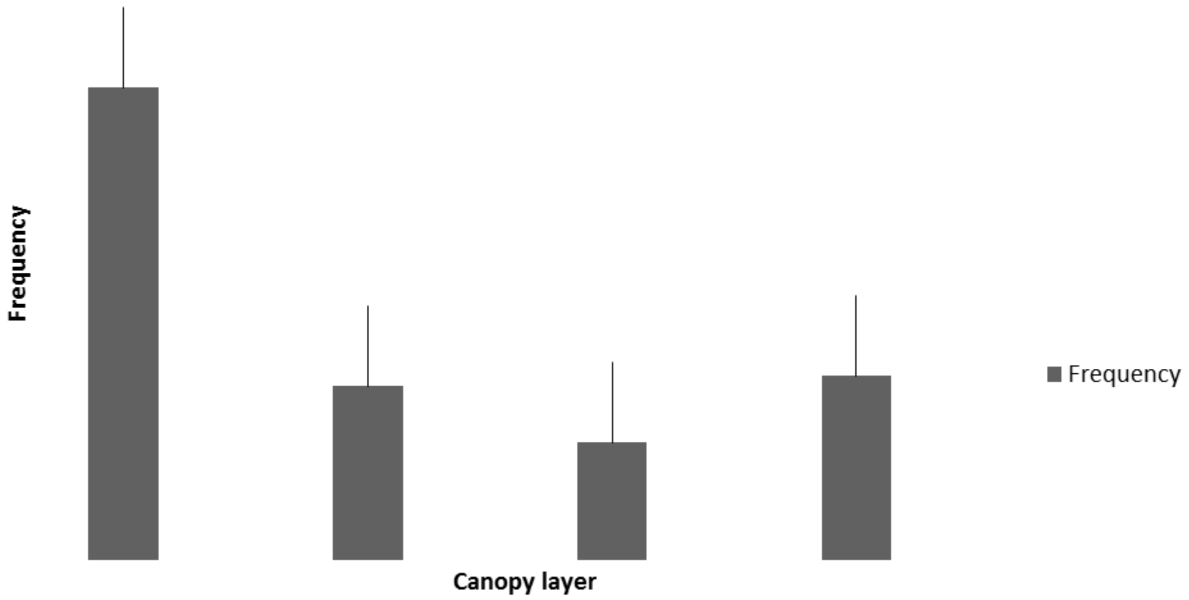


Fig. 3: Frequency of the canopy layers of *Pinus caribaea* in the study area

4.3 CORRELATION AND REGRESSION ANALYSES

Both linear and non-linear relationships among basic growth characteristics were evaluated to determine the relationship among dependent and predictors variables evaluated. The pattern of relationships among growth characteristics are shown in Figures 4 - 6. It is evident from the scatter diagrams in the figures that none of the predictor variables had linear relationship with corresponding dependent variables among one another. All the relationships evaluated are curvilinear and their corresponding coefficient of determination (R^2) ranges from 0.890 to 0.944. Relationship between merchantable volume and stump diameter had the highest R^2 value while diameter at breast height with total height had the lowest. The high relationships observed of diameter and stump on merchantable volume showed that these two variables are good predictor of merchantable volume. This observation agrees with similar results reported in tropical rain forest area of Nigeria for plantation grown T*ectona grandis* (Osho, 1983) and *Gmelina arborea* (Akindele, 2003).

The results of linear correlation analyses between growth characteristics and other parameters at individual, size class and whole stand levels are shown in Tables 6-9. The results of linear correlation at the individual tree level showed that there was high association between tree age and growth variables such as the tree total height, crown projection area, diameter at breast height and merchantable height with correlation coefficients (r) of 0.69, 0.53, 0.50 and 0.58 respectively. However, crown length, crown diameter, crown ratio, slenderness coefficient and basal area showed no significant linear association with the tree age (Table 6). Conversely, stem quality increment per year had negative association with the tree age. Diameter at breast height showed significant association with many of the growth characteristics except basal area, crown ratio, slenderness coefficient and stem quality. Associations between tree total height were only very significant with merchantable height (r = 0.88), stem quality (r = 0.73), stem volume (r = 0.68) and crown projection (r = 0.78) while the correlation coefficient with other growth characteristics is low ($r < 0.50$). Similarly, stem quality showed high correlation coefficient with basal area, stem volume and crown projection area, but its association with other growth variables is significantly low. There was high significant association with high correlation coefficient (r) between annual diameter at breast height with basal area, stem volume and stem quality. There was no linear correlation between basal area and other growth parameters except stem quality with correlation coefficient of $r = 0.78$ at $P < 0.05$ level of significance.

Linear correlation analysis at the whole stand level showed that there was high association between tree age and other growth characteristics such as diameter at breast height, tree total height, merchantable height and slenderness coefficient. Stem age however revealed negative association with stem quality and crown ratio; indicating that as the tree age increases, these two variables significantly decrease. Slenderness coefficient at the whole stand is highly associated with tree total height and merchantable height with correlation coefficient of $r = 0.98$ and 0.99 respectively. Linear association only existed between stand index and slenderness coefficient among all other growth characteristics within the whole stand level (Table7).

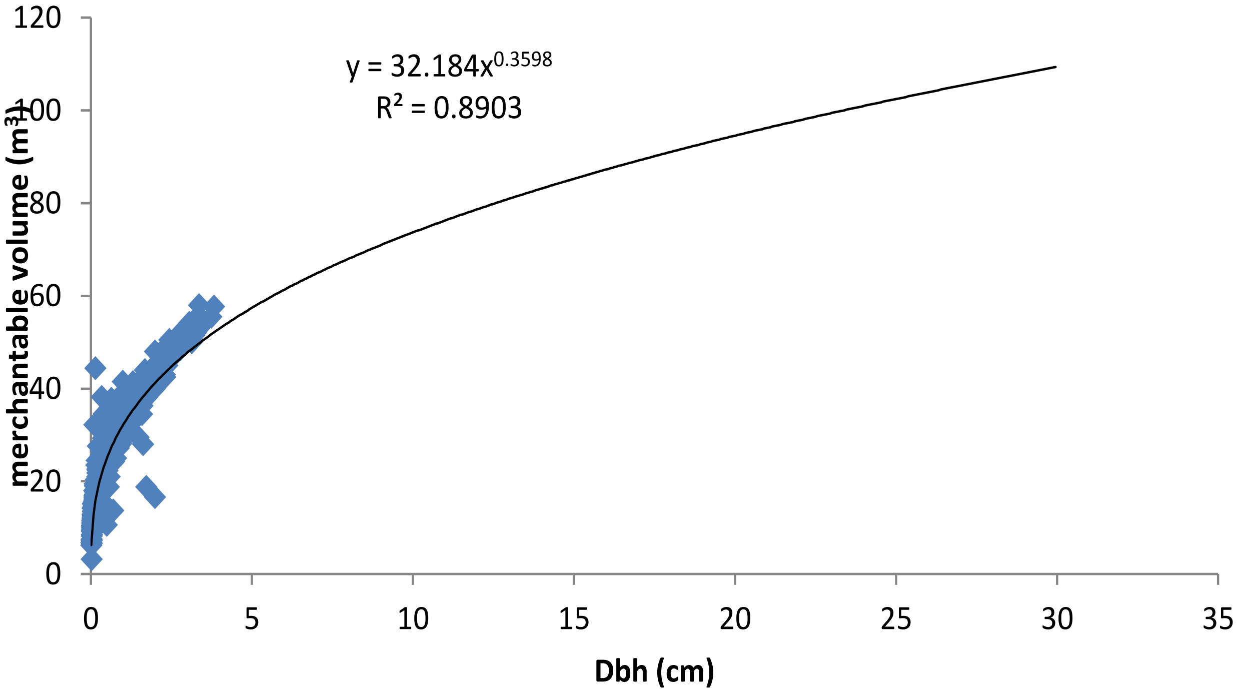


Fig.4: Relationship between merchantable volume and dbh for the pooled data of *Pinus caribaea* in the study area (n=1592)

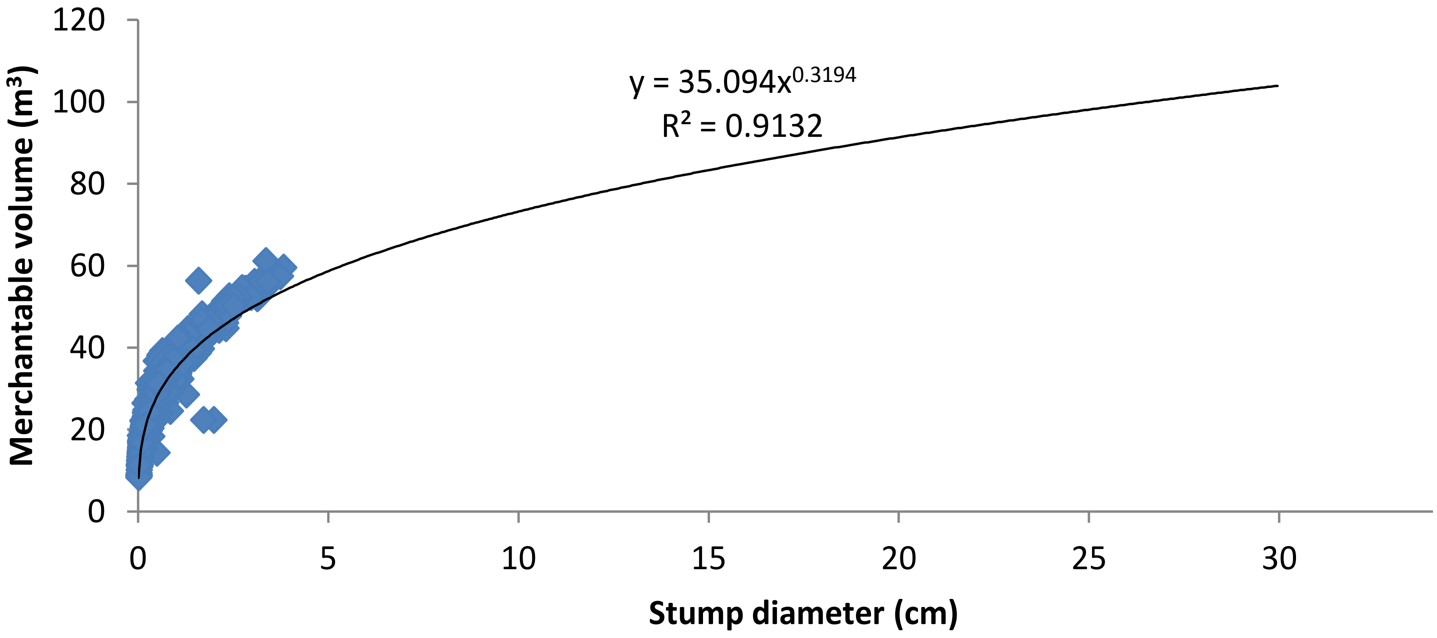


Fig.5:Relationship between merchantable volume and stump diameter

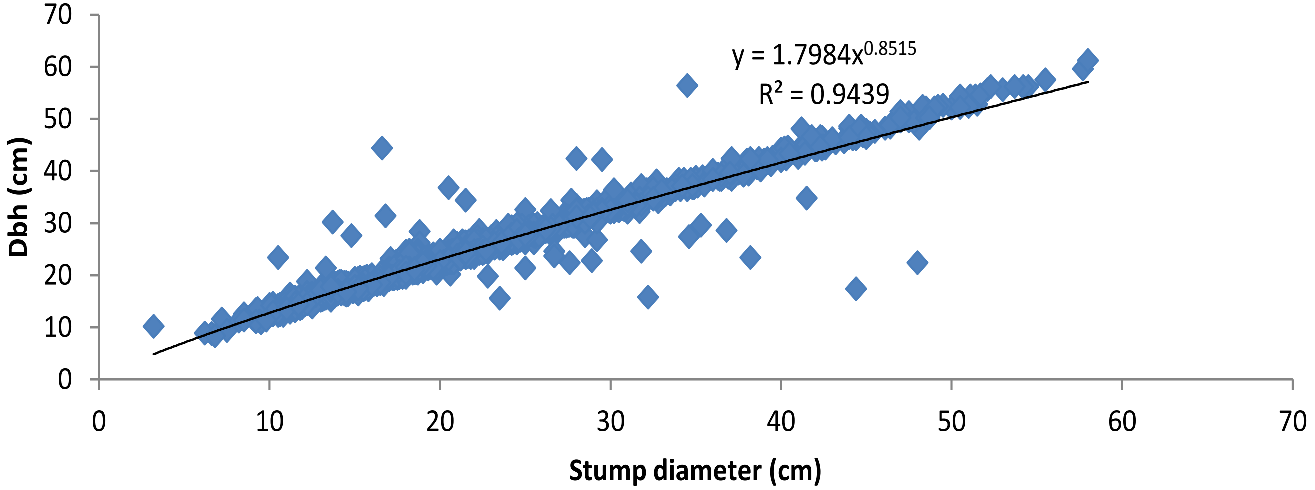


Fig.6:Relationship between diameter at breast height and stump diameter for the pooled data of *Pinus caribaea* in the study area (n=1592)

Table 6:Correlation matrix for individual tree growth characteristics

	AGE	DBH	THT	MHT	SQ	CL	CD	BA	SV	CR	SC	CPA	ΔDBH	ΔSQ	ΔBA	ΔSV
AGE	1.00															
DBH	0.50*	1.00														
THT	0.69*	0.69*	1.00													
MHT	0.58*	0.64*	0.88*	1.00												
SQ	0.48	0.55*	0.73*	0.66*	1.00											
CL	0.08	0.46	0.17	0.19	0.18	1.00										
CD	0.13	0.60*	0.29	0.30	0.26	0.73*	1.00									
BA	0.11	0.13	0.19	0.17	0.78*	0.02	0.04	1.00								
SV	0.49	0.97*	0.68*	0.64*	0.57*	0.57*	0.67*	0.15	1.00							
CR	0.04	-0.57*	0.11	0.04	0.00	-0.43	-0.47	0.02	-0.56*	1.00						
SC	-0.02	0.07	-0.10	-0.08	-0.14	0.06	0.07	-0.05	0.07	-0.21	1.00					
CPA	0.53*	0.87*	0.78*	0.70*	0.59*	0.27	0.41	0.14	0.84*	-0.43	0.03	1.00				
ΔDBH	-0.40	0.54*	0.05	0.10	0.10	0.42	0.51*	0.02	0.53*	-0.66*	0.12	0.43	1.00			
ΔSQ	-0.84*	-0.11	-0.39	-0.31	-0.26	0.02	0.06	-0.06	-0.12	-0.31	0.06	-0.04	0.73*	1.00		
ΔBA	-0.48	0.45	-0.01	0.04	0.06	0.38	0.47	0.01	0.46	-0.66*	0.12	0.37	0.98*	0.78*	1.00	
ΔSV	-0.34	0.44	0.18	0.19	0.16	0.18	0.30	0.04	0.42	-0.47	0.07	0.58*	0.85*	0.77*	0.85*	1.00

AGE- Individual tree age, DBH- diameter at breast height, THT-total height, MHT-Merchantable height,SV- Stem volume, SC-Slenderness Coefficient, CPA-Crown Projection Area, CR-Crown Ratio,*- coefficient of correlation and marked correlations are significant at $p< 0.05$)

Table 7: Correlation matrix for whole stand growth characteristics

	AGE	ΔDBH	THT	MHT	SC	ΔSQ	CL	CD	BA/ha	ΔBA	SV/ha	ΔSV	CR	SC	CPA/ha	SI
AGE	1.00															
ΔDBH	0.85*	1.00														
THT	0.81*	0.88*	1.00													
MHT	0.78*	0.88*	0.99*	1.00												
SC	0.82*	0.92*	0.98*	0.98*	1.00											
ΔSQ	-0.74*	-0.86*	-0.91*	-0.95*	-0.94*	1.00										
CL	0.14	0.20	-0.08	-0.05	0.03	-0.18	1.00									
CD	0.31	0.47	0.16	0.19	0.25	-0.36	0.87*	1.00								
BA/ha	-0.08	-0.15	-0.30	-0.33	-0.32	0.35	-0.07	-0.06	1.00							
ΔBA	0.16	0.30	-0.15	-0.13	-0.02	-0.05	0.73*	0.78*	0.20	1.00						
SV/ha	0.50*	0.43	0.39	0.35	0.35	-0.30	-0.11	0.03	0.74*	0.07	1.00					
ΔSV	0.35	0.40	0.32	0.32	0.35	-0.35	0.22	0.26	-0.04	0.21	0.19	1.00				
CR	-0.74*	-0.78*	-0.97*	-0.95*	-0.92*	0.82*	0.29	0.04	0.31	0.33	-0.36	-0.25	1.00			
SC	-0.18	-0.24	0.21	0.20	0.09	-0.04	-0.61*	-0.62*	-0.34	-0.95*	-0.16	-0.20	-0.37	1.00		
CPA/ha	-0.40	-0.34	-0.22	-0.11	-0.24	0.01	-0.11	-0.17	0.08	-0.25	-0.07	-0.23	0.18	0.27	1.00	
SI	0.00	0.20	0.53*	0.53*	0.45	-0.42	-0.49	-0.33	-0.24	-0.67*	0.11	0.01	-0.61*	0.73*	0.20	1.00

AGE- Stand age, ΔDBH- Stem diameter growth at breast height (cm/year),THT-Mean total height,MHT-Mean merchantable height, SV- Stand volume/ha, ΔBA-Basal area (m^2/year), BA- basal area/ha, SC-Slenderness coefficient, ΔCPA-Crown projection area/ha, CR- Crown ratio, SQ- Stem quality, ΔSQ-Stem quality (m/year), CL-Crown length, CD-Crown diameter,*- coefficient of correlation and marked correlations are significant at $p <$ 0.05)

The results of correlation analyses between diameter Weibull distribution parameters (a,b,c) and stand growth characteristics showed that location parameter (a) was highly and positively associated with stand age, diameter at breast height and tree total height while it was negatively associated with stand stem quality and crown ratio. Scale parameter (b) and shape parameter (c) had no association with any of the stand growth variables while sum of location and shape parameters (a+c) showed positive association with tree total height and quadratic mean diameter (Table 8). Similarly, stem quality distribution correlation results with stand growth variables showed that location parameter (a) was highly associated with stand age, total tree height and stand annual slenderness coefficient. Scale parameter (b) and shape parameter (c) however had no association with any of the stand growth characteristics. The sum of the location parameter and shape parameter (a+c) showed significant association with only tree total height, slenderness coefficient and logarithm of the inverse of age (Table 9).

Table 8: Correlation matrix for diameter Weibull parameter and stand growth characteristics

	AGE	DBH	BA/ha	THT	ΔSQ	ΔSV	CR	SI	QMD	a	B	c	a+c
AGE	1.00												
DBH	0.81*	1.00											
BA/ha	-0.08	-0.04	1.00										
THT	0.81*	0.72*	-0.30	1.00									
ΔSQ	-0.74*	-0.75*	0.35	-0.91*	1.00								
ΔSV	0.35	0.41	-0.04	0.32	-0.35	1.00							
CR	-0.74*	-0.58*	0.31	-0.97*	0.82*	-0.25	1.00						
SI	0.00	-0.04	-0.24	0.53*	-0.42	0.01	-0.61*	1.00					
QMD	0.80*	0.62*	-0.22	0.96*	-0.84*	0.27	-0.95*	0.58*	1.00				
A	0.67*	0.92*	-0.20	0.66*	-0.72*	0.40	-0.53*	-0.04	0.49	1.00			
B	0.22	0.19	-0.03	0.15	-0.08	-0.01	-0.17	0.02	0.22	0.08	1.00		
c	0.09	0.11	-0.02	0.04	0.01	-0.03	-0.07	-0.02	0.09	0.05	0.95*	1.00	
a+c	0.01	-0.04	-0.24	0.53*	-0.42	0.01	-0.61*	1.00	0.58*	-0.04	0.02	-0.02	1.00

AGE- Stand age, DBH- Stand diameter growth at breast height,THT-Mean total height,ΔSV- Stand volume/year, BA- basal area/ha, CR- Crown ratio,ΔSQ-Stem quality (m/year), QMD-Quadratic mean diameter, a-Location parameter, b- Scale parameter, c- Shape parameter, a+c- combination of location and shape parameters,
*- coefficient of correlation and marked correlations are significant at $p< 0.05$)

Table 9: Correlation matrix for stem quality distribution Weibull parameters and stand growth characteristics

	AGE	CR	THT	ΔSC	ΔSQ	SC	LNA^{-1}	SI	a	b	c	a+c
AGE	1.00											
CR	-0.74*	1.00										
THT	0.81*	-0.97*	1.00									
ΔSC	0.82*	-0.92*	0.98*	1.00								
ΔSQ	-0.74*	0.82*	-0.91*	-0.94*	1.00							
SC	-0.18	-0.37	0.21	0.09	-0.04	1.00						
LNA^{-1}	0.78*	-0.94*	0.94*	0.89*	-0.82*	0.33	1.00					
SI	0.00	-0.61*	0.53*	0.45	-0.42	0.73*	0.60*	1.00				
A	0.67*	-0.53*	0.66*	0.74*	-0.72*	-0.47	0.46	-0.04	1.00			
B	0.22	-0.17	0.15	0.15	-0.08	-0.10	0.21	0.02	0.08	1.00		
C	0.09	-0.07	0.04	0.05	0.01	-0.11	0.09	-0.02	0.05	0.95*	1.00	
a+c	0.01	-0.61*	0.53*	0.45	-0.42	0.73*	0.60*	1.00	-0.04	0.02	-0.02	1.00

AGE- Stand age, LNA^{-1}Logarithm of inverse of age, THT-Mean total height, CR- Crown ratio,ΔSC- Slenderness coefficient, ΔSQ-Stem quality (m/year),SI-Site Index, a-Location parameter, b- Scale parameter, c- Shape parameter, a+c- combination of location and shape parameters, *- coefficient of correlation and marked correlations are significant at $p< 0.05$)

4.5 GROWTH CHARACTERISTICS MODEL

4.5.1 Growth Characteristics Models among Canopy Layers

The growth characteristic models among the four canopy layers (Dominant, Co-dominant, Intermediate and suppressed) are shown in Table 10 through Table13. Six major growth characteristics were chosen for the comparison among the canopy layers and statistical fit indices such as coefficient of determination (R^2), root mean square error (RMSE) and F-ratio were used in evaluating the predictability of the growth models. The growth models evaluated were diameter at breast height model, basal area model, stem volume model, stem quality model, total height model and crown ratio model. Table 10 showed that coefficient of determination (R^2) for all the growth models evaluated ranged between 0.502 and 0.99 while crown ratio (CR) growth model had the highest R^2 value. From these fit statistics, the model clearly demonstrates the predictive ability of crown ratio from tree total height, crown projection area with age as a factor. The evaluation of the growth models among co-dominant canopy layer is shown in Table 11 with tree total height model having the highest (R^2) value and the least value found in the basal area growth model. These fit statistics show that the model possesses ability to predict tree height from crown projection area when age is factored into the model.

Table 10: Estimated parameters and models statistics among the dominant canopy layer

	DOMINANT CANOPY LAYER						
	GROWTH MODEL						
Equation	Model Form	Model Type	Parameter	Model RMSE	R^2	F –Ratio	P –Value
65.	$\Delta DBH= b_0Dbh^{b\,1}\exp(b_2CR+ b_3A)$	Diameter growth model	$b_0=0.0163$ $b_1=1.1088$ $b_2=-1.7575$ $b_3=-0.0718$	0.0104	0.709	-	<0.0000
66.	$\Delta BA= b_0BA^{b1}\exp(b_2CR+ b_3A^{-1})$	Basal area growth model	$b_0=0.0852$ $b_1=0.1359$ $b_2=-0.0106$ $b_3=1.7021$	0.0001	0.580	-	<0.0000
67.	$LNSV= b_0+ b_1LNDBH+ b_2A^{-1}$	Stem volume model	$b_0=-3.6294$ $b_1=0.8916$ $b_2=10.1941$	0.0288	0.928	1859.10	<0.0000
68.	$LNSQ= b_0+ b_1LNTHT+ b_2SC+b_3A^{-1}$	Stem quality model	$b_0=0.9521$ $b_1=0.3176$ $b_2=-0.0586$ $b_3=-2.7166$	0.0430	0.770	322.01	<0.0000
69.	$LNTHT= b_0\exp(b_1A^{-1}+ b_2LNSQ)$	Total height model	$b_0=0.7748$ $b_1=-0.6823$ $b_2=0.5667$	0.0051	0.502	-	<0.0000
70.	$LNCR= b_0+ b_1LNTHT+ b_2CPA+ b_3A^{-1}$	Crown ratio model	$b_0=-3.5507$ $b_1=0.6263$ $b_2=0.1558$ $b_3=10.2339$	0.0146	0.983	5575.3	<0.0000

Table 11:Estimated parameters and models statistics among the Co-dominant canopy layer

	CO-DOMINANT CANOPY LAYER						
	GROWTH MODEL						
Equation	Model Form	Model Type	Parameter	Model RMSE	R^2	F –Ratio	P –Value
71.	$\Delta DBH= b_0Dbh^{b\,1}\exp(b_2CR+ b_3A)$	Diameter growth model	$b_0=0.2096$ $b_1=0.9349$ $b_2=0.1709$ $b_3=-0.0416$	0.0014	0.986	-	<0.0000
72.	$\Delta BA= b_0BA^{b1}\exp(b_2CR+ b_3A)$	Basal area growth model	$b_0=0.2168$ $b_1=-0.0325$ $b_2=1.0953$ $b_3=-0.0192$	0.0000	0.841	-	<0.0000
73. .	$LNSV= b_0+ b_1LNDBH+ b_2A^{-1}$	Stem volume model	$b_0=-3.4506$ $b_1=0.7965$ $b_2=9.1410$	0.0317	0.943	6583.4	<0.0000
74.	$LNSQ= b_0+ b_1LNTHT+ b_2SC+ b_3A^{-1}$	Stem quality model	$b_0=0.8154$ $b_1=0.4042$ $b_2=-0.0925$ $b_3=-0.5443$	0.0384	0.848	1463.3	<0.0000
75.	$LNTHT= b_0 + b_1CPA+ b_2\,A^{-1}$	Total height model	$b_0=0.5872$ $b_1=0.5348$ $b_2=0.0567$	0.0068	0.996	1095.20	<0.0000
76.	$LNCR= b_0+ b_1CPA + b_2\,LNTHT+ b_3A^{-1}$	Crown ratio model	$b_0=-3.8225$ $b_1=-0.0749$ $b_2=1.0987$ $b_3=9.3778$	0.0173	0.984	16564	<0.0000

The parameters of the growth characteristics models and the fit indices among intermediate canopy layer in Table 12 with tree total height growth model having the highest value of coefficient of determination (R^2) while the lest value was found in the basal area growth model. Correspondingly, the growth characteristics models and the fit indices used for model evaluation among the suppressed canopy layer showed that the best fit model was found with total height model with the highest (R^2) value (Table 13). These equations also have small standard error and well distributed residuals as indication of a good model fitting. These findings agree with the report of Siipilehto (2011) while evaluating the methods and applications for improving parameters prediction models for stand structures in Finland. The study emphasized that until the late ’80s, stand variables such as mean age, mean diameter and mean height, total stem number, and basal area were considered adequate to characterize the entire growing stock while at the present time stand characteristics are assessed by tree species, and they are described separately for each storey.

Table 12: Estimated parameters and models statistics among the intermediate canopy layer

	INTERMEDIATE CANOPY LAYER						
	GROWTH MODEL						
Equation	Model Form	Model Type	Parameter	Model RMSE	R^2	F –Ratio	P –Value
77.	$LNDBH= b_0+ b_1LNSV+b_2LNBA+ b_3A^{-1}$	Diameter growth model	$b_0=3.8288$ $b_1=1.0887$ $b_2=0.0069$ $b_3=-8.4126$	0.0172	0.949	1200.4	<0.0000
78.	$LNBA= b_0+b_1LNDBH+b_2SC+b_3A^{-1}$	Basal area growth model	$b_0=0.3362$ $b_1=1.5838$ $b_2=-0.2446$ $b_3=-0.2917$	0.0393	0.895	547.49	<0.0000
79.	$LNSV=b_0+b_1LNDBH+b_2A^{-1}$	Stem volume model	$b_0=-3.4461$ $b_1=0.8616$ $b_2=7.5461$	0.0153	0.958	2234.1	<0.0000
80.	$LNSQ= b_0+b_1LNTHT+b_2SC+b_3A^{-1}$	Stem quality model	$b_0=0.7768$ $b_1=0.4592$ $b_2=-0.0971$ $b_3=-2.5546$	0.0359	0.649	119.13	<0.0000
81.	$LNTHT=b_0 +b_1LNSQ+b_2CPA+b_3A^{-1}$	Total height model	$b_0=0.5003$ $b_1=-0.0069$ $b_2=0.6371$ $b_3 =0.0131$	0.0085	0.990	6506.7	<0.0000
82.	$LNCR=b_0+b_1CPA +b_2A^{-1}$	Crown ratio model	$b_0=-3.1922$ $b_1=0.6363$ $b_2=7.6876$	0.0085	0.994	16568	<0.0000

Table 13: Estimated parameters and models statistics among the suppressed canopy layer

	SUPPRESSED CANOPY LAYER						
	GROWTH MODEL						
Equation	Model Form	Model Type	Parameter	Model RMSE	R^2	F –Ratio	P –Value
83.	$LNDBH= b_0+ b_1LNSV+b_2A^{-1}$	Diameter growth model	$b_0=3.2355$ $b_1=0.7465$ $b_2=-7.0209$	0.0440	0.815	673.02	<0.0000
84.	$\Delta BA= b_0+ b_1CR+b_2A^{-1}$	Basal area growth model	$b_0=0.0332$ $b_1=0.0117$ $b_2=0.0519$	0.0007	0.883	0.0007	<0.0000
85.	$LNSV= b_0+b_1LNDBH+ b_2LNBA+ b_3A^{-1}$	Stem volume model	$b_0=-3.4425$ $b_1=0.7405$ $b_2=0.0331$ $b_3=9.0749$	0.0401	0.891	831.94	<0.0000
86.	$LNSQ= b_0+b_1LNTHT+b_2SC+b_3A^{-1}$	Stem quality model	$b_0=0.5033$ $b_1=0.5558$ $b_2=-0.0202$ $b_3=-3.0814$	0.1059	0.624	168.64	<0.0000
87.	$LNTHT=b_0 +b_1LNSQ+b_2CPA+b_3A^{-1}$	Total height model	$b_0=0.4547$ $b_1=0.0032$ $b_2=0.6757$ $b_3=0.1052$	0.0127	0.989	9464.40	<0.0000
88.	$LNCR= b_0+b_1CPA +b_2THT+b_3A^{-1}$	Crown ratio model	$b_0=-3.1922$ $b_1=0.6363$ $b_2=7.6876$ $b_3=9.4314$	0.0169	0.985	6470.4	<0.0000

4.5.2 Individual Tree Growth Models

The growth characteristic models for individual tree level are shown in Table 14 and Table 15. The fit statistics used in evaluation of the growth models showed significant relationship among the growth variables. The values of coefficient of determination (R^2) ranged between 0.520 and 0.991; indicating that the growth models fitted to the individual tree data are suitable for the predictive models, and that each predictor variable fitted were appropriate for the explanatory dependent variables. The values of standard error of the models were also significantly small and thus indicate the goodness of fit for candidate models. The results of the models fitted to the individual tree growth data showed that many of individual growth models were non-linear predictive models while the remaining few yield models are linear (Tables 14 and 15).

Table14: Estimated parameters and models statistics in the individual tree model equations

Equation	Model Form	Model Type	Parameter	Model RMSE	R^2	F –Ratio	P –Value
	INDIVIDUAL TREE MODELS						
	GROWTH MODEL						
89.	$\Delta DBH= b_0Dbh^{b1}exp(b_2CR+b_3A)$	Diameter growth model	$b_0=0.1366$ $b_1=0.9734$ $b_2=0.0812$ $b_3=-0.0418$	0.0011	0.985	-	<0.0000
90.	$\Delta BA= b_0BA^{b1}exp(b_2CR+b_3A)$	Basal area growth model	$b_0=0.1561$ $b_1=0.8882$ $b_2=-0.0574$ $b_3=-0.0442$	0.0002	0.986	-	<0.0000
91.	$\Delta SQ= b_0SQ^{b1}exp(b_2SC+b_3A^{-1})$	Stem quality model	$b_0=0.0164$ $b_1=0.0176$ $b_2=-0.0056$ $b_3=21.4309$	0.0004	0.991	-	<0.0000
92.	$\Delta SV=b_0SV^{b1}exp(b_2BA+b_3A^{-1})$	Stem volume model	$b_0=0.0221$ $b_1=0.9689$ $b_2=0.0102$ $b_3=21.3223$	3.8800	0.987	-	<0.0000
	YIELD MODEL						
93.	$LNSQ=b_0THT^{b1}exp(b_2LNDBH+b_3A)$	Stem quality model	$b_0=0.6475$ $b_1=0.4899$ $b_2=0.1333$ $b_3=0.0054$	0.0024	0.593	-	<0.0000
94.	$LNSV=b_0+b_1LNDBH+b_3A^{-1}$	Stem volume model	$b_0=-0.3766$ $b_1=1.2278$ $b_2=-0.1105$	0.0456	0.949	15023.000	<0.0000
95.	$BA= b_0+b_1DBH+b_2CR+b_3A^{-1}$	Basal area model	$b_0=4.3854$ $b_1=0.1351$ $b_2=0.9368$ $b_3=-15.4647$	0.1822	0.631	903.580	<0.0000
96.	$LNCR= b_0+ b_1A+ b_2LNSQ+b_3THT$	Crown ratio model	$b_0=-2.9279$ $b_1=-0.0178$ $b_2=-0.0541$ $b_3=1.0433$	0.0170	0.989	46142.000	<0.0000

Table 15: Estimated parameters and models statistics among in the individual tree model equations

INDIVIDUAL TREE MODELS CONTINUES							
	SUBCOMPONENT MODEL						
Equation	Model Form	Model Type	Parameter	Model RMSE	R^2	F –Ratio	P –Value
97.	$LNDBH= b_0exp(b_2A^{-1} + b_2THT+ b_3BA)$	Diameter model	$b_0=0.6211$ $b_1=0.0851$ $b_2=0.6018$ $b_3=0.0278$	0.0018	0.808	-	<0.0000
98.	$LNBA= b_0exp(b_1A^{-1} + b_2DBH)$	Basal area model	$b_0=1.0777$ $b_1=-4.1437$ $b_2=0.5232$	0.0049	0.570	-	<0.0000
99.	$LNTHT= b_0exp(b_1A^{-1} + b_2LNSQ)$	Total height	$b_0=0.6222$ $b_1=0.6629$ $\beta_2=0.6889$	0.0029	0.543	-	<0.0000

4.5.3 Size Class Growth Models

The results of size class growth models are presented in Table 16 and Table 17. The models fitted to size class data were classified into diameter distribution models and stem quality distribution models. These models were pedestaled on the probability density function (PDF) which was primarily based on Weibull distribution functions for both diameter and stem quality; giving the Weibull diameter distribution and Weibull stem quality distribution functions. The probability and cumulative distribution functions of the three-parameter Weibull distribution for a random variable Diameter are:

$$f\,(Dbh,a,b,c) = \frac{c}{b}\left(\frac{Dbh-a}{b}\right)^{c-1} exp\left(-\left(\frac{Dbh-a}{b}\right)^{c}\right) = 0$$

$$(a \leq D \leq \infty) \qquad \ldots\ldots\ldots\ldots\ldots \quad \text{eqn. 100}$$
$$(D < a)$$

$$F(Dbh,a,b,c) = 1- exp\left(-\left(\frac{Dbh-a}{b}\right)^{c}\right) \quad \ldots\ldots\ldots\ldots\ldots \quad \text{eqn. 101}$$

where:
Dbh - diameter at breast height
a - location
b - scale parameter
c - shape parameter

According to Lei (2008), the above parameters of above equation were estimated from the tree diameter data of each set of diameter data by maximum likelihood estimation (MLE). The method of maximum likelihood is a commonly used procedure for the Weibull distribution in forestry because it has very desirable properties. Estimation of the parameters by maximum likelihood has been found to produce consistently better goodness-of-fit statistics compared to the previous methods, but it also puts the greatest demands on the computational resources (Cao and McCarty 2005). Consider the Weibull PDF given in equation 100 above, then the likelihood function (L) will be:

L(Dbh$_1$……….Dbh$_n$j, b, c) = $\prod_{i=1}^{n}\frac{c}{b}\left(\frac{Dbh-a}{b}\right)^{c-1} exp\left(-\left(\frac{Dbh-a}{b}\right)^{c}\right)$

eqn.102

On taking the logarithms of equation 102, differentiating with respect to b and c respectively, and satisfying the equations

b= $[n^{-1}\sum_{i=1}^{n} Dbh_i^c]^{1/c}$ eqn.103

c=$\left[(\sum_{i=1}^{n} Dbh_i^c lnDbh_i)\,(\sum_{i=1}^{n} Dbh_i^c)^{-1} - n^{-1}\sum_{i=1}^{n} lnDbh_i\right]^{-1}$ eqn.104

The value of c has to be obtained from equation 104 by the use of standard iterative procedures (i.e. Newton-Raphson method) and then used in equation 104 to obtain b. Similarly, the stem quality probability distribution function (PDF) was obtained after the order:

f (SQ,a,b,c) =$\frac{c}{b}\left(\frac{SQ-a}{b}\right)^{c-1} exp\left(-\left(\frac{SQ-a}{b}\right)^{c}\right)$= 0

(a $\leq$SQ$\leq\infty$) eqn. 105

(SQ< a)

F(SQ,a,b,c) = 1- $exp\left(-\left(\frac{SQ-a}{b}\right)^{c}\right)$ eqn. 106

Then, the Weibull distribution parameters were estimated using MLE function of equation 102 and 103 from stem quality data set. The prediction equations for the parameter for both diameter and stem distribution are shown is Table 16. Though the three Weibull parameters models were found significant in the two categories of the PDF, the scale parameter models (b) within the two classifications are highly found significant with highest values of coefficient of determination (R^2) and small standard error that reflect good fit models. The subcomponent models of class size models that may be essential for reasonable prediction of future estimates of Weibull parameters are shown in Table 17.

Table 16: Estimated parameters and models statistics in the size class model equations

Equation	SIZE CLASS MODEL						
	DIAMETER DISTRIBUTION						
	Model Form	Model Type	Parameter	Model RMSE	R^2	F –Ratio	P – Value
107.	$LNa= b_0+b_1DBH+LNQMD$	Location parameter model	$b_0=1.2931$ $b_1= -0.0049$ $b_2=0.0577$	0.0306	0.643	27.007	<0.0000
108.	$LNb=b_0+ b_1LNa+ b_2LNQMD$	Scale parameter model	$b_0=-1.0577$ $b_1=0.0263$ $b_2=1.6059$	0.0142	0.989	1315.300	<0.0000
109.	$LNa+c=b_0+ b_1DBH+ b_2LNQMD$	Shape parameter model	$b_0=1.3209$ $b_1=-0.0048$ $b_2=0.5513$	0.0294	0.643	27.016	<0.0000
	STEM QUALITY DISTRIBUTION						
110.	$LNa=b_0+ b_1LNTHT+ b_2SC+ b_3LNA^{-1}$	Location parameter model	$b_0=0.9559$ $b_1=0.0728$ $b_2=0.0023$ $b_3=0.3933$	0.0281	0.709	23.502	<0.0000
111.	$LNb=b_0+ b_1LNTHT+ b_2SC+ b_3LNA^{-1}$	Scale parameter model	$b_0=-2.4708$ $b_1=-0.2171$ $b_2=0.0001$ $b_3=4.9579$	0.0098	0.995	1855.900	<0.0000
112.	$LNa+c=b_0+ b_1LNTHT+ b_2SC+ b_3LNA^{-1}$	Shape parameter model	$b_0=0.9969$ $b_1=0.0702$ $b_2=0.0022$ $b_3=0.3769$	0.0269	0.709	23.527	<0.0000

Table 17: Estimated parameters and models statistics in the size class model equations

Equation	SIZE CLASS MODEL (SUBCOMPONENT)						
	Model Form	Model Type	Parameter	Model RMSE	R^2	F –Ratio	P –Value
113	$SQ= b_0+ b_1LNTHT+ b_2SC+ b_3SI$	Stem quality growth model	$b_0=0.9969$ $b_1=0.0702$ $b_2=0.0022$ $b_3=0.3769$	0.4889	0.954	199.080	<0.0000
114	$LNSQ= \beta_0+ b_1LNTHT+ b_2SC+ b_3LNAGE$	Stem quality growth model	$b_0=-0.9870$ $b_1=24.9863$ $b_2=-11.0344$ $b_3=0.0405$	0.0178	0.972	332.27	<0.0000
115.	$LNQMD=b_0+ b_1A^{-1}$	Quadratic mean diameter model	$b_0=1.8023$ $b_1= -9.7158$	0.018	0.981	1569.500	<0.0000
116.	$LNCR=b_0+ b_1LNAGE+b_2SI$	Mean crown ratio model	$b_0=-1.6987$ $b_1= -4.4935$ $b_2=0.0055$	0.649	0.781	53.647	<0.0000

4.5.4 Whole Stand Growth Models

The best adjudged models for the whole stand level are presented in Tables 18 and 19. The results showed the different relationships between the growth characteristics variables for both the growth and yield of *Pinus caribaea* in the whole stand level. The coefficient of determination (R^2) among the growth models ranged between 0.50 and 0.99 and the stem volume model been the measure of growth increment had the highest (R^2) and small standard error; indicating its predictability of the stem volume by the candidate volume model in relation to the predictor variables (Table 18). Similarly, the predictive yield models obtained for the whole stand level are shown in Table 19. The values of coefficient of determination (R^2) ranged between 0.502 and 0.99 with 99.9% of the stem volume as yield been explained by the combination of basal area and age. The equations obtained for both growth and yield models at the whole stand level all have high indices of fit such as high (R^2), low standard error and well distributed residuals as indication of a good fitting.

Table 18: Estimated parameters and models statistics in the whole stand model equations

		WHOLE STAND MODELS					
	GROWTH MODEL						
Equation	Model Form	Model Type	Parameter	Model RMSE	R^2	F –Ratio	P –Value
117.	$LNSV=b_0+ b_1SI+ b_2A^{-1}+ b_3LNBA$	Stem volume growth model	$b_0=-0.7759$ $b_1=0.00001$ $b_2=0.0005$ $b_3=0.9532$	0.0002	0.999	3477.000	<0.0000
118.	$LNBA=b_0+ b_1LNSV+ b_2CPA+ b_3SI$	Basal area growth model	$b_0=0.5660$ $b_1=-0.2106$ $b_2=0.0000$ $b_3=-0.0019$	0.0082	0.944	53.647	<0.0000
119.	$SI=b_0+ b_1LNTHT+ b_2LNSV+ b_3CPA$	Site index model	$b_0=3.4060$ $b_1=19.8549$ $b_2=-1.5971$ $b_3=0.0001$	1.8955	0.500	9.675	<0.0000
120.	$DBH=b_0+ b_1LNBA+b_2LNSV+b_3CPA$	Diameter growth model	$b_0=0.1495$ $b_1=0.4331$ $b_2=-0.0422$ $b_3=-9.0000$	0.0139	0.925	25.471	<0.0000
121.	$LNSQ= b_0+ b_1A+ b_2N+ b_3THT$	Stem quality model	$b_0=0.0811$ $b_1=0.0021$ $b_2=-0.0000$ $b_3=0.0015$	0.0154	0.711	23.826	<0.0000

Table 19: Estimated parameters and models statistics in the whole stand model equations

	WHOLE STAND MODEL CONTINUES						
Equation	YIELD MODELS						
	Model Form	Model Type	Parameter	Model RMSE	R^2	F –Ratio	P –Value
122.	LNSV=b_0+ b $_1A^{-1}$+ b_2LNBA	Stem volume growth model	b_0=2.4878 b_1=-0.7822 b_2=-4.2266	0.0416	0.928	192.160	<0.0000
123.	LNBA=b_0+ b_1A^{-1}+ b_2LNSV	Basal area model	b_0=0.5421 b_1=-0.1081 b_2=-0.2171	0.0094	0.925	184.650	<0.0000
124.	LNSQ=b_0THTexp(b_1N+ b_2A^{-1}+ ${}_3$CR)	Stem quality model	b_0=0.0175 b_1=-0.03542 b_2=-8.4890 b_3=4.2241	0.0025	0.778	-	<0.0000
125.	LNNUMTR=b_0+ b_1SC+ b_2THT+ b_3SI	Number of stem/Hectare	b_0=4.0316 b_1=-0.6173 b_2=-1.3743 b_3=0.0212	0.1505	0.502	9.729	<0.0000
126.	LNCPA=b_0+ b_1LNTHT+ b_2AGE	Crown projection area	b_0=5.3267 b_1=-2.2675 b_2=4.1116	0.1907	0.541	17.668	<0.0000
127.	LNCR=b_0+ b_1THT+ b_2CPA+ b_3LNA	Mean crown ratio	b_0=-2.1379 b_1=0.4891 b_2=-0.0609 b_3=-4.8512	0.0363	0.934	136.59	<0.0000
128.	LNSV=b_0+ b_1LNBA+ b_2AGE	Stem volume growth model	b_0=-0.7755 b_1=0.9526 b_2=-0.0006	0.0002	0.999	34114.00	<0.0000
129.	LNSQ=b_0+ b_1LNTHT+ b_2LNAGE	Mean stem quality model	b_0=-0.2932 b_1=0.3105 b_2=0.0105	0.0011	0.998	9984.80	<0.0000
130.	THT=b_0+ b_1SC+ b_2A^{-1}	Mean height model	b_0=14.0009 b_1=0.0931 b_2=-144.2350	1.3773	0.742	43.070	<0.0000

4.6 SITE INDEX EQUATION AND CURVE FOR SITE QUALITY EVALUATION OF THE STUDY AREA

The importance of site index and its curves expression can never be over-emphasized. The curves are extensively used by foresters for site quality description and evaluation as well as in estimating potential productivity of forest sites (Hägglund, 1981). The application of site index curves is based on the fact that there is an association between stand height and total volume production (Beamont, 1999) with plausible notion of where there is high quality sites, height growth is good (Bailey and Clutter, 1974; Clutter *et al.*,1983). Site index has traditionally been defined as the top height of a stand at a particular age (Clutter *et al.*, 1983). According to Hägglund (1981) the top height is the arithmetic mean height of the 100 trees ha^{-1} with the greatest diameters. Heights of individual trees can be measured easily and the average height growth of the dominant trees is less affected by thinning operations (Bailey and Clutter, 1974; Clutter *et al.*,1983) and also less affected by stand density (Monserud, 1984).The values of the site indices computed for this study is shown in Table 20 below, while the values generated for dominant height within and between the stands are shown in Figs. 7 and 8. The expression of the empirical site index equation obtained and used in the study is given below:

$lnHd = b_0 - b_1A^{-1}$ ………………..eqn.131

$lnHd = 4.211 - 23.495A^{-1}$ ………………..eqn.132

$b_0 = lnHd - b_1A^{-1}$ ………………..eqn.133

When A = Ai, Hd = SI

Therefore: $b_0 = \ln(SI) - b_1A^{-1}$ ………………..eqn.134

$b_0 = lnHd - b_1(0.04)$ ………………..eqn.135

Hence

$lnHd = \ln(SI) - b_1(0.04) + b_1A^{-1}$ ………………..eqn.136

$lnHd = \ln(SI) + b_1(A^{-1} - 0.04)$ ………………..eqn.137

By integration;

$$SI = \ Exp^{(lnHd - b_1 (A^{-1} - 0.04)} \qquad \text{…………………...eqn.138}$$

$$SI = \ Exp^{(lnHd - 23.495\ (A^{-1} - 0.04)} \qquad \text{…………eqn.139}$$

where

SI = Site index

A = Age (years)

Ai = index age = 25 years for this study

Hd= Dominant height (meter)

Exp = exponential function

ln = Natural logarithm

Table 20: Site index equation, model parameter and computed site index (SI) according to sites in the study area

Site index model	Model parameter	Site	Average Dominant Height	SI
$\ln Hd = b_o + b_1A^{-1}$	$b_0 = 4.211$ $b_1 = 23.495$	Oluwa FR	41.327	3.7215
	$R^2 = 0.9848$ SEE = 0.040	Shasha FR	40.119	3.6919
	P- value = 0.0000	J4 FR	46.217	3.8333

Hd = dominant height, SI = site index, FR = Forest Reserve, R^2 = coefficient of determination, SEE = standard error of the estimate, P-value = probability of significance, b_0& b_1 are model coefficients.

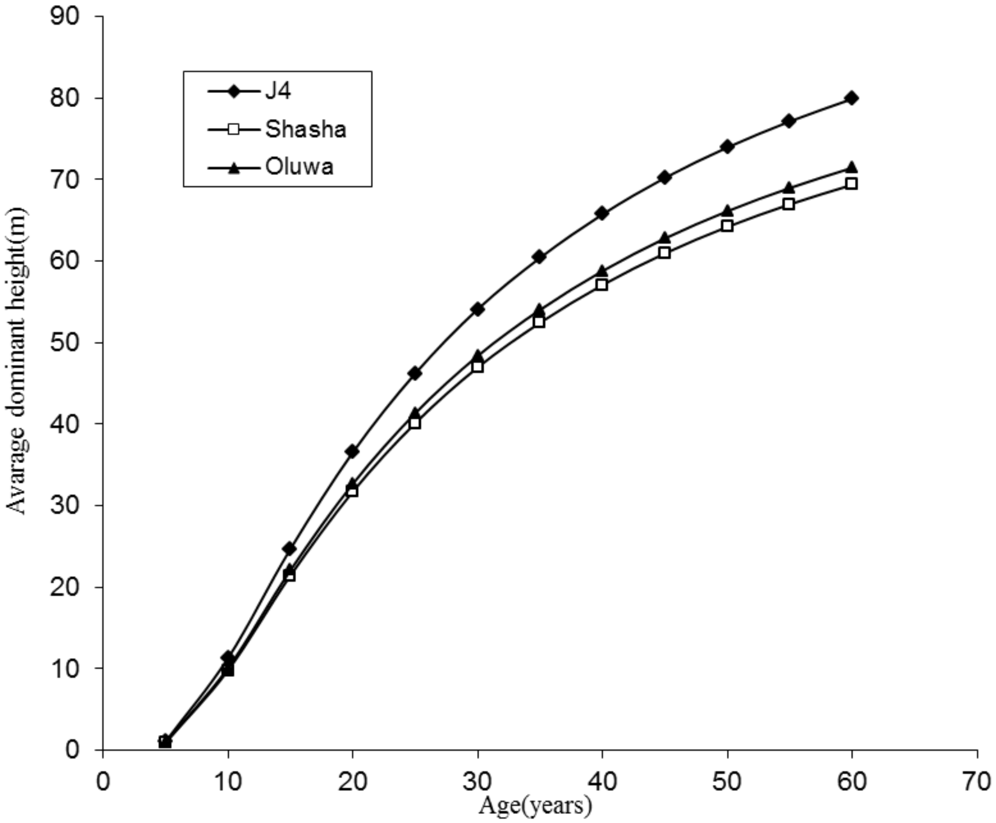
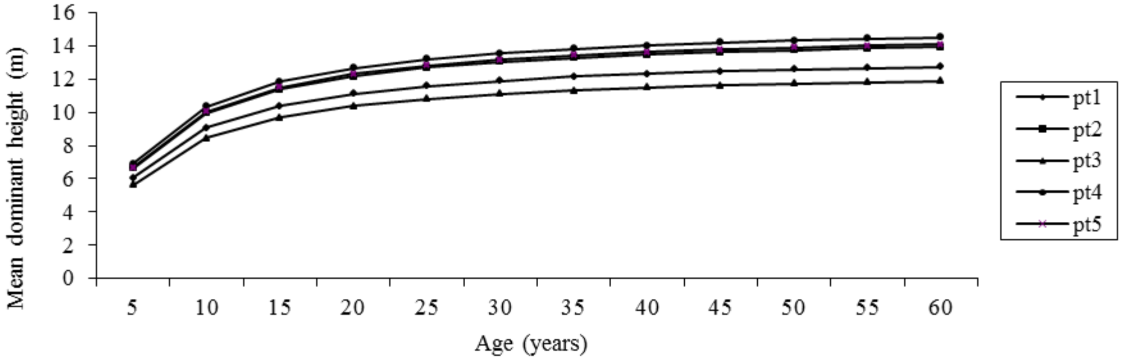
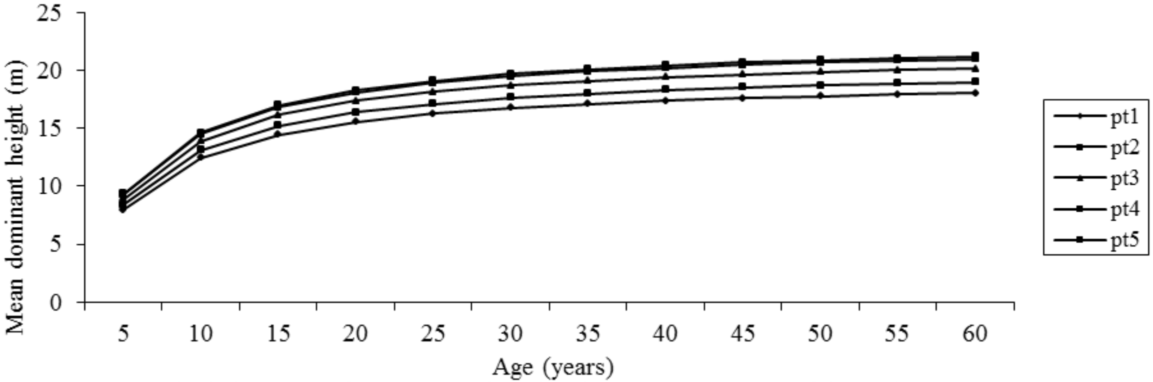


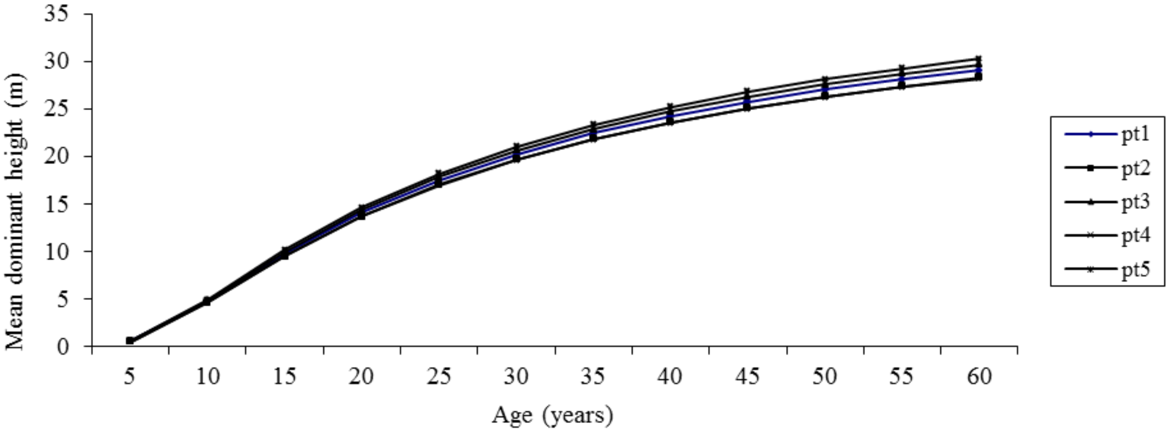
Fig.7:Site index curves for *Pinus caribaea* in the three plantations of the study area



Site curves for *Pinus caribaea* in Omo Forest Reserve of the study area



Site index curves for *Pinus caribaea* in Oluwa Forest Reserve of the study area



Site index curves for *Pinus caribaea* in Shasha Forest Reserve of the study area

Fig. 8: Site index curves for*Pinus caribaea* in the three plantationstands of the study area

4.7 MODELS FOR OPTIMAL ROTATION AGE AMONG CANOPY LAYER

The models for determination of the optimal rotation age in this study were based on the concept of forest growth and yield which defines the measure of the change in volume over an interval of time as well as the volume of timber in a forest at a specific point in time. According to Binkley *et al.* (1997), common growth and yield measures include the net increment in stem growth which is often expressed as current annual increment (CAI), the average increment across a given period of stand development, which is refer to as periodic annual increment (PAI) and the average or mean annual stem wood production per unit area up to age (A). The stem increments can be expressed in terms of basal area ($m^2ha^{-1}yr^{-1}$) and volume ($m^3ha^{-1}yr^{-1}$) and since mean annual increment (MAI) measures the average annual productivity of a stand over the life of the stand; its then believed that the age at which the MAI reaches its maximum is the harvest age (rotation) which eventually maximizes the biological volume productivity of the stand over its lifestyle. The models for determination of optimal rotation ages among the four canopies layer are shown in Tables 21. The optimal rotation ages of each canopy layers were obtained based on the mathematical relationship through integration method between stem volume and age using the model:

$$LNSV = b_0 + b_1(A^{-1}) \text{ ………………………….. eqn.140}$$

$$V = exp^{b_0+b_1^{A^{-1}}} \text{ …………………..….eqn.141}$$

Mean annual increment (MAI) mathematically as:

$$MAI = \frac{V}{A} \text{ ………………...……eqn.142}$$

Integrating the MAI by age

$$\frac{dMAI}{dA} = 0 \text{ ………………………..….eqn. 143}$$

Recall that $$MAI = \frac{V}{A} = v.A^{-1} \text{……………………eqn.144}$$

Substituting for V in equation 141 into equation 144

$$MAI = e^{b_0 + b_1 A^{-1}} .(A^{-1}) \text{ …………………..………eqn.145}$$

By integration using the power rule method, we have

$\frac{dMAI}{dA} = -A^{-2}. e^{b_0 + b_1A^{-1}} + A^{-2}.e^{b_0 + b_1A^{-1}}$ ……………..…..…………eqn.146

This then give

$A^{-2}. e^{b_0 + b_1A^{-1}}\{-1+b_1A^{-1}\}=0$ ……….………..…eqn.147

By elimination

$-1 + b_1A^{-1} = 0$ ……………………..…eqn.148

$b_1A^{-1}=1$ ……….……………………eqn.149

$A^{-1} = \frac{1}{b^1} = b_1^{-1}$ ……….……..………eqn.150

Thus, $A = b_1$ ……………………………….eqn.151

The optimal rotation age (rotation) - A = estimate of b_1.

Therefore, the optimal ages for the four canopy layers as estimated above is shown in Tables 21 and 22. Similarly, the stem volume curves for the determination of optimal rotation age were generated for each canopy layer from the models listed in Table 23. The optimal rotation age were estimated using empirical model coefficients while the stem volume curves determined from the optimal rotation age models are presented in Figure 9. Though the curves show sigmoidal trends of growth curves of biological entity, the points of descend of a matured stands were not achieved in all the stands evaluated. The residual plots of the optimal rotation age models under different canopy layers are shown in Figures 10 -14. A critical examination of the residual plots revealed that the normality assumption applies for the optimal age models following their evenly distribution along the fitted lines.

Table 21: Optimal rotation age models for different canopy layers in *Pinus caribaea* in the study area

Equation	Model	Canopy layer	Number	Model Coefficient	Estimated parameter	R^2	RMSE
152	$LNSV = b_0 + b_1(A^{-1})$	Pooled data	1592	b_0	0.517		
				b_1	-35.218	0.282	0.819
153	$LNSV = b_0 + b_1(A^{-1})$	Suppressed	309	b_0	-0.0198		
				b_1	-25.1529	0.240	0.575
154	$LNSV = b_0 + b_1(A^{-1})$	Intermediate	197	b_0	-0.4076		
				b_1	-10.5308	0.051	0.384
155	$LNSV = b_0 + b_1(A^{-1})$	Co-dominant	794	b_0	-0.200		
				b_1	-17.057	0.239	0.434
156	$LNSV = b_0 + b_1(A^{-1})$	Dominant	272	b_0	1.3479		
				b_1	-31.6305	0.469	0.001

A-Stand Age , SV- Tree volume

Table 22: Optimal age's models under different canopy layers in the study area using empirical model coefficients

S/N	Canopy Layer	Model Coefficient	Estimated Parameter	Optimal Rotation Age
1	Pooled data	b_0 b_1	0.517 -35.218	35 years
2	Suppressed	b_0 b_1	-0.0198 -25.1529	25 years
3	Intermediate	b_0 b_1	-0.4076 -10.5308	11years
4	Co-dominant	b_0 b_1	-0.200 -17.057	17years
5	Dominant	b_0 b_1	1.3479 -31.6305	32years

Table 23: Rotation age, yield (volume) and relative growth for the canopy layer

Canopy layer	Rotation age (years)	Volume at harvest(m^3/ha)	Mean annual yield (m^3/ha/year)	Relative growth (ranking)
Pooled data	35	15.33	0.44	3
Suppressed	25	8.96	0.36	5
Intermediate	11	6.38	0.58	2
Co-dominant	17	7.50	0.44	3
Dominant	32	35.81	1.12	1

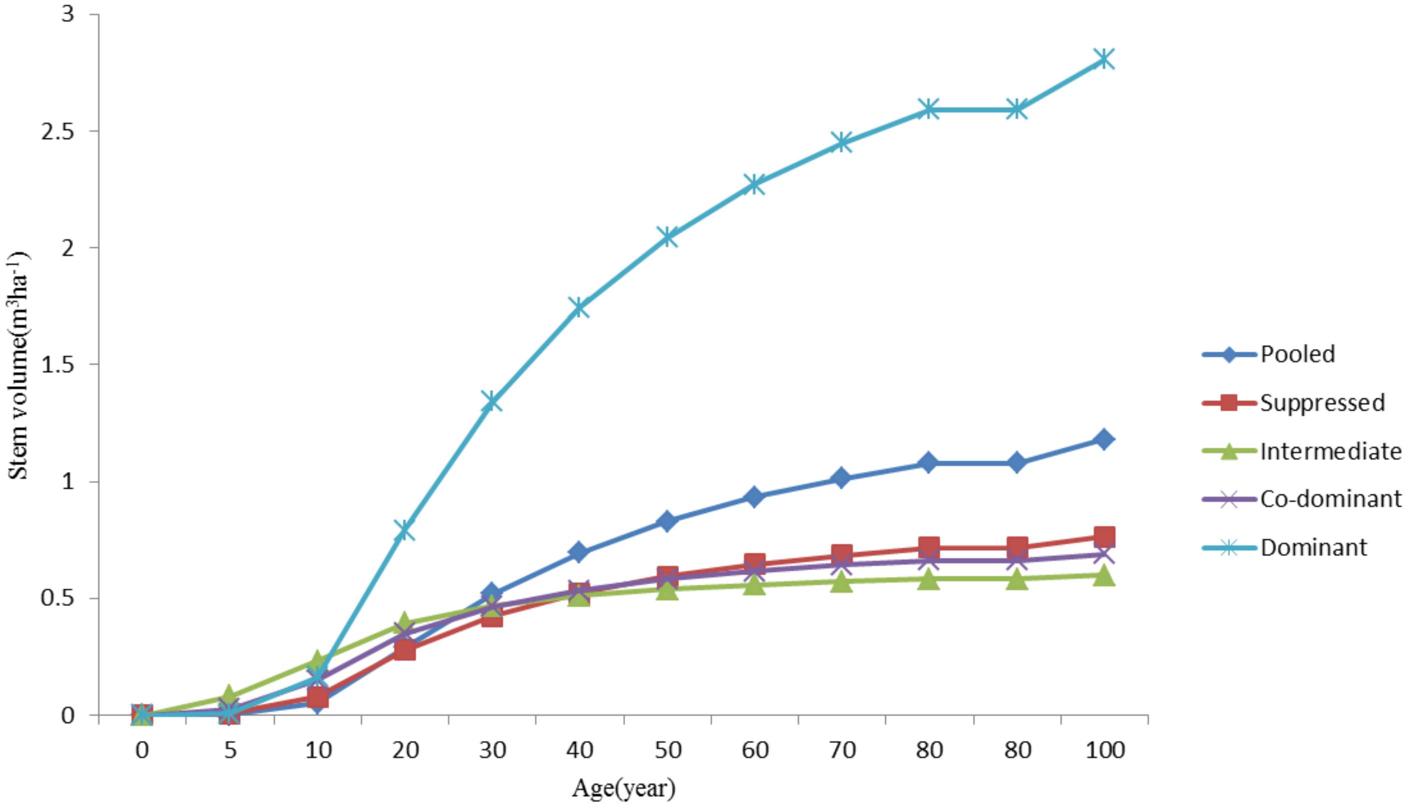


Fig. 9: Stem volume development curves for optimal age rotation at various level for *Pinus caribaea* in the study area

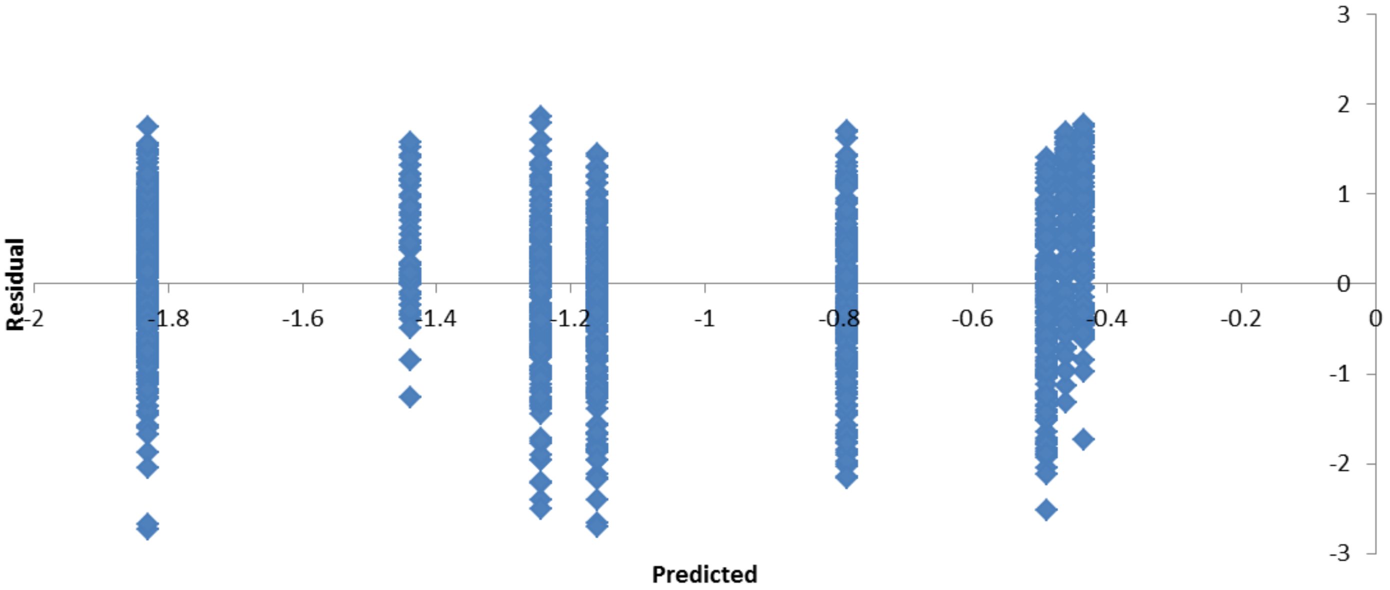


Fig. 10: Residual plot for relationship of stem volume and Age for determining optimal rotation of the pooled data of Pinus caribaea in the study area

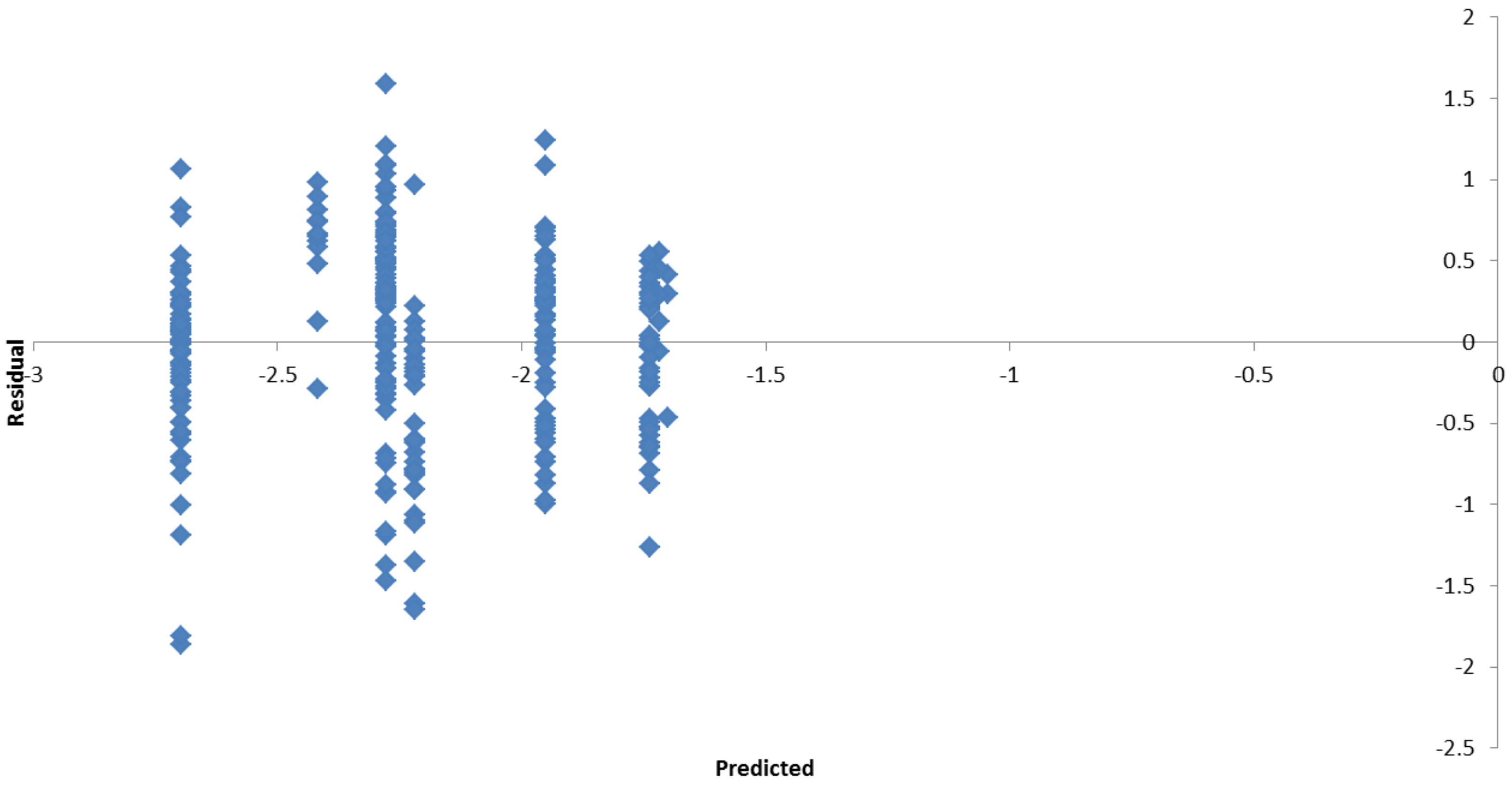


Fig.11: Residual plot for relationship between stem volume and age for determining optimal rotation among suppressed canopy

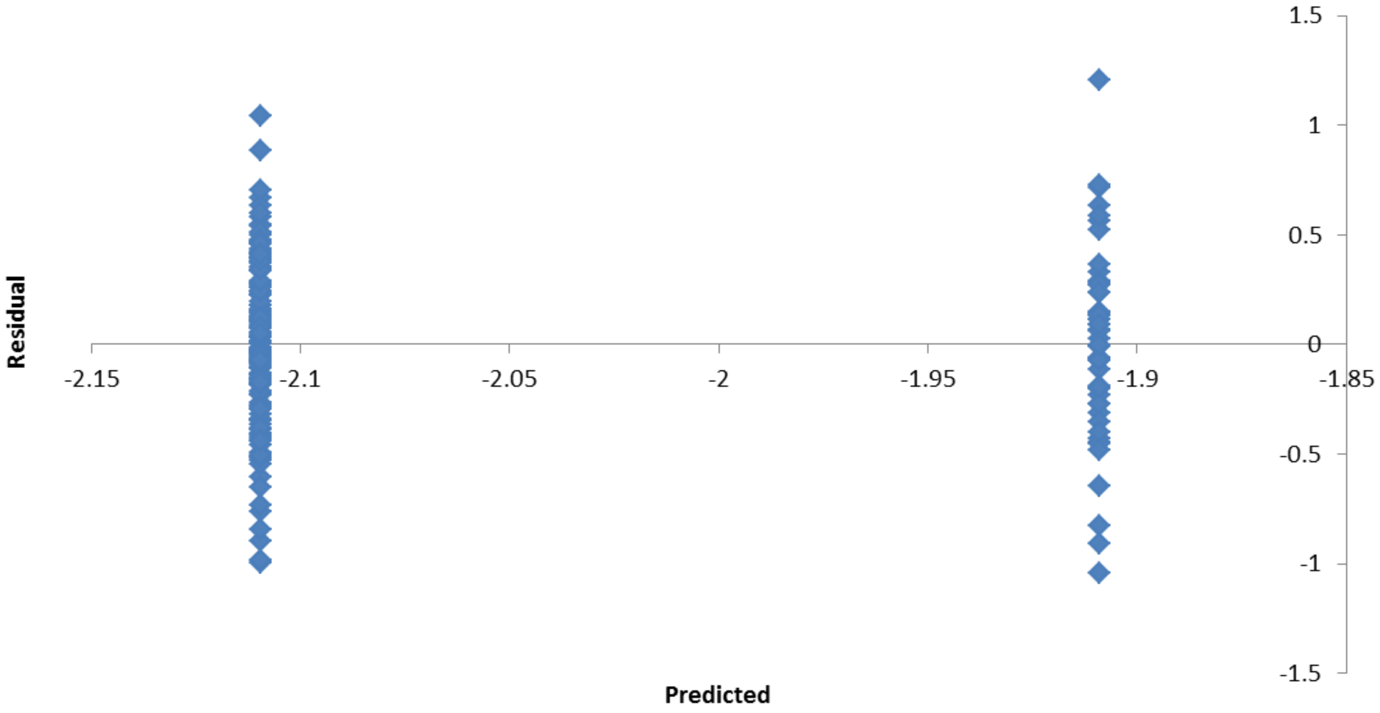


Fig.12:Residual plot for relationship of stem volume and age for determining optimal rotation among intermediate canopy in the study area

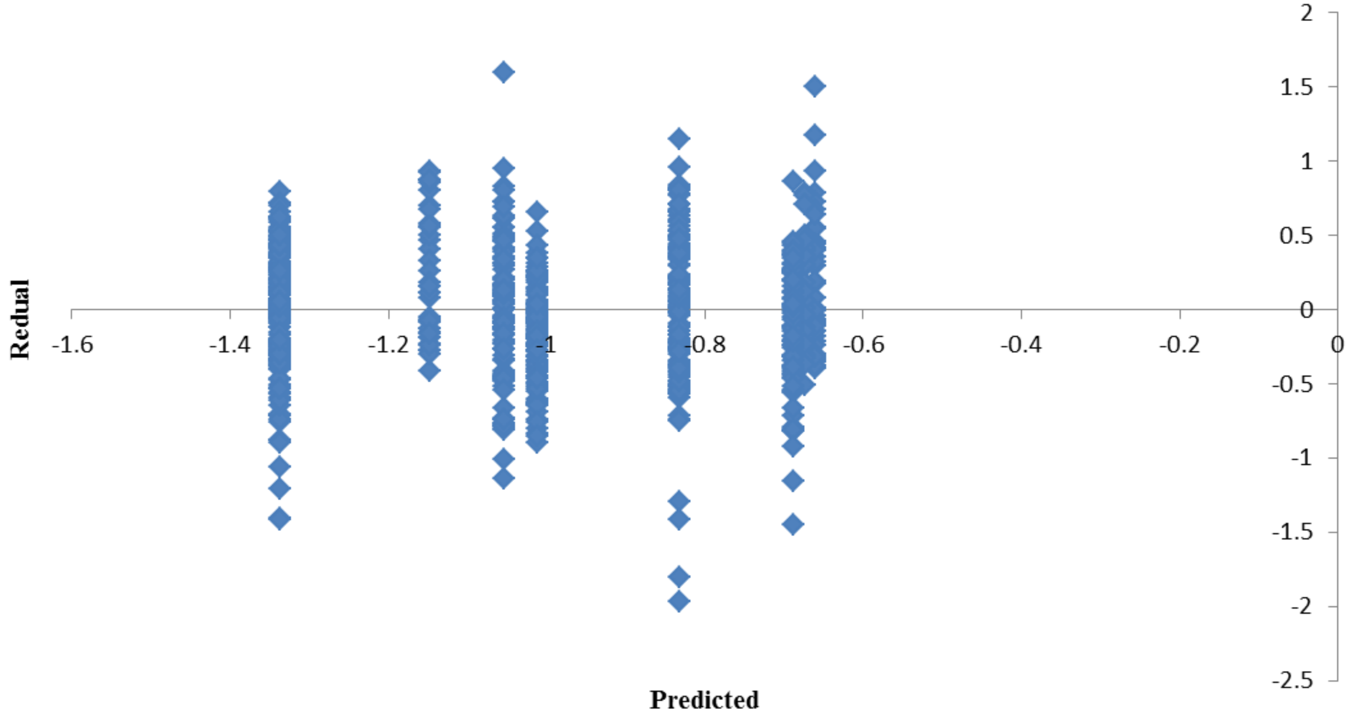


Fig. 13:Residual plot for relationship between stem volume and age for determining optimal rotation among Co-dominant canopy

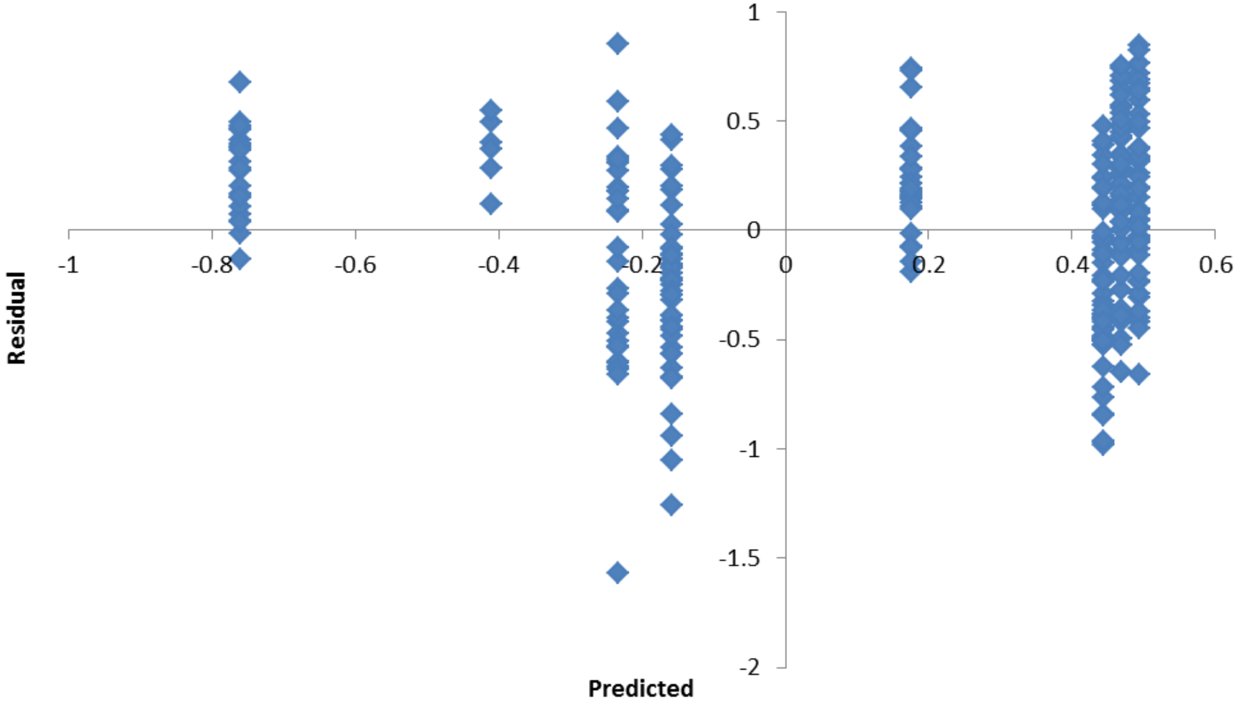


Fig.14:Residual plot for relationship of stem volume and Age for determining optimal rotation of the dominant Pinus caribaea in the study area

4.8 Volume projection of *Pinus caribaea* in the study area

Volume projection for the planning period of 25 years at 5 years interval for the eight stands that constituted the study area is shown in Table 24. The table presents the plausible projected volume (m^3ha^{-1}) in each stand per unit area. The model for determining optimal rotation age in the pooled data (Equation 122) was used to project the future volume at interval of 5 years for planning period of 25 years. There was progressive increment in the expected volume per hectare per year across the study area. This shows that *Pinus caribaea* stand is expected to progress in the productivity in terms of volume expected as the year progresses. The series of projected volume curves of *Pinus caribaea* for the planning period of the 25years at 5 years interval are shown in Fig.15 (1974 – 1984 stands) and Fig.16 (1991 -1996 stands). This was equally observed in the optimal rotation age curve used to determine the volume of pine among the canopy layer categorization.

Table 24: Projected volume of *Pinus caribaea* for the planning period of 25 years at interval of 5 years

Stand	*Pinus caribaea* projected volume (m^3ha^{-1}) for period of 25 years				
	V1	V2	V3	V4	V5
1996	36.03	51.24	64.80	76.64	86.91
1993	45.34	59.59	72.10	82.97	92.42
1991	51.24	64.80	76.64	86.91	95.84
1990	54.10	67.31	78.81	88.80	97.49
1984	69.74	80.92	90.63	99.09	106.49
1976	86.91	95.84	103.64	110.50	116.55
1975	88.80	97.49	105.08	111.77	117.68
1974	90.63	99.09	106.49	113.01	118.78
TOTAL	522.79	616.28	698.19	769.69	832.16

V1 –V5- represent projected volume at 5-years interval for each stand

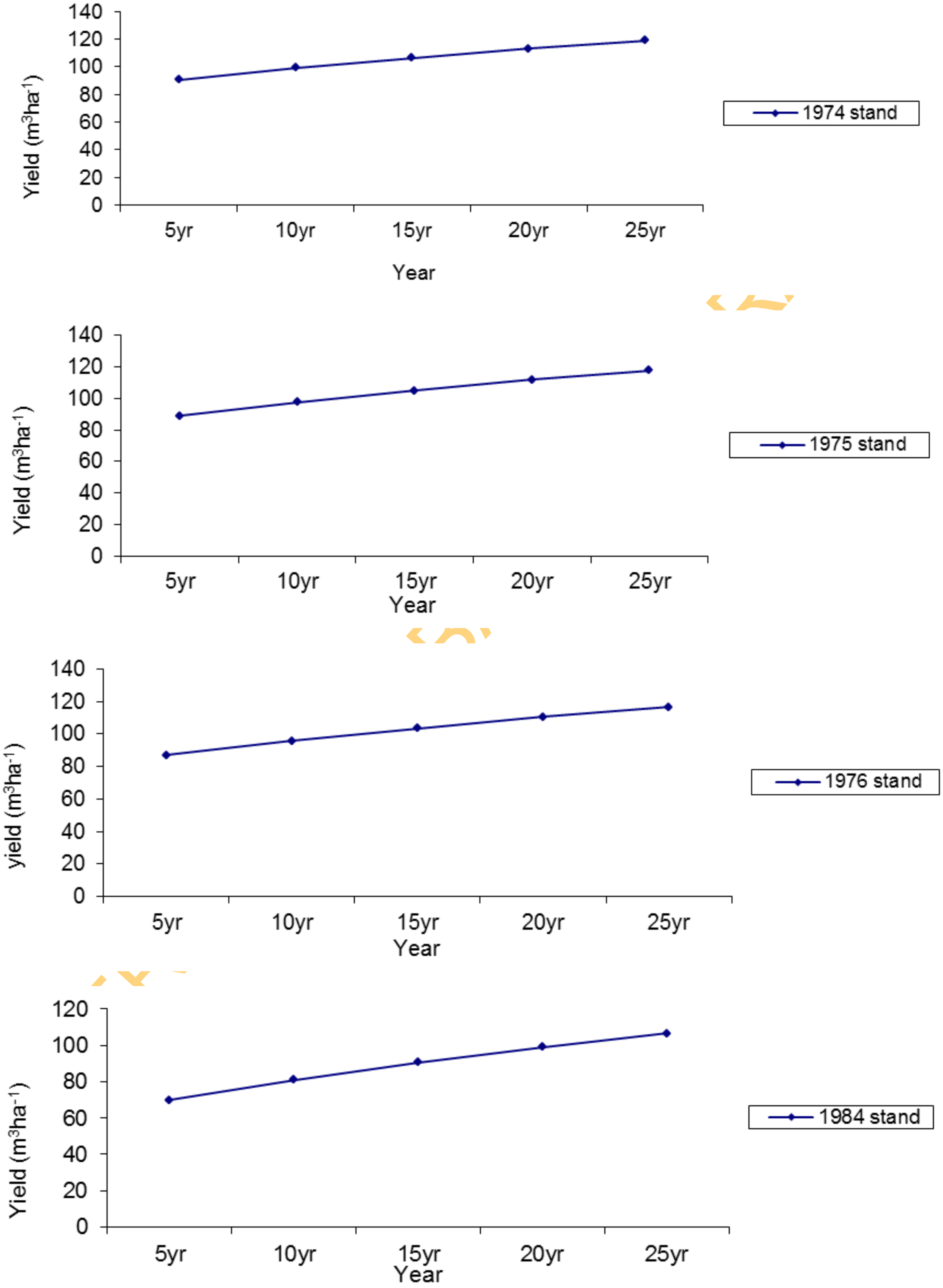


Fig. 15: Projected volume of *Pinus caribaea* for the planning period of 25 years at interval of 5years in age series 1974-1984

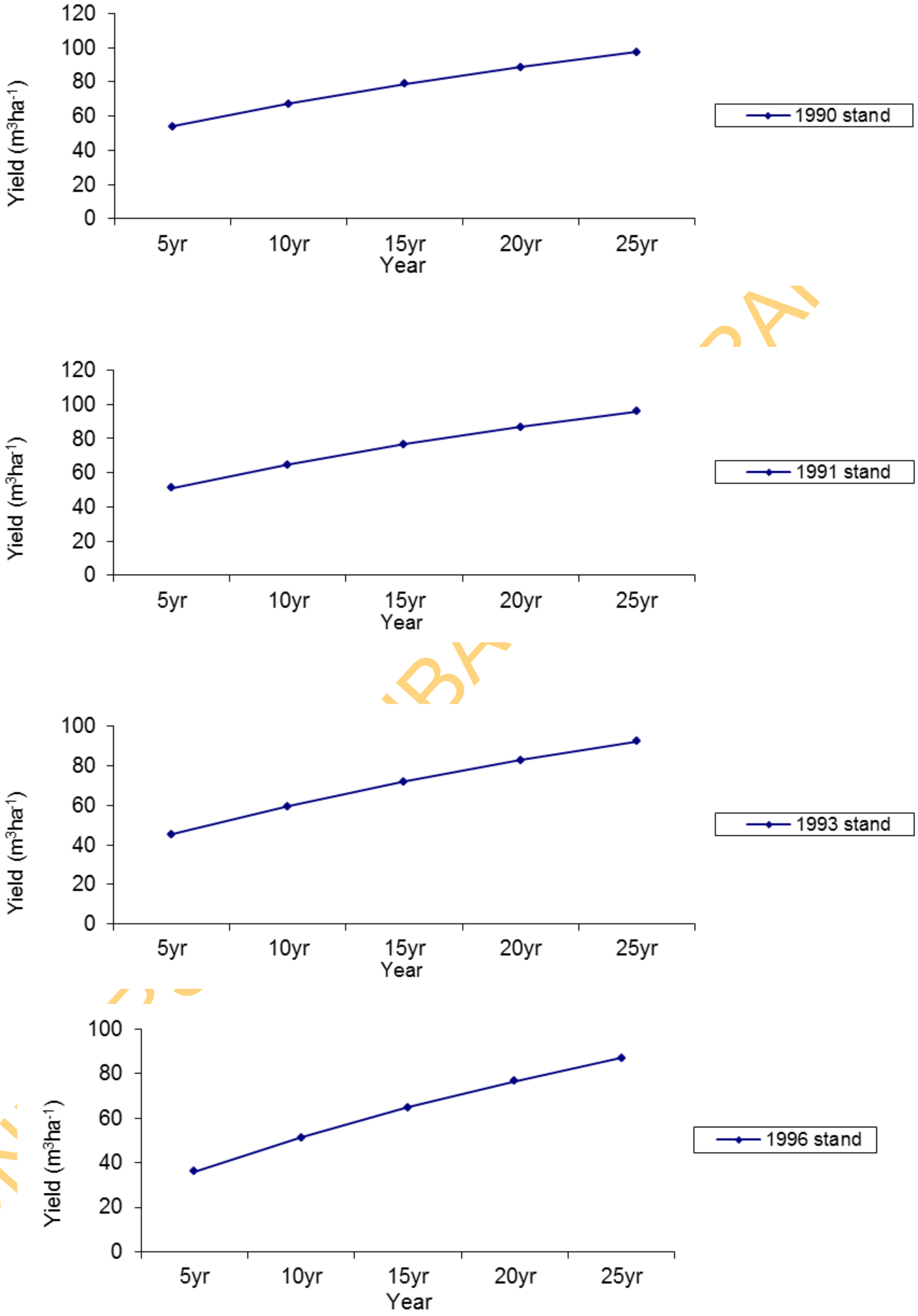


Fig. 16: Projected volume of *Pinus caribaea* for the planning period of 25 years at interval of 5years in age series 1990 -1996

4.9 Models Evaluation and validation

The summaries of the model validation for the best adjudged models among the individual stand, whole stand and size class models fitted to the data collected from the study area are shown in Tables 25-27. The results of the validation as shown in the tables indicated no significance difference between the observed and predicted values of the growth, yield and stem quality variables among individual, whole stand and size class respectively. However, model evaluation based on goodness of fit criteria methods was used for growth and yield models among canopy layers and models for determination of optimal rotation age. The goodness of fit criteria used included coefficient of determination (R^2), root mean square error (RMSE) and probability (P-value) of level of significance. The R^2 values of all the models adjudged the best candidate models in both canopy layer (growth and yield models) and optimal rotation age models were significantly high with low RMSEs. The probability (p-values) of level of significance for all these models also showed that were all less than 0.05 (<0.0000) for these categories of models. The residual plots between predicted and observed values also show that the best adjudged models fit well into the data and met assumptions of the models.

Table 25: Model validation of the best adjudged models among individual growth variable

Model	Mean observed value	Mean Predicted value	N	t	p-value	Remark
Growth models						
$\Delta DBH=0.01366DBH^{0.9734} exp^{-0.0812CR-0.0418A}$	0.0673	0.0654	478	2.147	0.352	Ns
$\Delta BA=0.0.1561BA^{0.8882} exp^{-0.00574CR-0.0442A}$	0.0095	0.0089	478	4.346	0.169	Ns
$\Delta SQ=0.0164SQ^{1.0176} exp^{-0.0052CR+21.4309A}$	0.0392	0.0387	478	3.521	0.281	Ns
$\Delta SV=0.0221SV^{0.9689} exp^{0.0102BA+21.3223A^{-1}}$	0.0063	0.0065	478	5.118	0.112	Ns
Yield models						
$LnSV=-0.3766+1.2278lnDBH-0.1101A^{-1}$	2.0445	2.0531	478	1.982	0.914	Ns
$BA=4.3854+0.1351DBH+0.9368CR-15.4647A^{-1}$	113.5057	112.9160	478	8.834	0.136	Ns
$LnCR=-2.9279-0.0178A+0.0541lnSQ+1.0433lnTHT$	-2.2239	-2.3412	478	1.673	0.846	Ns

Table 26: Model validation of the best adjudged models among size class growth variable

Model	Mean observed value	Mean Predicted value	N	T	p-value	Remark
Diameter distribution						
Lna=1.2931-0.0049DBH+0.5735lnQMD	1.3548	1.3526	7	0.3328	0.3750	Ns
Lnb=-1.0577+0.0263lna+1.6059lnQMD	0.1319	0.1327	7	0.4694	0.3216	Ns
Lna+c=1.3209-0.0048DBH+0.5513lnQMD	0.8800	0.8766	7	0.9723	0.1840	Ns
Stem quality distribution						
Lna=0.9559+0.0728lnTHT+0.0023SC+0.393lnA^{-1}	1.3548	1.3565	7	0.5092	0.3140	Ns
Lnb=-2.4708-0.2171THT+0.0001SC+4.9579lnA^{-1}	0.1319	0.1342	7	1.4653	0.0970	Ns
Lna+c=0.9969+0.0702lnTHT+0.022SC+0.3769lnA^{-1}	-0.8800	-0.8792	7	0.2918	0.3900	Ns

Table 27: Model validation of the best adjudged models among whole stand growth variable

Model	Mean observed value	Mean Predicted value	N	T	p-value	Remark
Growth models						
LnSV=-0.7759+0.0001SI+0.0005A^{-1}+0.9532lnBA	4.4129	4.4077	7	0.3555	0.367	Ns
LnBA=0.5660-0.2106lnSV+0.0001CPA+0.00019SI	1.2655	1.2684	7	0.4482	0.335	Ns
LnSQ=0.0811+0.0021A-0.00001N+0.0015THT	1.2710	1.2730	7	1.4110	0.104	Ns
Yield models						
LnSV=2.4848-0.7822A^{-1}-4.2266lnBA	3.0950	3.0950	7	0.9950	0.179	Ns
LnBA=0.5421-0.1081A^{-1}-0.2191lnSV	0.9434	0.9434	7	0.9870	0.181	Ns
LnSQ=-0.2932+0.3105lnTHT+0.0105lnA^{-1}	1.2695	1.2695	7	0.8570	0.213	Ns

CHAPTER FIVE

5.0 DISCUSSION

5.1 GROWTH CHARACTERISTICS ESTIMATE

Changes over time in the structure of forest resources are largely driven by stand dynamics as well as timber removals and changes in land use. Importantly, tree growth is an important facet of stand dynamics and the information about growth can be used to determine the presence of any unusual spatial or temporal patterns in growth rates or the occurrence of balance between growth and mortality adequately enough to sustain a forest ecosystem (Bechtold, 2003). Vanclay (1995) justified the relevance and implications of models for investigation of forest management alternatives for sustainable management. Hence, this study focused essentially on exploration and development of growth characteristics models and their implications on the yield (volume) of *Pinus caribaea* in Southwestern Nigeria.

The study revealed significant variations among growth characteristics variables which is similar to findings of earlier studies on growth characteristics (Evans, 1992; Xu and Harrington, 1998; Onyekwelu, 2003); who reported stunning variations among growth characteristics of tropical area grown plantation species. The study as part of agreement with their findings encountered four distinct canopy layers (dominant, co-dominant, intermediate and suppressed). One outstanding distinction of the variations of growth characteristics was the sequential variation among the canopy layer which coincidentally conforms to reports of past studies (Dupuy and Mille, 1993; Akindele and Abayomi, 1993; Onyekwelu, 2001).

The findings from the results of the study showed that dominant canopy layers had highest values of the estimates of total height, stem volume, stem quality, basal area and diameter at breast height.

This was also in consonant with similar studies on other plantation grown species (Nilsson and Abrektson, 1993; Fonwebon *et al.*,1994; Onifade, 1998). The highest estimate of crown ratio was however found within the intermediate canopy layer and the highest value of slenderness coefficient was found within suppressed canopy layer. These also agree with the earlier reports (Assman, 1970; Ruha and Varmola, 1997; Xu and Harrington, 1998; Varmola and Salminen, 2004; Huuskonen and Hynynen, 2006) on the growth characteristics variations among the canopy layers. According to their results, the crown ratio young pine stands varied considerably depending on the stand density which reflect element of competition. Nilsson and Gemmel (1993) found out that young pine reacted strongly to competition (stand density) when the reaction to competition was assessed as the number of current stands.

The study also revealed significant statistical relationships and associations between growth variables of *Pinus caribaea* which indicate a reasonable ability of all the growth parameters evaluated to predict the desired dependent variables. For example, coefficient of determination (R^2) value between relationship of merchantable volume and stump diameter was significantly high with low standard error estimate, which indicates reasonable goodness of fit model. This observation agrees with the earlier reports on studies of relationship among growth characteristics in tropical rainforest area plantation grown species (Osho, 1983; Akindele, 2003).

5.2 GROWTH CHARACTERISTICS MODELS

5.2.1 Canopy layer growth models

The results of canopy layers growth models provide one of the outstanding innovation of this study. The study unlike several studies on individual and whole stand modeling studies observed distinctions in growth models among the canopy layers. The models developed for these categorizations were both linear and nonlinear models with high levels of significant relationships among the growth variables within the canopy layers (Tables 10-13). It was evident from the results of growth models within dominant canopy layer that there were diameter, basal area and stem volume increments increase significantly with crown ratio and age; while stem volume increased with diameter at breast height and age and total height increased with crown projection area and age. The results of the study among co-dominant canopy layer revealed higher significant relationships of diameter at breast height, basal area and stem volume with increases in crown ratio and age. Similar trends were observed among intermediate and suppressed canopy layers which depicted distinct variations in the growth variables and models developed for their future predictions. These results agreed extensively with earlier studies on modeling canopy classification among plantation species (Weisberg *et al.*, 2003; Kerns and Ohmann, 2004; Korhonen *et al.*, 2007; Suchar and Crookson, 2010).

5.2.2 Individual growth models

This study has shown that all the individual tree models were significantly suitable for prediction purposes following their high satisfaction of goodness of fit. These models as revealed in the study were both linear and nonlinear but demonstrated models with non-existence of problem of multicollinearity (multicollinearity problem results when Xs of regression model becomes more highly correlated and it becomes more and more difficult to determine which X is actually producing the effect of Y). It was evident in this study that all individual models provide good fit and can easily be used for predicting the future growth values (Tables 14 and 15). The results were consistent with many other studies (Cao, 2000; Fang and Bailey, 2001; Akindele, 2003; Akindele, 2005).

This study also showed noteworthy contributions of crown ratio and age of the individual tree as factors to growth disparity among trees. The crown ratio factor was identified with growth models only while age of tree was majorly factored in for both growth and yield models within this categorization. This pattern of observation was however at variance with Prevosto *et al.*(2000) and Adesoye (2002) who reported that competition index was one unique independent variable that featured among all individual model fitted to *Nauclea diderrichii* data from Omo Forest Reserve, Nigeria and Mid-elevation Scots pine growth on a Volcanic substrate respectively. This study thus purported the possibility of fitting other growth related variables for *Pinus caribaea* plantation in southwestern Nigeria.

5.2.3 Size class growth models

The size class models evaluated in this study was based on Weibull probability density functions (PDF) for both diameter and stem quality distributions using maximum likelihood estimation (MLE). Though several methods have been proposed to estimate the parameters of Weibull PDF distribution in forestry, MLE is generally considered the best as it is asymptotically the most efficient method, and thus it is the most frequently used method to estimate parameters of Weibull PDF distributions (Zarnoch and Dell, 1985; Shiver, 1988; Cao and McCarty, 2006; Lei, 2006). The results of the size class models developed in this study for both diameter and stem quality distribution fitted significantly to the data. The location (a), scale (b) and shape (c) parameters revealed plausible Weibull parameters that can readily predict stem diameter and stem quality.

Though location parameter and sum of location and shape parameters significantly related to quadratic mean diameter; the level of significant relationship between scale parameter and quadratic mean diameter was high ($R^2 = 0.989$). This result was consistent with other studies on the evaluation of Weibull PDF distributions (Adesoye, 2002; Cao and McCarty, 2006; Cao, 2006). The Weibull parameter for the stem quality distribution also showed similar results of significant relationship between location parameter with the sum of location and shape parameters on height and stem age. The results of goodness of fit (R^2) for scale parameter with the same independent variables gave higher significant relationship ($R^2= 0.995$). These results agree with many other studies (Bailey *et al.*, 1989; Al-Fawzan Mohammad, 2000; Cao, 2004; Akinnagbe and Akindele, 2006); and justified their potential validity for reasonable predictive diameter and stem quality equations for future projections.

5.2.4 Whole stand growth models

Vanclay (1994) defined stand growth models as abstractions of the natural dynamics of a forest stand, which may encompasses growth, mortality and other changes in stand composition and structure. Population parameters such as stocking (number of trees per unit area), plantation age, site index, stand basal area per hectare, number of trees per hectare (Clutter *et al*., 1992), standing volume are used to predict the growth or yield of the whole forest. The whole stand models developed in this study were principally multiple linear models of population parameters which was consistent with findings of earlier studies on stand growth models (Akindele 1990; Mohren and Burkhart, 1994; Onyekwelu, 1995; Soares *et al.*, 1995; Adesoye, 2002;); and in agreement with their investigations, these models demonstrated significant relationships among the stand variables and thus guaranteed their usefulness for future projections among the *Pinus* stands in the study area.

The study has shown among the whole stand growth models that stem volume growth increased significantly with site index, age and basal area per hectare while the basal area growth also increased with site index, crown projection area and stem volume growth. Stem quality however increased reasonably with number of stem, age and stem total heights. Similarly, the results of yield models among the whole stand data produced comparable trends with growth models which made the results and the pattern in both whole growth and yield models agreed with earlier studies on *Pinus species* (Short III and Burkhart, 1992; Valentine *et al*.,1994; Oliver and Larson, 1996; Meldahl *et al.*,1998). The significant relationships among these stand growth variables and the credible evaluation of the models justified the potentials of these models. Adesoye (2002) reported that reasonable whole stand growth models are useful for predicting both current and future yield which often times are measured in terms of stem volume and basal area. This study thus projected future yield (in terms of volume per hectare) of *Pinus caribaea* in the study with adjudged best candidate model (Equation 127) for yield projection and predicted expected volume per hectare from each stand at different planning period of 25 years at 5 years interval (Table 23). This would thus represent the quantity of wood that are probably be available in each stand of *Pinus caribaea* through the proposed management planning model of 25 years. This view was equally shared and emphasized by other authors on future yield prediction for management options (Clutter *et al.*, 1992; Akindele and Abayomi, 1993; Onifade, 1998; Adesoye, 2002).

5.2.5 Optimal rotation age models

The optimal rotation age models developed in this study was based on the estimate computed from the mean annual increment (MAI) or yield often expressed in volume per hectare. This was computed from the growth equations when MAI is maximized and the results of the study showed variations among the canopy layers. Intermediate canopy had the least rotation age while the dominant canopy had the highest rotation age (Table 20). The variability among the canopy layers agreed with earlier studies on optimal rotation age (Fry and Poole, 1980; Lamprecht, 1986; McDade *et al.*,1994). Petit and Montagnini (2004) reported that variation among canopy layers is peculiarly related with fast growing species when he compared growth equations and rotation ages of ten native tree species in mixed and pure plantations in the humid neotropics. The study also recorded rotation ages and expected merchantable volumes to be yielded being computed from the optimal rotation models of each canopy layer evaluated; and at these various rotations ages, the stand within the canopy layers attain merchantable sizes that can be harvested (Table 21). The ranking among canopy layers showed that dominant canopy layer had the best relative growth from the concept of rotation ages and expected volume (Table 22). This investigation was in consonant with results of other studies on growth modeling and rotation ages among plantation grown species (Butterfield, 1993; Petit and Montagnini, 2004). This observation is invariably significant in solving the questions of productivity within different canopy layers using modeling options from the concept of rotation ages. Importantly, this study revealed pristine and novel information on the possibility of modeling canopy layers' rotation ages for determining productivity of any plantation grown species; particularly of *Pinus caribaea* in southwestern Nigeria. As can be seen from these investigations, canopy rotation age models categorization proffer good both silvicultural and yield results in terms of provision of satisfactory information about productivity of *Pinus caribaea* within each canopy layer which would undoubtedly offer plausible potentials of determining above-ground biomass alongside with yield (merchantable volume per hectare/year-m^3/ha/yr) per layer component. This would tremendously inform the forest managers and policy makers about various options for allowable cut among these canopy components with possible methods of felling systems for both sustained yield and sustainable management of *Pinus caribaea* plantations in southwestern and other ecological zones of Nigeria.

This study of canopy categorization has also dwelt apparently into the concept of hierarchical models in architectural modeling conceptualization; where ecosystems can be modeled at many different hierarchical levels. According to Maguire (2009), the phenomenon been modeled or simulated has a context represented by the next higher level of ecosystem organization as well as driving mechanisms represented by the next lower level of ecosystem organization. In this study, the level at which mechanisms are represented in models of canopy layers depends on the variations about the growth attributes identified and modeled in this study and this obvious discovery may possibly suggest further investigation into integrated systems for modeling stand dynamics and wood quality among these canopy facets.

5.3 SITE QUALITY EVALUATION

The linearised site index equation found suitable for this study was of the order of Schumacher (1939) and had been used and supported by Akindele (1991) as suitable site index equation suitable for any tropically grown plantation species. The anamorphic site index curves produced for the comparison of the three sites and plots within the individual stands were somewhat similar but with distinctive variations at the two levels of comparisons (Figs 7 and 8). The results of site quality evaluation in this study revealed significant variations in the site index equations and curves between the three study sites (J4 - Pine plantation, Shasha Forest Reserve Pine plantation and Oluwa Forest Reserve Pine plantation) with J4 Forest Reserve pine plantation having the highest site index among the three sites of the study area. This is in agreement with previous observations on site index study with possible variations among the site quality classes which ultimately describe the productivity of the categories of site worked in the study (Goudia, 1984; Hann and John, 1986; Carmean *et al.*, 1989; Johansson, 1995; Wang *et al.*, 2008; Waring *et al.*,2006). Akindele (1991) reported that for many exotic species in Nigeria, the leading factors that may resulted in such good growth seem to be the climate and relative good soil. Essentially, the study of Huebschmann and Martin (1996) was in consonant with the trend of findings in this study which emphasized the essence of site index as being most importantly used in determining which stands to manage and that the stands with high site indexes produce merchantable timber in a shorter time period than do stands with low indexes such that the former are more economical to manage.

Site index concept remains a concomitant concept on the evaluation of site quality both in the tropical and temperate regions of the world. Waring *et al.* (2002) gave a reasonable results on the assessment of site index and forest growth capacity across the pacific and inland Northwest USA with a MODIS satellite- derived vegetation index with significant site equations of best fit indexes which similarly agrees with the findings in this study. Still on the better observation of the J4 - Forest Reserve site index curve, Mehtätalo (2004) observed that the development of some growth characteristics models and site curves explanation of the site by site index concept of a shade-tolerant (dominant) tree species depends on mean tree size in the stand rather than on stand age. His study was also supported by Mehtätalo (2005) who observed that site properties affect the development rate of a forest stand; such that stands on poor sites develop more slowly and for longer than stands on rich sites. These revelations were similar to the observations in J4-Forest Reserve, Shasha Forest Reserve and Oluwa Forest Reserve with J4 having the highest site index and thus with greater possibility of highest merchantable timber production over Shasha and Oluwa Forest Reserve. On the factor of soil properties differentiation, the study of Johansson (1995) on Norway Spruce on farmland with different soil types indicated similar results as it aligned with the report of Johansson (1995) who worked on European Aspen growing forestland of different soils in Sweden. However, Wang *et al.* (2008), reported that the tendency for a predictor age to be derived, the closer must be the base age among the plantation species, the higher the accuracy that would likely be obtained when he studied pine plantation of Taiwan using base age of 25 years. This site index curves produced for this study was on similar threshold of base age of 25 years, and was in consonant with the previous studies (Johansson, 1995; 1996; Swenson *et al.*, 2005; Wang *et al.*, 2008; Johansson, 2012).

Again, the base age of 25 years used for the development of the site index curves in this study was very suitable for any site quality study on *Pinus caribaea* since the base age is essential and always chosen to extrapolate rotation age of many tropical tree species (Curtis *et al.,* 1974; Onyekwelu and Fuwape, 1998; Teshome and Petty, 2000). The results of the study showing pine plantation at J4 Forest Reserve having the highest height growth site curves over Shasha and Oluwa Forest Reserve pine plantations was in consonant with the study of Clutter *et al.*(1983) when he reported that site index curves of high height growth was an indication of a good site quality. Thus, the best site quality was found to be at J4 Forest Reserve whereas the poorest was presumably was at Oluwa Forest Reserve pine plantation.

This revelation about J4 Forest Reserve corresponds with the study of Onyekwelu (2005) on site index curves for site quality assessment of *Nauclea diderrichi* monoculture plantation in Omo-J4 Forest Reserve, with several classes of sites considered to be best for the species and the species growing on better site of high potential of higher volume production. Unarguable, the J4 Forest Reserve pine plantation was monoculture, and the study suggests that the J4 Forest Reserve site invariably would produce better volume (yield) of *Pinus caribaea* with the highest site index curves of height growth than any other pine plantation observed in this study. The plausible good of J4 Forest Reserve site quality as revealed by the results of site index curves could be relevant in projection for possible large-scale establishment of more pine plantations around J4 Forest Reserve areas. The results could also be used as a guide in making reasonable management decisions on such established plantation.

5.4 APPLICATIONS OF GROWTH AND YIELD MODELS FOR MANAGEMENT OPTIONS

There are many potential applications of growth characteristic models and yield studies of *Pinus caribaea* plantations in southwestern Nigeria. As it has been extensively justified, the statistical expeditions of the study can be applied with data normally available from stand inventories in the region which serve as baseline information about the possibilities inherent in *Pinus caribaea* plantations in Nigeria. The models categorically explored different levels of model types ranging from linear to nonlinear equations as well as probability density functions (PDF) for modeling pertinent distributions. This may be extremely interesting, considering the need for implementation and generalization of silvicultural practices in the area of study. Many of these principles and results agreed with several studies on reasonable growth modeling and yield predictions (Alder, 1979; Álvarez-González *et al*., 2002, 2004).

The study significantly revealed that growth modeling projects and pictures credible yield projections which is often expressed in terms of product classes or log quality grade, and very vital tool in management information for harvesting and reasonable decision making (Vanclay, 1994). The combined information on size class distribution, individual tree, whole stand growth and canopy layer models categorization enable much more realistic evaluations of alternative silvicultural regimes in terms of both volume yield and sustainable management in the study area.

Among notables in this study was the development of curves for determining stem volume curve with optimal rotation ages among the identified canopy layers. These curves are useful tools for the correct management of forest stands and contribute to estimation of the timing of intermediate and final cuts. It is well known that the interception between volume MAI and CAI curves indicates the biological rotation age for a given stand more so when MAI is maximized.

All the best adjudged predictive models presented in this study can be directly used for both current and future predictions and for optimizing timber management planning and in evaluating alternative management regimes at various levels of the *Pinus caribaea* plantations in the study area. These situations, in which planning can be carried out independently for each stand and canopy layer identified , will be the most typical in the region taking into account the place of southwestern geopolitical region in Nigeria Forestry management and administration. In this case, where stable patterns of cogent decisions are important, planning must be coordinated for all stands in the forest being considered and the information given by the model must be included in a forest level optimization model (Clutter *et al*., 1983; Vanclay and Sknovsgard, 1997; Fox *et al.* 2001).

As part of significant contributions of forest growth models which attempt to quantify the growth of a forest, the several models developed in this study would be relevant in predicting the future status of a *Pinus caribaea* plantations and the nature of probable harvesting techniques from the plantation forest, and this would help vigorously for considering alternative cultivation and silvicultural alternatives capable of ensuring sustainable management. Therefore the array of growth and yield models developed can be considered as a potential tool for sustainable management with pragmatic wider objectives that has environmental and socioeconomic synergies.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

Modeling generally is not only a method to bridge the gap between science and management, it can also help to understand its causes for possible recognition, conceptualization of problem and mathematical resolution of perceived gap or problem for future planning and prediction. This study has investigated the growth characteristics models and their applications to yield studies of *Pinus caribaea* in Southwestern Nigeria. This quantitative study explored several models fitted to data from individual, size class, whole stand levels as well as models among the canopy layers. The tests of relationships and associations between the growth characteristics within various levels of *Pinus caribaea* stands showed high significances at $P<0.05$ level of significance with higher values of coefficient of determination (R^2). Critical evaluation and validation of the growth and yield models developed produced reasonable estimates of the models that had stringent compliance with criteria for goodness fit.

The results on diameter distribution and stem quality distribution using Weibull probability density functions (PDF) in this study have shown that the three Weibull parameters (location (a) Scale (b) and shape (c)) are adequate projection both for current and future diameter and stem quality distributions alongside other size class growth attributes. Growth and yield models developed and validated under individual, whole stand and canopy layers provided estimates of good fit models and several models of growth and yield characteristics adjudged as the best candidate models for these various levels.

The expected volume projection obtained for 25 years management planning period of 5 years intervals showed uniform progression in volume expected from the entire stand of *Pinus caribaea* plantations within the period of projection. This significantly indicates a possible trend of progression along the proposed years of planning. The implications of this trend also ensure progression in the number of tree to compensate for the increasing volume expected along the planning period.

This study has therefore shown effects of variation among growth attributes of *Pinus caribaea* plantation in Southwestern Nigeria and possibility of progressive productivity in the yield (volume). The potential revelation about Weibull parameters suitable for both current and future prediction of diameter distribution and stem quality ensures the validity of the study on the possibility of boosting further investigations on the relationships between growth attributes and other stand dynamics. This would in turn proffer reliable information for forest managers, modelers and policy makers on effective and sustainable management of *Pinus caribaea* plantations in the Southwestern region of Nigeria. As the study is providing a baseline data on *Pinus caribaea* plantations in southwestern Nigeria, this would provide laudable information and veritable database on sustainable management options being the first quantitative study on growth characteristics models for *Pinus caribaea* in Nigeria.

Thus, the information that is being provided on growth characteristics and yield studies are relevant for effective management of *Pinus caribaea* in the study area and other *Pinus caribaea* plantations in Nigeria Thereby helping in critical projection of the timber production potentials of the pine plantations in the study area and the country (Nigeria) at large using empirical modeling methods.

The study has proffered opportunity to have reasonable classification of estimates of growth attributes among the *Pinus* stands for effectual silvicultural treatments among the canopy layers. Taking reference from dominant canopy layer with highest estimate of stem volume and with probable highest predicted volume across the projected planning period, the timber productivity potentials of this species are made known. With the investigation on expected volume for 5 years planning period, changes on site productivity over successive rotation ages of the species can be properly managed across the study sites.

6.2 RECOMMENDATIONS

Indeed, information on growth attributes and yield potentials from *Pinus caribaea* plantations in the study area has provided reliable and reasonable estimates of growth and yield models. Thus the following recommendations are made:

1. There is need for regular and proper monitoring of integrated inventory activities of *Pinus caribaea* plantations in other parts of the country for reasonable comparative studies for relationship between growth attributes and prediction models across the regions.
2. The development of optimal productivity potentials identified in the study necessitates adequate management of the *Pinus caribaea* in the study area and other pine plantations in Nigeria.
3. Though, there has not been a recorded facts on the *Pinus caribaea* timber conversion and utilization in Nigeria, the knowledge of expected volume and yield productivity demands an urgent investigations into the preservative and durability potentials should there be any move for its timber conversion.
4. There is also urgent need of incorporating the information on growth attributes and yield productivity potential with realistic economic parameters that would ensure good economic analysis of the future yield and expected productivity.

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Appendix 1: Data for individual tree

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1	Oluw1974	1	1	37	50.5	52.4	44.5	28.9	19.3	17.3	15.3	2.6	3.2	D	0.505	0.524	0.445	0.289	0.200296	2.604696	0.134715	38.21782	8.042477
2	Oluw1974	1	2	37	20.3	22.3	18.4	16.3	15.4	13.2	11.2	2.5	2.8	C	0.203	0.223	0.184	0.163	0.032365	0.365829	0.162338	75.86207	6.157522
3	Oluw1974	1	3	37	20	22.1	18.1	16	14.9	12.9	10.9	2.5	2.8	C	0.2	0.221	0.181	0.16	0.031416	0.346983	0.167785	74.5	6.157522
4	Oluw1974	1	4	37	25.2	27.2	23.4	21.6	15.8	13.8	11.8	2.5	2.8	C	0.252	0.272	0.234	0.216	0.049876	0.613574	0.158228	62.69841	6.157522
5	Oluw1974	1	5	37	23.5	26.4	21.5	19.5	14.8	12.9	10.9	2.5	2.8	C	0.235	0.264	0.215	0.195	0.043374	0.494122	0.168919	62.97872	6.157522
6	Oluw1974	1	6	37	13.3	16.4	11.2	9.3	12.4	10.2	8.2	2.4	2.6	S	0.133	0.164	0.112	0.093	0.013893	0.114453	0.193548	93.23308	5.309292
7	Oluw1974	1	7	37	33	36.2	28.1	26.1	18.8	16.8	14.8	2.5	2.8	C	0.33	0.362	0.281	0.261	0.08553	1.132564	0.132979	56.9697	6.157522
8	Oluw1974	1	8	37	26.9	28.8	24.8	20.9	16.4	14.2	12.2	2.5	2.8	C	0.269	0.288	0.248	0.209	0.056832	0.692656	0.152439	60.96654	6.157522
9	Oluw1974	1	9	37	29.2	34.1	25.2	22.1	16.8	14.8	12.8	2.5	2.8	C	0.292	0.341	0.252	0.221	0.066966	0.812003	0.14881	57.53425	6.157522
10	Oluw1974	1	10	37	53	55.6	49.8	29.9	17.6	18.4	16.4	2.6	3.2	D	0.53	0.556	0.498	0.299	0.220618	3.349223	0.147727	33.20755	8.042477
11	Oluw1974	1	11	37	40	42.4	38.3	28.4	18.2	16.2	14.1	2.6	3.1	D	0.4	0.424	0.383	0.284	0.125664	1.796526	0.142857	45.5	7.547676
12	Oluw1974	1	12	37	23	26.6	19.2	17.4	14.8	12.8	10.8	2.5	2.8	C	0.23	0.266	0.192	0.174	0.041548	0.416346	0.168919	64.34783	6.157522
13	Oluw1974	1	13	37	28	32.4	26.1	24	16.4	14.2	12.2	2.5	2.8	C	0.28	0.324	0.261	0.24	0.061575	0.808679	0.152439	58.57143	6.157522
14	Oluw1974	1	14	37	45	47.6	42.1	29.4	18.8	16.8	14.8	2.6	2.9	D	0.45	0.476	0.421	0.294	0.159043	2.247443	0.138298	41.77778	6.605199
15	Oluw1974	1	15	37	33	36.2	30.3	24.3	16.6	14.6	12.4	2.5	2.8	C	0.33	0.362	0.303	0.243	0.08553	1.065131	0.150602	50.30303	6.157522
16	Oluw1974	1	16	37	44.2	46.2	40.3	26.3	18.2	16.2	14.2	2.6	2.9	D	0.442	0.462	0.403	0.263	0.153439	1.976904	0.142857	41.17647	6.605199
17	Oluw1974	1	17	37	21	26.1	19.1	17.4	15.6	13.4	11.4	2.5	2.8	C	0.21	0.261	0.191	0.174	0.034636	0.428553	0.160256	74.28571	6.157522
18	Oluw1974	1	18	37	28	33.4	24.2	21.1	16.4	14.4	12.2	2.5	2.8	C	0.28	0.334	0.242	0.211	0.061575	0.73576	0.152439	58.57143	6.157522
19	Oluw1974	1	19	37	29.3	32.4	27.4	24.2	16.8	14.8	12.8	2.5	2.8	C	0.293	0.324	0.274	0.242	0.067426	0.898612	0.14881	57.33788	6.157522
20	Oluw1974	1	20	37	29.4	32.6	27.4	24.4	16.6	14.6	12.8	2.5	2.8	C	0.294	0.326	0.274	0.244	0.067887	0.890811	0.150602	56.46259	6.157522
21	Oluw1974	1	21	37	44	48.2	41.4	28.6	14.8	12.8	10.8	2.5	2.8	C	0.44	0.482	0.414	0.286	0.152053	1.67502	0.168919	33.63636	6.157522
22	Oluw1974	1	22	37	20	24.2	18.4	16.1	14.9	12.8	10.6	2.5	2.8	C	0.2	0.242	0.184	0.161	0.031416	0.368461	0.167785	74.5	6.157522
23	Oluw1974	2	1	37	21	24.2	19.6	17.4	14.8	12.8	10.8	2.5	2.8	C	0.21	0.242	0.196	0.174	0.034636	0.406319	0.168919	70.47619	6.157522
24	Oluw1974	2	2	37	28	32.4	26.4	24.1	15.8	13.8	11.4	2.5	2.8	C	0.28	0.324	0.264	0.241	0.061575	0.798149	0.158228	56.42857	6.157522
25	Oluw1974	2	3	37	47	49.6	42.5	28.5	18.6	16.8	14.8	2.5	2.8	C	0.47	0.496	0.425	0.285	0.173494	2.308501	0.134409	39.57447	6.157522
26	Oluw1974	2	4	37	23.2	26.1	20.1	18.2	14.8	12.9	10.9	2.5	2.8	C	0.232	0.261	0.201	0.182	0.042273	0.443848	0.168919	63.7931	6.157522
27	Oluw1974	2	5	37	20.6	24.4	18.5	16.6	14.4	12.4	10.4	2.5	2.8	C	0.206	0.244	0.185	0.166	0.033329	0.363574	0.173611	69.90291	6.157522
28	Oluw1974	2	6	37	32.2	36.2	26.4	24.2	15.8	13.8	11.8	2.6	2.9	D	0.322	0.362	0.264	0.242	0.081433	0.846111	0.164557	49.06832	6.605199
29	Oluw1974	2	7	37	23	26.4	20.1	18	14.7	12.9	10.7	2.5	2.8	C	0.23	0.264	0.201	0.18	0.041548	0.445285	0.170068	63.91304	6.157522
30	Oluw1974	2	8	37	25.4	27.4	21.4	19.4	14.6	12.8	10.8	2.5	2.8	C	0.254	0.274	0.214	0.194	0.050671	0.495779	0.171233	57.48031	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
31	Oluw1974	2	9	37	51.5	52.8	48.4	29.5	19.8	18.8	16.9	2.6	3.3	D	0.515	0.528	0.484	0.295	0.208307	3.20616	0.131313	38.4466	8.552986
32	Oluw1974	2	10	37	45	47.8	42	28.8	19.4	17.8	15.4	2.6	3.2	D	0.45	0.478	0.42	0.288	0.159043	2.36969	0.134021	43.11111	8.042477
33	Oluw1974	2	11	37	39.5	42.4	36.5	29.6	18.4	16.4	14.4	2.6	3	D	0.395	0.424	0.365	0.296	0.122542	1.718031	0.141304	46.58228	7.068583
34	Oluw1974	2	12	37	38.6	40.6	34.5	29.6	17.8	15.8	13.6	2.6	3	D	0.386	0.406	0.345	0.296	0.117021	1.506802	0.146067	46.11399	7.068583
35	Oluw1974	3	1	37	21.2	24.2	19.2	17.3	14.8	12.4	10.2	2.5	2.8	C	0.212	0.242	0.192	0.173	0.035299	0.382982	0.168919	69.81132	6.157522
36	Oluw1974	3	2	37	52.1	55.6	49.2	29.1	19.5	18.3	16.3	2.6	3.2	D	0.521	0.556	0.492	0.291	0.213189	3.262797	0.133333	37.42802	8.042477
37	Oluw1974	3	3	37	19.5	23.6	17.6	15.5	12.8	10.4	8.4	2.4	2.6	S	0.195	0.236	0.176	0.155	0.029865	0.277206	0.1875	65.64103	5.309292
38	Oluw1974	3	4	37	41.4	44.6	28.4	29.4	18.4	16.4	14.2	2.5	2.8	C	0.414	0.446	0.284	0.294	0.134614	1.305176	0.13587	44.44444	6.157522
39	Oluw1974	3	5	37	44.8	46.8	40.6	29.8	18.8	16.8	14.9	2.6	2.9	D	0.448	0.468	0.406	0.298	0.157633	2.126922	0.138298	41.96429	6.605199
40	Oluw1974	3	6	37	46.1	48.2	42.8	29.9	19.1	17.2	15.2	2.6	2.9	D	0.461	0.482	0.428	0.299	0.166914	2.374092	0.136126	41.43167	6.605199
41	Oluw1974	3	7	37	51.4	54.4	46.2	28.8	19.6	18.4	16.4	2.6	2.9	D	0.514	0.544	0.462	0.288	0.207499	2.968919	0.132653	38.1323	6.605199
42	Oluw1974	3	8	37	24	26.2	21.2	18.6	14.6	12.6	10.6	2.5	2.8	C	0.24	0.262	0.212	0.186	0.045239	0.466789	0.171233	60.83333	6.157522
43	Oluw1974	3	9	37	42.4	44.5	38.2	28.4	18.8	16.8	14.4	2.6	2.9	D	0.424	0.445	0.382	0.284	0.141196	1.896466	0.138298	44.33962	6.605199
44	Oluw1974	3	10	37	17.5	21.4	15.6	13.5	13.6	11.6	9.6	2.6	2.6	S	0.175	0.214	0.156	0.135	0.024053	0.245022	0.191176	77.71429	5.309292
45	Oluw1974	3	11	37	23	27.4	20.1	18.4	15.6	13.4	11.2	2.5	2.8	C	0.23	0.274	0.201	0.184	0.041548	0.474535	0.160256	67.82609	6.157522
46	Oluw1974	4	1	37	57.7	59.6	52.7	29.4	19.8	18.8	16.8	2.6	3.2	D	0.577	0.596	0.527	0.294	0.261482	3.820737	0.131313	34.31542	8.042477
47	Oluw1974	4	2	37	24.8	26.8	22.6	20.8	14.9	12.4	10.4	2.5	2.8	C	0.248	0.268	0.226	0.208	0.048305	0.518423	0.167785	60.08065	6.157522
48	Oluw1974	4	3	37	21.5	34.4	19.5	17.5	14.2	12.2	10.2	2.5	2.8	C	0.215	0.344	0.195	0.175	0.036305	0.480787	0.176056	66.04651	6.157522
49	Oluw1974	4	4	37	26.6	28.5	24.5	22.4	14.8	12.8	10.8	2.5	2.8	C	0.266	0.285	0.245	0.224	0.055572	0.622456	0.168919	55.6391	6.157522
50	Oluw1974	4	5	37	34.5	56.4	30.4	24.5	18.2	16.2	14.2	2.6	2.9	D	0.345	0.564	0.304	0.245	0.093482	1.585734	0.142857	52.75362	6.605199
51	Oluw1974	4	6	37	34.5	36.4	30.3	24.5	18.4	16.4	14.4	2.6	2.9	D	0.345	0.364	0.303	0.245	0.093482	1.201661	0.141304	53.33333	6.605199
52	Oluw1974	4	7	37	37.8	39.8	35.8	26.4	19.1	17.1	15	2.6	2.9	D	0.378	0.398	0.358	0.264	0.112221	1.658097	0.136126	50.5291	6.605199
53	Oluw1974	4	8	37	43.7	45.6	41.6	29.7	17.4	15.4	15.4	2.6	3.1	D	0.437	0.456	0.416	0.297	0.149987	1.992409	0.149425	39.81693	7.547676
54	Oluw1974	4	9	37	34.8	36.9	30.4	28.4	18.8	16.8	14.4	2.6	2.9	D	0.348	0.369	0.304	0.284	0.095115	1.289739	0.138298	54.02299	6.605199
55	Oluw1974	4	10	37	44.4	46.2	41.8	28.8	19.4	17.4	15.2	2.6	2.9	D	0.444	0.462	0.418	0.288	0.15483	2.266913	0.134021	43.69369	6.605199
56	Oluw1974	4	11	37	34	38.2	30.1	26.4	18.2	16.2	14.1	2.6	2.9	D	0.34	0.382	0.301	0.264	0.090792	1.225743	0.142857	53.52941	6.605199
57	Oluw1974	4	12	37	32.9	36.4	28.6	24.8	17.8	15.8	13.8	2.6	2.9	D	0.329	0.364	0.286	0.248	0.085012	1.077921	0.146067	54.10334	6.605199
58	Oluw1974	4	13	37	20.5	36.8	18.5	16.4	14	12	10	2.5	2.8	C	0.205	0.368	0.185	0.164	0.033006	0.470014	0.178571	68.29268	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
59	Oluw1974	4	14	37	35.4	38.9	30.4	26.2	18.8	16.8	14.8	2.6	2.9	D	0.354	0.389	0.304	0.262	0.098423	1.296662	0.138298	53.10734	6.605199
60	Oluw1974	5	1	37	42	44.1	38.2	28.4	18	16	14	2.6	2.9	D	0.42	0.441	0.382	0.284	0.138544	1.798736	0.144444	42.85714	6.605199
61	Oluw1974	5	2	37	44.2	46.2	40.4	29.2	18.8	16.8	14.8	2.6	2.9	D	0.442	0.462	0.404	0.292	0.153439	2.092616	0.138298	42.53394	6.605199
62	Oluw1974	5	3	37	40	42	36.2	26.2	17	15.6	13.6	2.6	2.9	D	0.4	0.42	0.362	0.262	0.125664	1.570774	0.152941	42.5	6.605199
63	Oluw1974	5	4	37	54.2	56.2	51.4	29.8	19.8	18.4	16.4	2.6	3.2	D	0.542	0.562	0.514	0.298	0.230722	3.519938	0.131313	36.53137	8.042477
64	Oluw1974	5	5	37	48.5	52.1	46.5	28.9	19.4	17.4	15.4	2.6	3.1	D	0.485	0.521	0.465	0.289	0.184745	2.778424	0.134021	40	7.547676
65	Oluw1974	5	6	37	38	41.6	36.4	28.8	18.6	16.6	14.6	2.6	2.9	D	0.38	0.416	0.364	0.288	0.113411	1.707892	0.139785	48.94737	6.605199
66	Oluw1974	6	1	37	33.5	35.6	28.8	24.2	18.2	16.2	14.2	2.6	2	D	0.335	0.356	0.288	0.242	0.088141	1.096498	0.142857	54.32836	3.141593
67	Oluw1974	6	2	37	36.3	39.4	32.4	27.3	18.8	18.8	14.8	2.6	2.9	D	0.363	0.394	0.324	0.273	0.103491	1.59878	0.138298	51.79063	6.605199
68	Oluw1974	6	3	37	24.9	28.6	22.8	20.8	14.8	12.8	16.8	2.5	2.8	C	0.249	0.286	0.228	0.208	0.048695	0.55794	0.168919	59.43775	6.157522
69	Oluw1974	6	4	37	50.5	52.5	48.5	29.8	19.8	18.2	16.2	2.6	3.1	D	0.505	0.525	0.485	0.298	0.200296	3.109782	0.131313	39.20792	7.547676
70	Oluw1974	6	5	37	35.2	38.2	32.2	25.6	18.4	16.4	14.4	2.6	2.9	D	0.352	0.382	0.322	0.256	0.097314	1.344289	0.141304	52.27273	6.605199
71	Oluw1974	6	6	37	46.4	48.4	42.2	29.8	18.8	16.9	14.9	2.6	2.9	D	0.464	0.484	0.422	0.298	0.169093	2.290508	0.138298	40.51724	6.605199
72	Oluw1974	6	7	37	31.6	33.8	28.6	23.6	18.2	16.1	14.1	2.6	2.9	D	0.316	0.338	0.286	0.236	0.078427	1.047681	0.142857	57.59494	6.605199
73	Oluw1974	6	8	37	35.5	37.5	33.5	28.5	18.6	16.6	14.6	2.6	2.9	D	0.355	0.375	0.335	0.285	0.09898	1.457496	0.139785	52.39437	6.605199
74	Oluw1974	6	9	37	38.2	42.2	36.2	29.2	17.4	15.4	13.4	2.6	2.9	D	0.382	0.422	0.362	0.292	0.114608	1.587534	0.149425	45.54974	6.605199
75	Oluw1974	6	10	37	45.5	47.6	42.5	29.8	18.8	16.8	14.8	2.6	3.1	D	0.455	0.476	0.425	0.298	0.162597	2.282417	0.138298	41.31868	7.547676
76	Oluw1974	6	11	37	24.2	26.2	22.6	20.4	14.8	12.4	10.2	2.5	2.8	C	0.242	0.262	0.226	0.204	0.045996	0.510587	0.168919	61.15702	6.157522
77	Oluw1974	6	12	37	30.5	34.6	28.4	24.5	17.4	15.4	13.4	2.5	2.8	C	0.305	0.346	0.284	0.245	0.073062	1.012695	0.143678	57.04918	6.157522
78	Oluw1974	6	13	37	47.5	49.6	42.5	29.5	18.2	16.2	14.2	2.6	2.9	D	0.475	0.496	0.425	0.295	0.177205	2.238354	0.142857	38.31579	6.605199
79	Oluw1974	6	14	37	23.1	26.2	21.2	19.1	14.4	12.4	10.4	2.5	2.8	C	0.231	0.262	0.212	0.191	0.04191	0.462439	0.173611	62.33766	6.157522
80	Oluw1974	6	15	37	38	42.1	36.1	28.4	18.2	16.2	14.1	2.6	2.9	D	0.38	0.421	0.361	0.284	0.113411	1.652312	0.142857	47.89474	6.605199
81	Oluw1974	7	1	37	31	32.1	28.2	24.1	16.8	12.8	12.8	2.5	2.8	C	0.31	0.321	0.282	0.241	0.075477	0.802937	0.14881	54.19355	6.157522
82	Oluw1974	7	2	37	42.1	44.1	38.1	26.2	18.2	14.2	14.2	2.6	2.9	D	0.421	0.441	0.381	0.262	0.139205	1.568377	0.142857	43.2304	6.605199
83	Oluw1974	7	3	37	50	52.1	43.2	28.8	19.6	18.6	16.6	2.6	3.1	D	0.5	0.521	0.432	0.288	0.19635	2.680353	0.132653	39.2	7.547676
84	Oluw1974	7	4	37	20	24.2	18.1	16	14.5	12.5	18.5	2.5	2.8	C	0.2	0.242	0.181	0.16	0.031416	0.352133	0.172414	72.5	6.157522
85	Oluw1974	7	5	37	37.5	39.6	34.6	27.8	18.6	16.6	14.6	2.6	2.9	D	0.375	0.396	0.346	0.278	0.110447	1.549224	0.139785	49.6	6.605199
86	Oluw1974	7	6	37	25	32.6	26.4	24.2	15.4	13.4	11.4	2.5	2.8	C	0.25	0.326	0.264	0.242	0.049087	0.778141	0.162338	61.6	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
87	Oluw1974	7	7	37	55.5	57.5	52.4	29.9	19.8	18.8	16.8	2.6	3.2	D	0.555	0.575	0.524	0.299	0.241922	3.73648	0.131313	35.67568	8.042477
88	Oluw1974	7	8	37	21.8	24.8	18.6	16.8	14.8	12.8	10.8	2.5	2.8	C	0.218	0.248	0.186	0.168	0.037325	0.382205	0.168919	67.88991	6.157522
89	Oluw1974	7	9	37	32	36.2	28.4	24.2	16.6	14.6	12.6	2.5	2.8	C	0.32	0.362	0.284	0.242	0.080425	0.978945	0.150602	51.875	6.157522
90	Oluw1974	8	1	37	48.1	48.2	42.1	28.2	19.2	17.2	15.1	2.6	2.9	D	0.481	0.482	0.421	0.282	0.181711	2.298332	0.135417	39.91684	6.605199
91	Oluw1974	8	2	37	41	44.1	38.2	24.1	18.2	16.2	14.2	2.6	2.9	D	0.41	0.441	0.382	0.241	0.132025	1.773348	0.142857	44.39024	6.605199
92	Oluw1974	8	3	37	50	52.1	48.1	29.8	19.8	18.6	16.6	2.6	3.1	D	0.5	0.521	0.481	0.298	0.19635	3.130311	0.131313	39.6	7.547676
93	Oluw1974	8	4	37	34.8	36.8	30.2	28.4	16.8	14.8	12.8	2.6	2.9	D	0.348	0.368	0.302	0.284	0.095115	1.125379	0.154762	48.27586	6.605199
94	Oluw1974	8	5	37	20.5	24.5	18.5	16.4	14.8	12.8	10.8	2.5	2.8	C	0.205	0.245	0.185	0.164	0.033006	0.375016	0.168919	72.19512	6.157522
95	Oluw1974	8	6	37	49.5	52.6	44.6	28.8	17.8	15.8	13.8	2.6	2.9	D	0.495	0.526	0.446	0.288	0.192442	2.389376	0.146067	35.9596	6.605199
96	Oluw1974	8	7	37	28	32.2	26.2	24.6	14.4	12.4	10.8	2.5	2.8	C	0.28	0.322	0.262	0.246	0.061575	0.712202	0.173611	51.42857	6.157522
97	Oluw1974	8	8	37	40.5	44.2	38.5	26.5	16.8	14.8	12.8	2.6	2.9	D	0.405	0.442	0.385	0.265	0.128825	1.663164	0.154762	41.48148	6.605199
98	Oluw1974	8	9	37	51	52.4	48.2	28.9	19.8	18.4	16.4	2.6	3.1	D	0.51	0.524	0.482	0.289	0.204282	3.100756	0.131313	38.82353	7.547676
99	Oluw1974	8	10	37	28.1	32.6	24.1	24.2	16.8	14.8	12.8	2.5	2.8	C	0.281	0.326	0.241	0.242	0.062016	0.769432	0.14881	59.78648	6.157522
100	Oluw1974	8	11	37	43.9	46.8	38.8	27.9	18.8	16.8	14	2.6	2.9	D	0.439	0.468	0.388	0.279	0.151363	1.977094	0.138298	42.8246	6.605199
101	Oluw1975	9	1	36	32.2	36.4	28.2	24.4	16.8	14.6	12.6	2.6	2.9	D	0.322	0.364	0.282	0.244	0.081433	0.974924	0.154762	52.17391	6.605199
102	Oluw1975	9	2	36	44	48.6	40.1	28.6	18.6	16.8	14.8	2.6	3.2	D	0.44	0.486	0.401	0.286	0.152053	2.11378	0.139785	42.27273	8.042477
103	Oluw1975	9	3	36	39.5	42.4	36.5	26.8	18.2	16.2	14.1	2.6	2.9	D	0.395	0.424	0.365	0.268	0.122542	1.663591	0.142857	46.07595	6.605199
104	Oluw1975	9	4	36	40.4	44.6	38.4	28.2	18.4	16.4	14.4	2.6	3.1	D	0.404	0.446	0.384	0.282	0.12819	1.86395	0.141304	45.54455	7.547676
105	Oluw1975	9	5	36	47.5	51.2	44.5	28.8	18.6	16.8	14.9	2.6	3.2	D	0.475	0.512	0.445	0.288	0.177205	2.500807	0.139785	39.15789	8.042477
106	Oluw1975	9	6	36	58	61.2	48.2	29.9	20.4	18.4	16.2	2.6	3.2	D	0.58	0.612	0.482	0.299	0.264208	3.355697	0.127451	35.17241	8.042477
107	Oluw1975	9	7	36	51.1	54.4	46.1	28.9	19.6	17.4	15.4	2.6	3.2	D	0.511	0.544	0.461	0.289	0.205084	2.80047	0.132653	38.35616	8.042477
108	Oluw1975	10	1	36	30.1	32.4	28.6	24.2	19.2	17.4	15.2	2.5	2.9	C	0.301	0.324	0.286	0.242	0.071158	1.1177	0.130208	63.78738	6.605199
109	Oluw1975	10	2	36	36	38.4	32.1	26.4	19.4	17.6	15.4	2.6	2.9	D	0.36	0.384	0.321	0.264	0.101788	1.44984	0.134021	53.88889	6.605199
110	Oluw1975	10	3	36	30	34.6	28.4	24.1	18.6	16.8	14.8	2.5	2.8	C	0.3	0.346	0.284	0.241	0.070686	1.100483	0.134409	62	6.157522
111	Oluw1975	10	4	36	34	38.4	32.1	26.2	18.4	14.8	12.6	2.6	2.9	D	0.34	0.384	0.321	0.262	0.090792	1.217146	0.141304	54.11765	6.605199
112	Oluw1975	10	5	36	24	28.2	22.4	20.1	18.2	16.2	14.2	2.5	2.8	C	0.24	0.282	0.224	0.201	0.045239	0.679918	0.137363	75.83333	6.157522
113	Oluw1975	10	6	36	34.9	36.8	30.2	28.4	15.8	13.8	11.8	2.6	2.9	D	0.349	0.368	0.302	0.284	0.095662	1.04934	0.164557	45.27221	6.605199
114	Oluw1975	10	7	36	32.8	34.1	28.8	24.6	14.4	12.6	10.6	2.6	2.9	D	0.328	0.341	0.288	0.246	0.084496	0.838808	0.180556	43.90244	6.605199

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
115	Oluw1975	10	8	36	36.5	39.4	34.2	28.5	18.2	16.4	14.8	2.6	2.9	D	0.365	0.394	0.342	0.285	0.104635	1.511996	0.142857	49.86301	6.605199
116	Oluw1975	10	9	36	29.5	32.5	26.5	22.8	14.8	12.8	10.8	2.5	2.8	C	0.295	0.325	0.265	0.228	0.068349	0.734729	0.168919	50.16949	6.157522
117	Oluw1975	10	10	36	21.5	24.6	18.4	16.5	16.4	14.6	12.4	2.5	2.8	C	0.215	0.246	0.184	0.165	0.036305	0.426499	0.152439	76.27907	6.157522
118	Oluw1975	10	11	36	48.3	52.4	42.3	29.4	19.8	18.4	16.6	2.6	3.2	D	0.483	0.524	0.423	0.294	0.183225	2.593358	0.131313	40.99379	8.042477
119	Oluw1975	11	1	36	54.5	56.2	51.4	29.4	18.6	16.6	14.6	2.6	3.4	D	0.545	0.562	0.514	0.294	0.233283	3.170451	0.139785	34.12844	9.079203
120	Oluw1975	11	2	36	47	51.4	44.1	28.8	17.5	15.4	13.4	2.6	3.1	D	0.47	0.514	0.441	0.288	0.173494	2.267966	0.148571	37.23404	7.547676
121	Oluw1975	11	3	36	26.4	28.2	24.4	22.6	14.8	12.6	10.6	2.6	2.9	C	0.264	0.282	0.244	0.226	0.054739	0.608183	0.175676	56.06061	6.605199
122	Oluw1975	11	4	36	54.2	56.1	50.2	28.8	18.4	16.6	14.5	2.6	3.2	D	0.542	0.561	0.502	0.288	0.230722	3.054453	0.141304	33.94834	8.042477
123	Oluw1975	11	5	36	50.5	54.4	48.4	29.5	18.5	16.4	14.2	2.6	3.2	D	0.505	0.544	0.484	0.295	0.200296	2.833684	0.140541	36.63366	8.042477
124	Oluw1975	12	1	36	44.7	48.6	40.2	29.4	18.6	16.4	14.2	2.6	2.9	D	0.447	0.486	0.402	0.294	0.15693	2.080309	0.139785	41.61074	6.605199
125	Oluw1975	12	2	36	17.3	19.8	15.2	13.3	12.4	10.4	8.4	2.4	2.6	S	0.173	0.198	0.152	0.133	0.023506	0.203263	0.193548	71.6763	5.309292
126	Oluw1975	12	3	36	41.2	48.1	40	23.2	18.2	16.1	14	2.6	2.9	D	0.412	0.481	0.4	0.232	0.133317	1.949814	0.142857	44.17476	6.605199
127	Oluw1975	12	4	36	32.4	36.6	28.4	26.4	17.6	15.6	13.6	2.6	2.9	D	0.324	0.366	0.284	0.264	0.082448	1.074674	0.147727	54.32099	6.605199
128	Oluw1975	12	5	36	23	26.2	20.6	18.6	16.8	14.4	12.4	2.5	2.8	C	0.23	0.262	0.206	0.186	0.041548	0.514563	0.14881	73.04348	6.157522
129	Oluw1975	12	6	36	27.7	29.6	25.5	21.4	16.8	14.8	12.8	2.5	2.6	C	0.277	0.296	0.255	0.214	0.060263	0.762357	0.14881	60.64982	5.309292
130	Oluw1975	12	7	36	33.2	35.4	28.8	26.2	18.2	16.2	14.2	2.6	2.9	D	0.332	0.354	0.288	0.262	0.08657	1.114863	0.142857	54.81928	6.605199
131	Oluw1975	12	8	36	20.5	24.5	18.4	16.5	14.6	12.8	10.8	2.8	2.8	C	0.205	0.245	0.184	0.165	0.033006	0.373094	0.191781	71.21951	6.157522
132	Oluw1975	12	9	36	24.4	28.6	20.2	18.4	16.8	14.8	12.8	2.5	2.8	C	0.244	0.286	0.202	0.184	0.046759	0.540255	0.14881	68.85246	6.157522
133	Oluw1975	12	10	36	25.2	29.4	21.3	19.2	16.8	14.4	12.6	2.5	2.8	C	0.252	0.294	0.213	0.192	0.049876	0.574489	0.14881	66.66667	6.157522
134	Oluw1975	12	11	36	29	32.2	26.4	24.2	16.6	14.6	12.8	2.5	2.8	C	0.29	0.322	0.264	0.242	0.066052	0.842872	0.150602	57.24138	6.157522
135	Oluw1975	12	12	36	18.5	24.6	16.4	14.5	14.8	12.4	10.2	2.5	2.8	C	0.185	0.246	0.164	0.145	0.02688	0.306979	0.168919	80	6.157522
136	Oluw1975	12	13	36	22.5	26.4	20.5	18.5	15.6	13.6	11.8	2.5	2.8	C	0.225	0.264	0.205	0.185	0.039761	0.484262	0.160256	69.33333	6.157522
137	Oluw1975	12	14	36	23.1	27.4	19.2	17.6	16.4	14.4	12.2	2.5	2.8	C	0.231	0.274	0.192	0.176	0.04191	0.477851	0.152439	70.99567	6.157522
138	Oluw1975	13	1	36	27.7	29.6	25.4	21.2	16.8	14.8	12.4	2.5	2.8	C	0.277	0.296	0.254	0.212	0.060263	0.756762	0.14881	60.64982	6.157522
139	Oluw1975	13	2	36	25.1	27.2	19.1	17.4	15.6	13.8	16.8	2.5	2.8	C	0.251	0.272	0.191	0.174	0.049481	0.451936	0.160256	62.15139	6.157522
140	Oluw1975	13	3	36	51.7	54.6	44.8	28.9	19.6	17.6	15.8	2.6	3.2	D	0.517	0.546	0.448	0.289	0.209928	2.728784	0.132653	37.91103	8.042477
141	Oluw1975	13	4	36	46.4	48.8	42.2	26.4	18.5	16.8	14.6	2.6	3.1	D	0.464	0.488	0.422	0.264	0.169093	2.243484	0.140541	39.87069	7.547676
142	Oluw1975	13	5	36	21.5	26.4	19.5	17.5	16.6	14.6	12.8	2.5	2.8	C	0.215	0.264	0.195	0.175	0.036305	0.482411	0.150602	77.2093	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
143	Oluw1975	13	6	36	31.6	34.6	28.5	24.6	18.4	16.4	14.2	2.6	2.9	D	0.316	0.346	0.285	0.246	0.078427	1.084395	0.141304	58.22785	6.605199
144	Oluw1975	13	7	36	23.3	26.4	21.4	19.3	14.6	12.6	10.8	2.5	2.8	C	0.233	0.264	0.214	0.193	0.042638	0.47852	0.171233	62.66094	6.157522
145	Oluw1975	13	8	36	24.9	26.8	21.6	18.8	14.8	12.8	10.9	2.5	2.8	C	0.249	0.268	0.216	0.188	0.048695	0.492253	0.168919	59.43775	6.157522
146	Oluw1975	13	9	36	15.5	18.6	13.6	11.5	12.6	10.6	8.7	2.4	2.6	S	0.155	0.186	0.136	0.115	0.018869	0.169009	0.190476	81.29032	5.309292
147	Oluw1975	13	10	36	37	39.2	32.4	26.4	18.8	16.8	14.8	2.6	2.9	D	0.37	0.392	0.324	0.264	0.107521	1.414611	0.138298	50.81081	6.605199
148	Oluw1975	13	11	36	40	44.1	38.2	28.8	19.6	17.6	15.6	2.6	3.1	D	0.4	0.441	0.382	0.288	0.125664	1.98388	0.132653	49	7.547676
149	Oluw1975	13	12	36	20	24.4	18.2	16.4	14.8	12.8	10.8	2.5	2.8	C	0.2	0.244	0.182	0.164	0.031416	0.366817	0.168919	74	6.157522
150	Oluw1975	13	13	36	52.3	56.2	48.1	29.8	19.8	18.6	16.8	2.6	3.2	D	0.523	0.562	0.481	0.298	0.214829	3.238421	0.131313	37.85851	8.042477
151	Oluw1975	13	14	36	42.4	46.5	38.4	20.4	18.4	16.3	14.3	2.6	3.1	D	0.424	0.465	0.384	0.204	0.141196	1.808633	0.141304	43.39623	7.547676
152	Oluw1975	14	1	36	42.6	44.4	40.2	29.8	19.4	17.4	15.2	2.6	3.1	D	0.426	0.444	0.402	0.298	0.142531	2.123585	0.134021	45.53991	7.547676
153	Oluw1975	14	2	36	37	39.1	34.3	26.4	18.8	16.6	14.8	2.6	2.9	D	0.37	0.391	0.343	0.264	0.107521	1.50622	0.138298	50.81081	6.605199
154	Oluw1975	14	3	36	19	22.6	17.2	15.1	14.4	12.4	10.2	2.4	2.6	S	0.19	0.226	0.172	0.151	0.028353	0.311992	0.166667	75.78947	5.309292
155	Oluw1975	14	4	36	26.9	28.4	24.5	22.3	16.2	14.2	12.2	2.5	2.8	C	0.269	0.284	0.245	0.223	0.056832	0.688648	0.154321	60.22305	6.157522
156	Oluw1975	14	5	36	22.5	26.6	20.4	18.5	14.4	12.4	10.4	2.5	2.8	C	0.225	0.266	0.204	0.185	0.039761	0.440598	0.173611	64	6.157522
157	Oluw1975	14	6	36	17.3	19.6	15.3	13.4	14.4	12.2	10.2	2.4	2.6	S	0.173	0.196	0.153	0.134	0.023506	0.239559	0.166667	83.23699	5.309292
158	Oluw1975	14	7	36	45.2	47.3	41.2	28.8	18.8	16.8	14.8	2.6	3.2	D	0.452	0.473	0.412	0.288	0.16046	2.167555	0.138298	41.59292	8.042477
159	Oluw1975	14	8	36	18	24.2	16.1	14	13.6	11.8	9.6	2.4	2.8	S	0.18	0.242	0.161	0.14	0.025447	0.280885	0.176471	75.55556	6.157522
160	Oluw1975	14	9	36	31.2	34.2	26.8	24.2	15.8	13.8	11.8	2.6	2.9	D	0.312	0.342	0.268	0.242	0.076454	0.836053	0.164557	50.64103	6.605199
161	Oluw1975	14	10	36	35.1	37.1	32.4	26.8	17.6	15.8	13.8	2.6	2.9	D	0.351	0.371	0.324	0.268	0.096762	1.301671	0.147727	50.14245	6.605199
162	Oluw1975	14	11	36	20.5	22.6	18.4	16.5	14.6	12.6	10.6	2.5	2.8	C	0.205	0.226	0.184	0.165	0.033006	0.352504	0.171233	71.21951	6.157522
163	Oluw1975	14	12	36	53.7	56.2	50.6	29.7	20.4	18.2	16.1	2.6	3.2	D	0.537	0.562	0.506	0.297	0.226484	3.4025	0.127451	37.98883	8.042477
164	Oluw1975	15	1	36	51	52.4	48.2	28.9	19.6	17.6	15.6	2.6	3.2	D	0.51	0.524	0.482	0.289	0.204282	2.965941	0.132653	38.43137	8.042477
165	Oluw1975	15	2	36	41.5	44.6	38.4	27.8	18.4	16.2	14.2	2.6	3.1	D	0.415	0.446	0.384	0.278	0.135265	1.836469	0.141304	44.33735	7.547676
166	Oluw1975	15	3	36	50.5	52.2	42.4	29.8	19.2	17.2	15.2	2.6	3.2	D	0.505	0.522	0.424	0.298	0.200296	2.432475	0.135417	38.0198	8.042477
167	Oluw1975	15	4	36	37.7	39.6	34.6	26.4	19.4	17.4	15.4	2.6	2.9	D	0.377	0.396	0.346	0.264	0.111628	1.606603	0.134021	51.45889	6.605199
168	Oluw1975	15	5	36	27.7	34.4	25.6	22.8	15.6	13.6	11.6	2.5	2.8	C	0.277	0.344	0.256	0.228	0.060263	0.769888	0.160256	56.31769	6.157522
169	Oluw1975	15	6	36	42.3	46.6	38.4	26.8	18.4	16.4	14.4	2.6	3.1	D	0.423	0.466	0.384	0.268	0.140531	1.886577	0.141304	43.49882	7.547676
170	Oluw1975	15	7	36	47.8	49.4	44.8	29.4	18.6	16.6	14.8	2.6	3.2	D	0.478	0.494	0.448	0.294	0.179451	2.462561	0.139785	38.91213	8.042477

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
171	Oluw1975	15	8	36	26.8	29.6	24.6	22.8	16.6	14.6	12.6	2.5	2.8	C	0.268	0.296	0.246	0.228	0.05641	0.729412	0.150602	61.9403	6.157522
172	Oluw1975	15	9	36	40.3	42.3	38.4	26.6	17.8	15.8	13.8	2.6	3.1	D	0.403	0.423	0.384	0.266	0.127556	1.736285	0.146067	44.16873	7.547676
173	Oluw1975	15	10	36	41.4	44.8	36.6	29.4	18.2	16.2	14.2	2.6	3.1	D	0.414	0.448	0.366	0.294	0.134614	1.745157	0.142857	43.96135	7.547676
174	Oluw1975	16	1	36	30.9	32.8	28.6	24.6	16.8	14.6	12.6	2.6	2.9	D	0.309	0.328	0.286	0.246	0.074991	0.946555	0.154762	54.36893	6.605199
175	Oluw1975	16	2	36	41.8	44.8	36.4	28.9	18.6	16.8	14.6	2.6	3.1	D	0.418	0.448	0.364	0.289	0.137228	1.790539	0.139785	44.49761	7.547676
176	Oluw1975	16	3	36	47	50.2	44.6	29.8	19.2	17.2	15.2	2.6	3.1	D	0.47	0.502	0.446	0.298	0.173494	2.558738	0.135417	40.85106	7.547676
177	Oluw1975	16	4	36	18	22.4	16.2	14.1	12.4	10.4	8.2	2.4	2.6	S	0.18	0.224	0.162	0.141	0.025447	0.238282	0.193548	68.88889	5.309292
178	Oluw1975	16	5	36	21.5	25.6	19.4	16.8	14.6	12.6	10.6	2.5	2.8	C	0.215	0.256	0.194	0.168	0.036305	0.402939	0.171233	67.90698	6.157522
179	Oluw1975	16	6	36	32	34.6	28.6	24.8	17.8	15.6	13.4	2.5	2.8	C	0.32	0.346	0.286	0.248	0.080425	1.038179	0.140449	55.625	6.157522
180	Oluw1975	16	7	36	39	42.1	36.4	27.6	18.2	16.2	14.2	2.6	2.9	D	0.39	0.421	0.364	0.276	0.119459	1.661261	0.142857	46.66667	6.605199
181	Oluw1975	16	8	36	28.8	32.6	26.6	24.4	15.8	13.8	11.8	2.5	2.8	C	0.288	0.326	0.266	0.244	0.065144	0.810784	0.158228	54.86111	6.157522
182	Oluw1975	16	9	36	49.2	52.4	46.1	28.9	18.8	16.8	14.9	2.6	2.9	D	0.492	0.524	0.461	0.289	0.190117	2.656929	0.138298	38.21138	6.605199
183	Oluw1976	17	1	35	35.5	37.6	32.4	22.2	20.5	18.4	16.6	2.6	2.9	D	0.355	0.376	0.324	0.222	0.09898	1.470577	0.126829	57.74648	6.605199
184	Oluw1976	17	2	35	35	37.8	31.8	22.4	20.2	18.2	16.4	2.6	2.9	D	0.35	0.378	0.318	0.224	0.096211	1.423602	0.128713	57.71429	6.605199
185	Oluw1976	17	3	35	10	12.8	8.6	6.2	15.2	13.6	11.8	2.4	2.6	S	0.1	0.128	0.086	0.062	0.007854	0.088677	0.157895	152	5.309292
186	Oluw1976	17	4	35	17	19.8	15.4	12.4	17.2	14.8	12.4	2.5	2.8	C	0.17	0.198	0.154	0.124	0.022698	0.28952	0.145349	101.1765	6.157522
187	Oluw1976	17	5	35	14.5	16.6	12.2	10.5	14.6	12.3	10.6	2.5	2.8	C	0.145	0.166	0.122	0.105	0.016513	0.157975	0.171233	100.6897	6.157522
188	Oluw1976	17	6	35	42.5	44.8	38.4	26.1	22.8	20.5	18.4	2.6	3.1	D	0.425	0.448	0.384	0.261	0.141863	2.304136	0.114035	53.64706	7.547676
189	Oluw1976	17	7	35	19.5	21.6	16.8	14.2	17.8	15.6	13.2	2.5	2.8	C	0.195	0.216	0.168	0.142	0.029865	0.366986	0.140449	91.28205	6.157522
190	Oluw1976	17	8	35	18.5	22.2	16.4	14.1	16.6	14.8	12.6	2.5	2.8	C	0.185	0.222	0.164	0.141	0.02688	0.342419	0.150602	89.72973	6.157522
191	Oluw1976	17	9	35	16.3	18.4	14.2	12.4	15.8	13.4	11.2	2.5	2.8	C	0.163	0.184	0.142	0.124	0.020867	0.227831	0.158228	96.93252	6.157522
192	Oluw1976	17	10	35	30.9	32.8	28.4	20.6	18.6	16.8	14.9	2.5	2.9	D	0.309	0.328	0.284	0.206	0.074991	1.039398	0.134409	60.19417	6.605199
193	Oluw1976	17	11	35	25.9	27.8	22.6	18.4	16.4	14.8	12.6	2.5	2.8	C	0.259	0.278	0.226	0.184	0.052685	0.611115	0.152439	63.32046	6.157522
194	Oluw1976	17	12	35	21.2	24.2	18.4	16.8	17.2	14.4	12.2	2.5	2.8	C	0.212	0.242	0.184	0.168	0.035299	0.41886	0.145349	81.13208	6.157522
195	Oluw1976	17	13	35	33.3	36.4	28.6	24.6	18.4	15.6	13.8	2.6	2.9	D	0.333	0.364	0.286	0.246	0.087092	1.062259	0.141304	55.25526	6.605199
196	Oluw1976	17	14	35	34.5	36.8	28.8	24.6	18.6	13.8	11.9	2.6	2.9	D	0.345	0.368	0.288	0.246	0.093482	0.953275	0.139785	53.91304	6.605199
197	Oluw1976	17	15	35	26	28.2	24.1	20.2	16.4	14.6	12.8	2.6	2.9	D	0.26	0.282	0.241	0.202	0.053093	0.673966	0.158537	63.07692	6.605199
198	Oluw1976	17	16	35	26.7	28.8	24.2	20.4	16.2	14.2	12.4	2.6	2.9	D	0.267	0.288	0.242	0.204	0.05599	0.666958	0.160494	60.67416	6.605199

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
199	Oluw1976	17	17	35	18.5	22.4	16.4	12.8	14.8	12.6	10.4	2.5	2.8	C	0.185	0.224	0.164	0.128	0.02688	0.287222	0.168919	80	6.157522
200	Oluw1976	17	18	35	27.5	30.2	25.2	20.5	16.4	14.3	12.6	2.6	2.9	D	0.275	0.302	0.252	0.205	0.059396	0.724871	0.158537	59.63636	6.605199
201	Oluw1976	17	19	35	41	42.6	36.4	28.4	18.8	16.6	14.8	2.6	3.1	D	0.41	0.426	0.364	0.284	0.132025	1.721217	0.138298	45.85366	7.547676
202	Oluw1976	17	20	35	35	38.8	28.9	24.2	17.6	15.8	13.9	2.6	2.9	D	0.35	0.388	0.289	0.242	0.096211	1.123438	0.147727	50.28571	6.605199
203	Oluw1976	17	22	35	32.7	34.8	28.4	22.8	16.6	14.8	12.2	2.6	2.9	D	0.327	0.348	0.284	0.228	0.083982	0.960351	0.156627	50.76453	6.605199
204	Oluw1976	18	1	35	21.5	23.6	18.8	17.2	15.6	13.8	11.7	2.5	2.8	C	0.215	0.236	0.188	0.172	0.036305	0.409435	0.160256	72.55814	6.157522
205	Oluw1976	18	2	35	17.4	20.4	15.6	13.4	18.4	16.2	8.8	2.5	2.8	C	0.174	0.204	0.156	0.134	0.023779	0.332752	0.13587	105.7471	6.157522
206	Oluw1976	18	3	35	30	32.6	26.4	21.4	18.6	16.4	14.2	2.6	2.9	D	0.3	0.326	0.264	0.214	0.070686	0.924942	0.139785	62	6.605199
207	Oluw1976	18	4	35	45	47.4	42.2	28.6	16.6	14.8	12.6	2.6	3.1	D	0.45	0.474	0.422	0.286	0.159043	1.973752	0.156627	36.88889	7.547676
208	Oluw1976	18	5	35	49	52.1	44.4	28.8	18.6	16.8	14.9	2.6	3.1	D	0.49	0.521	0.444	0.288	0.188574	2.513432	0.139785	37.95918	7.547676
209	Oluw1976	18	6	35	22.5	24.6	18.5	16.4	12.6	10.8	8.6	2.5	2.8	C	0.225	0.246	0.185	0.164	0.039761	0.317114	0.198413	56	6.157522
210	Oluw1976	18	7	35	20.3	22.4	18.6	16.3	14.8	12.6	10.6	2.5	2.8	C	0.203	0.224	0.186	0.163	0.032365	0.35482	0.168919	72.9064	6.157522
211	Oluw1976	18	8	35	18	22.6	16.4	14.2	13.8	11.6	9.4	2.4	2.6	S	0.18	0.226	0.164	0.142	0.025447	0.271533	0.173913	76.66667	5.309292
212	Oluw1976	18	9	35	25.1	27.4	22.6	18.4	15.6	13.8	11.8	2.5	2.8	C	0.251	0.274	0.226	0.184	0.049481	0.565834	0.160256	62.15139	6.157522
213	Oluw1976	18	10	35	24.1	26.4	20.6	16.8	14.8	12.8	10.6	2.5	2.8	C	0.241	0.264	0.206	0.168	0.045617	0.448475	0.168919	61.41079	6.157522
214	Oluw1976	18	11	35	21	24.2	18.6	14.4	13.8	11.4	9.1	2.5	2.8	C	0.21	0.242	0.186	0.144	0.034636	0.32484	0.181159	65.71429	6.157522
215	Oluw1976	18	12	35	27.8	29.6	23.8	18.4	14.6	12.8	10.9	2.6	3	D	0.278	0.296	0.238	0.184	0.060699	0.58316	0.178082	52.51799	7.068583
216	Oluw1976	18	13	35	42.4	44.2	38.4	28.8	18.8	16.6	14.8	2.6	3.1	D	0.424	0.442	0.384	0.288	0.141196	1.886394	0.138298	44.33962	7.547676
217	Oluw1976	18	14	35	26.4	28.6	24.2	20.4	14.8	12.6	10.8	2.6	2.9	D	0.264	0.286	0.242	0.204	0.054739	0.589915	0.175676	56.06061	6.605199
218	Oluw1976	19	1	35	21.9	23.8	18.8	14.4	15.6	13.8	11.6	2.5	2.8	C	0.219	0.238	0.188	0.144	0.037668	0.395164	0.160256	71.23288	6.157522
219	Oluw1976	19	2	35	21.1	23.4	18.4	14.2	14.6	12.5	10.2	2.5	2.8	C	0.211	0.234	0.184	0.142	0.034967	0.344175	0.171233	69.19431	6.157522
220	Oluw1976	19	3	35	30.4	32.5	28.6	24.8	16.8	14.6	12.8	2.6	2.9	D	0.304	0.325	0.286	0.248	0.072583	0.944699	0.154762	55.26316	6.605199
221	Oluw1976	19	4	35	20	23.6	18.4	16.2	14.8	12.8	10.4	2.5	2.8	C	0.2	0.236	0.184	0.162	0.031416	0.364197	0.168919	74	6.157522
222	Oluw1976	19	5	35	36.5	38.6	32.4	28.4	18.8	16.4	14.6	2.6	2.9	D	0.365	0.386	0.324	0.284	0.104635	1.394438	0.138298	51.50685	6.605199
223	Oluw1976	19	6	35	37.7	39.8	33.6	28.8	18.4	16.6	14.4	2.6	2.9	D	0.377	0.398	0.336	0.288	0.111628	1.505696	0.141304	48.80637	6.605199
224	Oluw1976	19	7	35	27.2	29.4	24.8	21.3	17.8	15.4	13.8	2.6	2.9	D	0.272	0.294	0.248	0.213	0.058107	0.761632	0.146067	65.44118	6.605199
225	Oluw1976	19	8	35	43	46.2	38.8	29.4	18.4	16.8	14.8	2.6	3.1	D	0.43	0.462	0.388	0.294	0.14522	1.983725	0.141304	42.7907	7.547676
226	Oluw1976	19	10	35	17	21.4	15.2	13.8	12.6	10.8	8.9	2.4	2.6	S	0.17	0.214	0.152	0.138	0.022698	0.222315	0.190476	74.11765	5.309292
227	Oluw1976	19	12	35	38.2	42.4	36.4	29.4	18.6	16.8	14.6	2.6	2.9	D	0.382	0.424	0.364	0.294	0.114608	1.750926	0.139785	48.6911	6.605199

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
228	Oluw1976	19	13	35	31.6	33.4	28.2	24.4	18.4	16.4	14.1	2.6	2.9	D	0.316	0.334	0.282	0.244	0.078427	1.050167	0.141304	58.22785	6.605199
229	Oluw1976	19	14	35	12	14.8	10.2	8.1	14.6	12.8	10.4	2.5	2.8	C	0.12	0.148	0.102	0.081	0.01131	0.117422	0.171233	121.6667	6.157522
230	Oluw1976	19	16	35	31.6	33.4	28.2	24.4	17.8	15.6	13.8	2.6	2.9	D	0.316	0.334	0.282	0.244	0.078427	0.998939	0.146067	56.32911	6.605199
231	Oluw1976	19	17	35	24.7	28.4	22.4	18.9	14.8	12.4	10.6	2.5	2.8	C	0.247	0.284	0.224	0.189	0.047916	0.514672	0.168919	59.91903	6.157522
232	Oluw1976	20	1	35	31.5	33.8	28.4	24.2	18.6	16.4	14.2	2.6	2.9	D	0.315	0.338	0.284	0.242	0.077931	1.063571	0.139785	59.04762	6.605199
233	Oluw1976	20	2	35	17	20.4	15.4	13.2	12.6	10.8	8.6	2.4	2.6	S	0.17	0.204	0.154	0.132	0.022698	0.217577	0.190476	74.11765	5.309292
234	Oluw1976	20	3	35	26.7	28.8	24.6	22.6	16.6	14.8	12.6	2.5	2.8	C	0.267	0.288	0.246	0.226	0.05599	0.728593	0.150602	62.17228	6.157522
235	Oluw1976	20	4	35	44.6	48.2	41.4	28.8	18.6	16.8	14.8	2.6	3.2	D	0.446	0.482	0.414	0.288	0.156228	2.200989	0.139785	41.70404	8.042477
236	Oluw1976	20	5	35	12.1	16.2	10.2	8.6	11.8	9.6	7.2	2.4	2.6	S	0.121	0.162	0.102	0.086	0.011499	0.094569	0.20339	97.52066	5.309292
237	Oluw1976	20	6	35	13.8	15.9	11.2	9.6	11.6	9.4	7.2	2.4	2.6	S	0.138	0.159	0.112	0.096	0.014957	0.104186	0.206897	84.05797	5.309292
238	Oluw1976	20	7	35	36.3	38.6	34.2	28.2	16.8	14.7	12.8	2.6	2.9	D	0.363	0.386	0.342	0.282	0.103491	1.339984	0.154762	46.28099	6.605199
239	Oluw1976	20	8	35	18.7	21.4	16.6	14.7	12.4	10.6	8.4	2.4	2.6	S	0.187	0.214	0.166	0.147	0.027465	0.246467	0.193548	66.31016	5.309292
240	Oluw1976	20	9	35	21.2	24.2	18.4	15.4	14.6	12.8	10.6	2.5	2.8	C	0.212	0.242	0.184	0.154	0.035299	0.364767	0.171233	68.86792	6.157522
241	Oluw1976	20	10	35	33	36.4	30.2	27.8	17.6	15.5	13.6	2.6	2.9	D	0.33	0.364	0.302	0.278	0.08553	1.165824	0.147727	53.33333	6.605199
242	Oluw1976	20	11	35	28	32.4	25.8	23.4	16.8	14.2	12.1	2.5	2.8	C	0.28	0.324	0.258	0.234	0.061575	0.791816	0.14881	60	6.157522
243	Oluw1976	20	12	35	16.5	18.8	14.4	12.2	14.6	12.8	10.9	2.5	2.8	C	0.165	0.188	0.144	0.122	0.021382	0.223132	0.171233	88.48485	6.157522
244	Oluw1976	20	13	35	14	16.4	12.2	10.1	12.8	10.6	8.8	2.4	2.6	S	0.14	0.164	0.122	0.101	0.015394	0.134082	0.1875	91.42857	5.309292
245	Oluw1976	20	14	35	26.4	28.8	22.8	18.4	19.2	15.6	13.4	2.6	2.8	C	0.264	0.288	0.228	0.184	0.054739	0.663122	0.135417	72.72727	6.157522
246	Oluw1976	20	15	35	20.5	22.6	18.2	16.1	16.6	14.8	12.4	2.5	2.8	C	0.205	0.226	0.182	0.161	0.033006	0.405854	0.150602	80.97561	6.157522
247	Oluw1976	20	16	35	31.3	33.4	28.4	22.6	18.8	16.4	14.6	2.6	2.9	D	0.313	0.334	0.284	0.226	0.076945	1.041726	0.138298	60.0639	6.605199
248	Oluw1976	20	17	35	21.5	23.6	18.5	16.4	14.6	12.8	10.4	2.5	2.8	C	0.215	0.236	0.185	0.164	0.036305	0.367762	0.171233	67.90698	6.157522
249	Oluw1976	20	18	35	11	13.2	9.2	7.1	12.6	10.8	8.9	2.4	2.6	S	0.11	0.132	0.092	0.071	0.009503	0.079622	0.190476	114.5455	5.309292
250	Oluw1976	20	19	35	16	19.4	14.1	12.2	14.9	12.8	10.4	2.5	2.8	C	0.16	0.194	0.141	0.122	0.020106	0.221242	0.167785	93.125	6.157522
251	Oluw1976	20	20	35	14.9	16.8	12.4	10.8	12.6	10.6	8.9	2.4	2.6	S	0.149	0.168	0.124	0.108	0.017437	0.140685	0.190476	84.56376	5.309292
252	Oluw1976	20	21	35	30	32.4	28.4	24.44	16.6	14.8	12.4	2.6	2.9	D	0.3	0.324	0.284	0.2444	0.070686	0.944115	0.156627	55.33333	6.605199
253	Oluw1976	20	22	35	9.2	11.4	7.1	5.2	12.8	10.6	8	2.4	2.6	S	0.092	0.114	0.071	0.052	0.006648	0.049763	0.1875	139.1304	5.309292
254	Oluw1976	20	23	35	13.1	15.3	11.4	9.2	11.6	9.5	7.2	2.4	2.6	S	0.131	0.153	0.114	0.092	0.013478	0.10428	0.206897	88.54962	5.309292
255	Oluw1976	20	24	35	15.4	19.2	13.4	11.2	12.8	10.8	8.4	2.4	2.6	S	0.154	0.192	0.134	0.112	0.018627	0.171388	0.1875	83.11688	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
256	Oluw1976	20	25	35	14.5	18.4	12.5	10.6	12.6	10.6	8.1	2.4	2.6	S	0.145	0.184	0.125	0.106	0.016513	0.149288	0.190476	86.89655	5.309292
257	Oluw1976	20	26	35	18	22.1	16.1	14.2	12.8	10.4	8.6	2.4	2.6	S	0.18	0.221	0.161	0.142	0.025447	0.235091	0.1875	71.11111	5.309292
258	Oluw1976	20	27	35	25.1	27.8	23.6	20.1	14.8	12.6	10.8	2.5	2.8	C	0.251	0.278	0.236	0.201	0.049481	0.561548	0.168919	58.96414	6.157522
259	Oluw1976	20	28	35	26.3	28.8	24.2	21.4	14.6	12.8	10.9	2.5	2.8	C	0.263	0.288	0.242	0.214	0.054325	0.608206	0.171233	55.51331	6.157522
260	Oluw1976	20	29	35	21.1	24.2	19.2	17.1	14.6	12.6	10.6	2.5	2.8	C	0.211	0.242	0.192	0.171	0.034967	0.388024	0.171233	69.19431	6.157522
261	Oluw1976	20	30	35	19.2	23.4	17.2	15.2	11.4	9.8	7.4	2.4	2.6	S	0.192	0.234	0.172	0.152	0.028953	0.251684	0.210526	59.375	5.309292
262	Oluw1976	20	31	35	16.7	18.8	14.4	12.2	11.5	9.8	7.8	2.4	2.6	S	0.167	0.188	0.144	0.122	0.021904	0.170835	0.208696	68.86228	5.309292
263	Oluw1976	20	32	35	15.2	19.4	13.1	10.3	12.2	10.4	8.1	2.4	2.6	S	0.152	0.194	0.131	0.103	0.018146	0.159128	0.196721	80.26316	5.309292
264	Oluw1976	20	33	35	24.4	28.6	20.6	18.4	12.8	10.6	10.8	2.5	2.8	C	0.244	0.286	0.206	0.184	0.046759	0.395997	0.195313	52.45902	6.157522
265	Oluw1976	20	34	35	48.5	50.2	42.4	30.5	18.9	16.8	14.9	2.6	3.2	D	0.485	0.502	0.424	0.305	0.184745	2.340151	0.137566	38.96907	8.042477
266	Oluw1976	20	35	35	25.7	27.8	23.4	21.7	16.3	14.5	12.2	2.5	2.8	C	0.257	0.278	0.234	0.217	0.051875	0.651783	0.153374	63.42412	6.157522
267	Oluw1976	20	36	35	20.6	22.4	18.4	14.8	12.8	10.6	8.4	2.4	2.6	S	0.206	0.224	0.184	0.148	0.033329	0.287919	0.1875	62.13592	5.309292
268	Oluw1976	20	37	35	38.1	39.4	32.6	28.1	15.8	13.8	11.8	2.5	2.8	C	0.381	0.394	0.326	0.281	0.114009	1.190972	0.158228	41.46982	6.157522
269	Oluw1976	21	1	35	26.2	28.4	24.1	20.8	15.6	13.8	11.8	2.5	2.8	C	0.262	0.284	0.241	0.208	0.053913	0.643525	0.160256	59.54198	6.157522
270	Oluw1976	21	2	35	18.4	22.6	16.4	14.2	13.4	11.2	9.1	2.4	2.6	S	0.184	0.226	0.164	0.142	0.02659	0.26217	0.179104	72.82609	5.309292
271	Oluw1976	21	3	35	25.5	27.8	23.4	21.4	16.8	14.4	12.2	2.5	2.8	C	0.255	0.278	0.234	0.214	0.051071	0.644851	0.14881	65.88235	6.157522
272	Oluw1976	21	4	35	13.5	15.6	11.4	9.6	11.6	9.8	7.8	2.4	2.6	S	0.135	0.156	0.114	0.096	0.014314	0.109727	0.206897	85.92593	5.309292
273	Oluw1976	21	5	35	18	22.1	16.2	14.4	12.8	10.4	8.2	2.4	2.6	S	0.18	0.221	0.162	0.144	0.025447	0.237629	0.1875	71.11111	5.309292
274	Oluw1976	21	6	35	16.5	19.4	14.4	12.2	12.6	10.3	8.1	2.4	2.6	S	0.165	0.194	0.144	0.122	0.021382	0.182642	0.190476	76.36364	5.309292
275	Oluw1976	21	7	35	18.3	21.6	16.2	14.2	11.6	9.8	7.8	2.5	2.8	C	0.183	0.216	0.162	0.142	0.026302	0.220383	0.215517	63.38798	6.157522
276	Oluw1976	21	9	35	38.5	41.6	36.4	28.8	16.6	14.8	12.4	2.6	2.9	D	0.385	0.416	0.364	0.288	0.116416	1.522699	0.156627	43.11688	6.605199
277	Oluw1976	21	10	35	18	22.2	16.1	14.2	12.6	10.8	8.2	2.5	2.8	C	0.18	0.222	0.161	0.142	0.025447	0.24476	0.198413	70	6.157522
278	Oluw1976	21	11	35	14	18.2	12.2	10.1	11.8	9.9	7.6	2.4	2.6	S	0.14	0.182	0.122	0.101	0.015394	0.133298	0.20339	84.28571	5.309292
279	Oluw1976	21	12	35	29.5	33.4	26.4	22.5	14.8	12.6	10.4	2.5	2.8	C	0.295	0.334	0.264	0.225	0.068349	0.7273	0.168919	50.16949	6.157522
280	Oluw1976	21	13	35	24.5	26.6	22.3	20.4	14.6	12.4	10.1	2.5	2.8	C	0.245	0.266	0.223	0.204	0.047144	0.505269	0.171233	59.59184	6.157522
281	Oluw1976	21	14	35	39.5	42.6	36.8	28.1	18.4	16.6	14.8	2.6	2.9	D	0.395	0.426	0.368	0.281	0.122542	1.742983	0.141304	46.58228	6.605199
282	Oluw1976	21	15	35	13	16.4	11.2	9	11.5	9.6	7.8	2.4	2.6	S	0.13	0.164	0.112	0.09	0.013273	0.10703	0.208696	88.46154	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
283	Oluw1976	21	16	35	22.5	26.1	20.4	18.5	14.6	12.8	10.4	2.5	2.8	C	0.225	0.261	0.204	0.185	0.039761	0.450395	0.171233	64.88889	6.157522
284	Oluw1976	21	17	35	27.6	29.6	25.4	23.6	14.8	12.9	10.8	2.5	2.8	C	0.276	0.296	0.254	0.236	0.059828	0.677766	0.168919	53.62319	6.157522
285	Oluw1976	21	18	35	38.2	40.1	36.4	28.8	16.6	14.8	12.9	2.6	2.9	D	0.382	0.401	0.364	0.288	0.114608	1.498957	0.156627	43.4555	6.605199
286	Oluw1976	21	19	35	14.6	16.8	12.4	10.4	12.5	10.4	8.1	2.4	2.6	S	0.146	0.168	0.124	0.104	0.016742	0.136876	0.192	85.61644	5.309292
287	Oluw1976	21	20	35	23.9	25.8	21.4	19.8	14.8	12.6	10.2	2.5	2.8	C	0.239	0.258	0.214	0.198	0.044863	0.476579	0.168919	61.92469	6.157522
288	Oluw1976	21	21	35	11.2	13.4	9.1	7.8	11.6	9.8	7.8	2.4	2.6	S	0.112	0.134	0.091	0.078	0.009852	0.073331	0.206897	103.5714	5.309292
289	Oluw1976	21	22	35	14.6	18.2	12.4	10.2	12.4	10.6	8.2	2.4	2.6	S	0.146	0.182	0.124	0.102	0.016742	0.145736	0.193548	84.93151	5.309292
290	Oluw1976	21	23	35	32.2	34.6	28.2	24.1	16.8	14.6	12.2	2.6	2.9	D	0.322	0.346	0.282	0.241	0.081433	0.947719	0.154762	52.17391	6.605199
291	Oluw1976	21	24	35	16.3	18.8	14.2	12.2	12.8	10.4	0.2	2.4	2.6	S	0.163	0.188	0.142	0.122	0.020867	0.17818	0.1875	78.52761	5.309292
292	Oluw1976	21	25	35	24.3	26.6	28.8	18.4	14.6	12.6	10.2	2.5	2.8	C	0.243	0.266	0.288	0.184	0.046377	0.719751	0.171233	60.0823	6.157522
293	Oluw1976	21	26	35	29.7	32.8	27.4	23.6	14.6	12.8	10.8	2.5	2.8	C	0.297	0.328	0.274	0.236	0.069279	0.776742	0.171233	49.15825	6.157522
294	Oluw1976	21	27	35	24.2	28.6	22.6	20.2	13.8	11.6	9.9	2.5	2.8	C	0.242	0.286	0.226	0.202	0.045996	0.496383	0.181159	57.02479	6.157522
295	Oluw1976	21	28	35	27.3	30.2	24.8	21.4	14.6	12.8	10.9	2.5	2.8	C	0.273	0.302	0.248	0.214	0.058535	0.641749	0.171233	53.47985	6.157522
296	Oluw1976	21	29	35	26.5	28.4	24.2	20.1	14.8	12.6	10.8	2.5	2.8	C	0.265	0.284	0.242	0.201	0.055155	0.586031	0.168919	55.84906	6.157522
297	Oluw1976	21	30	35	12.6	14.6	10.4	8.8	12.8	10.4	8.1	2.4	2.6	S	0.126	0.146	0.104	0.088	0.012469	0.098459	0.1875	101.5873	5.309292
298	Oluw1976	21	31	35	31.1	33.4	27.6	24.2	16.6	14.8	12.4	2.6	2.9	D	0.311	0.334	0.276	0.242	0.075964	0.919884	0.156627	53.37621	6.605199
299	Oluw1976	21	32	35	12.1	14.4	10.6	8.9	11.6	9.5	7.2	2.4	2.6	S	0.121	0.144	0.106	0.089	0.011499	0.091526	0.206897	95.86777	5.309292
300	Oluw1976	22	1	35	20.1	22.4	18.2	16.1	14.6	12.4	10.2	2.5	2.8	C	0.201	0.224	0.182	0.161	0.031731	0.338579	0.171233	72.63682	6.157522
301	Oluw1976	22	2	35	22.8	24.3	20.6	18.8	14.8	12.6	10.4	2.5	2.8	C	0.228	0.243	0.206	0.188	0.040828	0.435651	0.168919	64.91228	6.157522
302	Oluw1976	22	3	35	17	19.2	15.2	13.1	13.8	11.6	9.6	2.5	2.8	C	0.17	0.192	0.152	0.131	0.022698	0.222361	0.181159	81.17647	6.157522
303	Oluw1976	22	4	35	23.6	26.4	20.2	18.2	14.6	12.8	10.8	2.5	2.8	C	0.236	0.264	0.202	0.182	0.043744	0.445748	0.171233	61.86441	6.157522
304	Oluw1976	22	5	35	23.1	26.2	20.1	18.2	14.6	12.8	10.6	2.5	2.8	C	0.231	0.262	0.201	0.182	0.04191	0.441284	0.171233	63.20346	6.157522
305	Oluw1976	22	7	35	12.5	15.4	10.2	8.5	12.6	10.8	8.4	2.4	2.6	S	0.125	0.154	0.102	0.085	0.012272	0.102575	0.190476	100.8	5.309292
306	Oluw1976	22	8	35	25.6	27.8	22.4	20.6	14.8	12.9	10.8	2.5	2.8	C	0.256	0.278	0.224	0.206	0.051472	0.54107	0.168919	57.8125	6.157522
307	Oluw1976	22	9	35	16.8	19.4	14.8	12.8	13.4	11.6	9.8	2.4	2.6	S	0.168	0.194	0.148	0.128	0.022167	0.215065	0.179104	79.7619	5.309292
308	Oluw1976	22	10	35	24.7	28.6	22.6	18.8	14.6	12.8	10.9	2.5	2.8	C	0.247	0.286	0.226	0.188	0.047916	0.538585	0.171233	59.10931	6.157522
309	Oluw1976	22	11	35	26.5	30.2	24.4	20.4	15.8	13.4	11.2	2.5	2.8	C	0.265	0.302	0.244	0.204	0.055155	0.650692	0.158228	59.62264	6.157522
310	Oluw1976	22	12	35	25.2	27.4	22.5	18.4	14.6	12.8	10.9	2.5	2.8	C	0.252	0.274	0.225	0.184	0.049876	0.521809	0.171233	57.93651	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
311	Oluw1976	22	13	35	15.5	18.6	13.8	11.5	13.4	11.2	9.1	2.4	2.6	S	0.155	0.186	0.138	0.115	0.018869	0.181789	0.179104	86.45161	5.309292
312	Oluw1976	22	14	35	28	32.2	24.8	22.4	14.8	12.4	10.2	2.5	2.8	C	0.28	0.322	0.248	0.224	0.061575	0.649061	0.168919	52.85714	6.157522
313	Oluw1976	22	15	35	30.6	34.4	26.6	24.6	15.6	13.8	11.9	2.6	2.9	D	0.306	0.344	0.266	0.246	0.073542	0.83434	0.166667	50.98039	6.605199
314	Oluw1976	22	17	35	27	29.4	25.4	22.4	14.8	12.6	10.8	2.5	2.8	C	0.27	0.294	0.254	0.224	0.057256	0.650953	0.168919	54.81481	6.157522
315	Oluw1976	22	18	35	42.4	44.8	36.8	28.8	18.6	16.4	14.2	2.6	3.2	D	0.424	0.448	0.368	0.288	0.141196	1.771811	0.139785	43.86792	8.042477
316	Oluw1976	22	19	35	23	26.2	20.4	18.1	15.6	13.4	10.2	2.5	2.8	C	0.23	0.262	0.204	0.181	0.041548	0.469857	0.160256	67.82609	6.157522
317	Oluw1976	22	20	35	33	36.4	28.6	24.4	16.8	14.6	12.8	2.6	2.9	D	0.33	0.364	0.286	0.244	0.08553	0.992292	0.154762	50.90909	6.605199
318	Oluw1976	22	21	35	26.6	28.8	24.4	22.8	14.4	12.6	10.8	2.5	2.8	C	0.266	0.288	0.244	0.228	0.055572	0.615321	0.173611	54.13534	6.157522
319	Oluw1976	22	22	35	23.5	27.4	20.6	18.4	15.4	13.4	11.2	2.5	2.8	C	0.235	0.274	0.206	0.184	0.043374	0.488813	0.162338	65.53191	6.157522
320	Oluw1976	22	23	35	20.3	22.5	18.3	16.2	13.6	11.8	9.6	2.5	2.8	C	0.203	0.225	0.183	0.162	0.032365	0.325644	0.183824	66.99507	6.157522
321	Oluw1976	22	24	35	27	29.6	25.1	23.1	14.8	12.8	10.9	2.5	2.8	C	0.27	0.296	0.251	0.231	0.057256	0.658446	0.168919	54.81481	6.157522
322	Oluw1976	22	25	35	16.6	18.8	14.4	12.2	13.6	11.4	9.6	2.5	2.8	C	0.166	0.188	0.144	0.122	0.021642	0.198727	0.183824	81.92771	6.157522
323	Oluw1976	22	26	35	27.4	30.2	25.6	23.4	14.8	12.8	10.8	2.5	2.8	C	0.274	0.302	0.256	0.234	0.058965	0.683785	0.168919	54.0146	6.157522
324	Oluw1976	22	27	35	43.2	45.4	38.9	28.4	18.4	16.2	14.1	2.6	3.1	D	0.432	0.454	0.389	0.284	0.146574	1.891672	0.141304	42.59259	7.547676
325	Oluw1976	22	28	35	20.9	22.8	18.8	16.6	14.6	12.6	10.4	2.5	2.8	C	0.209	0.228	0.188	0.166	0.034307	0.364365	0.171233	69.85646	6.157522
326	Oluw1976	22	29	35	17.5	19.6	15.6	13.4	13.6	11.4	9.2	2.4	2.6	S	0.175	0.196	0.156	0.134	0.024053	0.229384	0.176471	77.71429	5.309292
327	Oluw1976	23	1	35	33	36.2	30.8	24.6	16.8	14.8	12.6	2.6	2.9	D	0.33	0.362	0.308	0.246	0.08553	1.106238	0.154762	50.90909	6.605199
328	Oluw1976	23	2	35	27.3	29.4	24.2	21.3	14.6	12.8	10.4	2.5	2.8	C	0.273	0.294	0.242	0.213	0.058535	0.613341	0.171233	53.47985	6.157522
329	Oluw1976	23	3	35	36.8	28.6	34.2	26.4	17.6	15.6	13.4	2.6	2.9	D	0.368	0.286	0.342	0.264	0.106362	1.26473	0.147727	47.82609	6.605199
330	Oluw1976	23	4	35	30.2	32.2	28.1	22.4	14.8	12.8	10.9	2.5	2.8	C	0.302	0.322	0.281	0.224	0.071631	0.786997	0.168919	49.00662	6.157522
331	Oluw1976	23	5	35	36.5	38.4	32.4	24.8	16.9	14.9	12.9	2.6	2.9	D	0.365	0.384	0.324	0.248	0.104635	1.22654	0.153846	46.30137	6.605199
332	Oluw1976	23	6	35	29.5	31.5	27.6	22.4	14.6	12.6	10.8	2.5	2.8	C	0.295	0.315	0.276	0.224	0.068349	0.748972	0.171233	49.49153	6.157522
333	Oluw1976	23	7	35	33	36.4	28.4	23.4	16.8	14.8	12.4	2.6	2.9	D	0.33	0.364	0.284	0.234	0.08553	0.987791	0.154762	50.90909	6.605199
334	Oluw1976	23	8	35	45	46.4	40.6	28.6	18.6	16.8	14.4	2.6	3.2	D	0.45	0.464	0.406	0.286	0.159043	2.103313	0.139785	41.33333	8.042477
335	Oluw1976	23	9	35	19.8	22.8	17.4	15.8	14.4	12.2	10.1	2.5	2.8	C	0.198	0.228	0.174	0.158	0.030791	0.316284	0.173611	72.72727	6.157522
336	Oluw1976	23	10	35	21	24.6	19.4	17.2	14.6	12.8	10.6	2.5	2.8	C	0.21	0.246	0.194	0.172	0.034636	0.403203	0.171233	69.52381	6.157522
337	Oluw1976	23	11	35	18	22.1	16.1	14.2	13.8	11.4	9.6	2.5	2.8	C	0.18	0.221	0.161	0.142	0.025447	0.257696	0.181159	76.66667	6.157522
338	Oluw1976	23	12	35	29.5	31.4	27.6	21.8	14.6	12.6	10.8	2.5	2.8	C	0.295	0.314	0.276	0.218	0.068349	0.74356	0.171233	49.49153	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
339	Oluw1976	23	13	35	12.1	14.4	10.2	8.4	12.4	10.2	8.1	2.4	2.6	S	0.121	0.144	0.102	0.084	0.011499	0.092672	0.193548	102.4793	5.309292
340	Oluw1976	23	14	35	19.3	22.6	17.3	15.2	13.6	11.8	9.6	2.4	2.6	S	0.193	0.226	0.173	0.152	0.029255	0.299495	0.176471	70.46632	5.309292
341	Oluw1976	24	1	35	37	41.4	34.2	28.6	18.8	16.4	14.2	2.6	2.9	D	0.37	0.414	0.342	0.286	0.107521	1.547913	0.138298	50.81081	6.605199
342	Oluw1976	24	2	35	24.2	26.4	22.1	20.2	14.6	12.8	10.6	2.5	2.8	C	0.242	0.264	0.221	0.202	0.045996	0.51248	0.171233	60.33058	6.157522
343	Oluw1976	24	3	35	24.9	26.8	22.4	20.4	14.8	12.6	10.8	2.5	2.8	C	0.249	0.268	0.224	0.204	0.048695	0.518129	0.168919	59.43775	6.157522
344	Oluw1976	24	4	35	19.9	21.8	17.8	15.6	13.4	11.2	9.1	2.5	2.8	C	0.199	0.218	0.178	0.156	0.031103	0.291157	0.186567	67.33668	6.157522
345	Oluw1976	24	5	35	16.1	18.2	14.2	12.1	12.8	10.4	8.2	2.4	2.6	S	0.161	0.182	0.142	0.121	0.020358	0.174827	0.1875	79.50311	5.309292
346	Oluw1976	24	6	35	37.1	38.4	34.1	28.8	17.8	15.4	13.2	2.6	2.9	D	0.371	0.384	0.341	0.288	0.108103	1.402076	0.146067	47.97844	6.605199
347	Oluw1976	24	7	35	22	24.4	20.1	18.4	14.2	12.6	10.4	2.5	2.8	C	0.22	0.244	0.201	0.184	0.038013	0.420574	0.176056	64.54545	6.157522
348	Oluw1976	24	8	35	30	32.6	28.2	24.6	16.6	14.8	12	2.6	2.9	D	0.3	0.326	0.282	0.246	0.070686	0.939381	0.156627	55.33333	6.605199
349	Oluw1976	24	9	35	30.4	32.8	28.1	24.2	16.8	14.9	12.2	2.6	2.9	D	0.304	0.328	0.281	0.242	0.072583	0.94008	0.154762	55.26316	6.605199
350	Oluw1976	24	10	35	36.4	42.4	28	18.8	17.8	15.6	13.8	2.6	2.9	D	0.364	0.424	0.28	0.188	0.104062	1.079665	0.146067	48.9011	6.605199
351	Oluw1976	24	11	35	27.2	29.6	25.6	23.4	15.6	13.4	11.1	2.5	2.8	C	0.272	0.296	0.256	0.234	0.058107	0.709544	0.160256	57.35294	6.157522
352	Oluw1976	24	12	35	34.5	36.6	30.8	22.8	18.4	16.8	14.4	2.6	2.9	D	0.345	0.366	0.308	0.228	0.093482	1.243371	0.141304	53.33333	6.605199
353	Oluw1976	24	13	35	21.2	24.4	17.6	15.4	14.8	12.6	10.8	2.5	2.8	C	0.212	0.244	0.176	0.154	0.035299	0.34167	0.168919	69.81132	6.157522
354	Oluw1976	24	14	35	31.5	34.8	17.8	24.4	16.6	14.8	12.8	2.6	2.9	D	0.315	0.348	0.178	0.244	0.077931	0.595484	0.156627	52.69841	6.605199
355	Oluw1976	24	15	35	19	21.4	17.4	14.2	14.8	12.2	10.1	2.5	2.8	C	0.19	0.214	0.174	0.142	0.028353	0.298737	0.168919	77.89474	6.157522
356	Oluw1976	24	16	35	33.5	35.6	29.8	23.4	16.8	14.6	12.6	2.6	2.9	D	0.335	0.356	0.298	0.234	0.088141	1.025722	0.154762	50.14925	6.605199
357	Oluw1976	24	17	35	37.2	39.8	32.8	22.4	16.4	14.8	12.4	2.6	2.9	D	0.372	0.398	0.328	0.224	0.108687	1.237782	0.158537	44.08602	6.605199
358	Sha1984	25	1	27	34.1	36.4	31.6	28.1	16.4	14.2	12.6	2.5	2.8	C	0.341	0.364	0.316	0.281	0.091327	1.135491	0.152439	48.09384	6.157522
359	Sha1984	25	2	27	20.7	22.6	18.4	14.8	12.8	10.6	8.4	2.5	2.6	S	0.207	0.226	0.184	0.148	0.033654	0.289168	0.195313	61.83575	5.309292
360	Sha1984	25	3	27	37	39.2	34.6	29.8	16.8	14.5	12.7	2.6	2.8	C	0.37	0.392	0.346	0.298	0.107521	1.369121	0.154762	45.40541	6.157522
361	Sha1984	25	4	27	43	46.1	41.4	38.1	17.4	16.8	14.6	2.6	2.9	D	0.43	0.461	0.414	0.381	0.14522	2.294262	0.149425	40.46512	6.605199
362	Sha1984	25	5	27	25	26.2	22.6	19.3	12.4	10.4	9.8	2.5	2.8	C	0.25	0.262	0.226	0.193	0.049087	0.422289	0.201613	49.6	6.157522
363	Sha1984	25	6	27	30.9	32.8	28.4	25.4	14.8	12.6	10.4	2.6	2	C	0.309	0.328	0.284	0.254	0.074991	0.815966	0.175676	47.89644	3.141593
364	Sha1984	25	7	27	18.3	22.2	16.4	14.6	12.6	10.9	9.3	2.4	2.6	C	0.183	0.222	0.164	0.146	0.026302	0.254234	0.190476	68.85246	5.309292
365	Sha1984	25	8	27	31.7	32.6	29.2	24.6	14.4	12.8	11.6	2.6	2.9	C	0.317	0.326	0.292	0.246	0.078924	0.850907	0.180556	45.42587	6.605199
366	Sha1984	25	9	27	18.3	21.8	16.4	12.4	12.5	10.6	8.2	2.4	2.6	S	0.183	0.218	0.164	0.124	0.026302	0.236553	0.192	68.30601	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
367	Sha1984	25	10	27	41.4	43.4	38.6	32.1	17.1	16.2	14.8	2.6	2.9	D	0.414	0.434	0.386	0.321	0.134614	1.881758	0.152047	41.30435	6.605199
368	Sha1984	25	11	27	13.4	16.6	10.8	8.4	12.1	10.4	8.1	2.4	2.5	S	0.134	0.166	0.108	0.084	0.014103	0.110635	0.198347	90.29851	4.908739
369	Sha1984	25	12	27	23	25.2	20.6	18.6	14.2	12.6	10.6	2.4	2.6	C	0.23	0.252	0.206	0.186	0.041548	0.441765	0.169014	61.73913	5.309292
370	Sha1984	25	13	27	15.9	18.4	13.8	10.4	10.1	9.6	8.4	2.4	2.5	S	0.159	0.184	0.138	0.104	0.019856	0.151862	0.237624	63.52201	4.908739
371	Sha1984	25	14	27	30.3	32.6	28.4	24.6	13.8	12.4	10.8	2.6	2.8	C	0.303	0.326	0.284	0.246	0.072107	0.794399	0.188406	45.54455	6.157522
372	Sha1984	25	15	27	17.5	19.8	14.6	12.2	9.8	9.2	8.1	2.4	2.5	S	0.175	0.198	0.146	0.122	0.024053	0.167818	0.244898	56	4.908739
373	Sha1984	25	16	27	31.7	32.9	28.4	26.1	13.6	12.8	11.2	2.6	2.9	C	0.317	0.329	0.284	0.261	0.078924	0.836059	0.191176	42.90221	6.605199
374	Sha1984	25	17	27	26.9	29.4	24.6	21.6	12.4	10.6	9.4	2.4	2.8	C	0.269	0.294	0.246	0.216	0.056832	0.520543	0.193548	46.09665	6.157522
375	Sha1984	25	18	27	25.8	27.6	22.7	20.2	12.5	10.9	9.2	2.4	2.9	C	0.258	0.276	0.227	0.202	0.052279	0.460996	0.192	48.44961	6.605199
376	Sha1984	26	1	27	25.1	27.4	23.4	18.8	14.4	12.6	10.4	2.5	2.8	C	0.251	0.274	0.234	0.188	0.049481	0.543364	0.173611	57.37052	6.157522
377	Sha1984	26	2	27	22.6	24.4	20.2	16.7	14.6	12.7	10.8	2.5	2.8	C	0.226	0.244	0.202	0.167	0.040115	0.416672	0.171233	64.60177	6.157522
378	Sha1984	26	3	27	27	29.8	25.4	22.4	15.8	13.6	11.2	2.5	2.8	C	0.27	0.298	0.254	0.224	0.057256	0.706832	0.158228	58.51852	6.157522
379	Sha1984	26	4	27	39	41.4	36.8	32.6	16.4	14.8	12.6	2.6	2.9	D	0.39	0.414	0.368	0.326	0.119459	1.587374	0.158537	42.05128	6.605199
380	Sha1984	26	5	27	17.7	19.8	15.4	12.8	12.6	10.8	8.9	2.5	2.8	C	0.177	0.198	0.154	0.128	0.024606	0.212697	0.198413	71.18644	6.157522
381	Sha1984	26	6	27	27.6	29.8	25.6	22.3	14.8	12.6	10.2	2.5	2.8	C	0.276	0.298	0.256	0.223	0.059828	0.660851	0.168919	53.62319	6.157522
382	Sha1984	26	7	27	23.8	25.6	21.4	18.4	13.4	11.6	9.2	2.5	2.8	C	0.238	0.256	0.214	0.184	0.044488	0.429074	0.186567	56.30252	6.157522
383	Sha1984	26	8	27	23.8	25.4	21.2	18.1	12.8	10.4	8.9	2.5	2.8	C	0.238	0.254	0.212	0.181	0.044488	0.377168	0.195313	53.78151	6.157522
384	Sha1984	26	9	27	22.8	24.6	20.4	17.6	12.7	10.8	8.6	2.5	2.8	C	0.228	0.246	0.204	0.176	0.040828	0.364677	0.19685	55.70175	6.157522
385	Sha1984	26	10	27	27.4	29.8	25.6	22.8	14.8	12.6	10.4	2.5	2.8	C	0.274	0.298	0.256	0.228	0.058965	0.66457	0.168919	54.0146	6.157522
386	Sha1984	26	11	27	13.2	15.6	11.4	9.6	12.4	10.6	8.4	2.5	2.6	C	0.132	0.156	0.114	0.096	0.013685	0.118684	0.201613	93.93939	5.309292
387	Sha1984	26	12	27	24.6	28.4	21.4	18.8	13.8	11.5	9.8	2.5	2.8	C	0.246	0.284	0.214	0.188	0.047529	0.450376	0.181159	56.09756	6.157522
388	Sha1984	26	13	27	25	21.4	16.6	14.4	12.8	10.6	8.4	2.5	2.8	C	0.25	0.214	0.166	0.144	0.049087	0.245255	0.195313	51.2	6.157522
389	Sha1984	26	14	27	28.5	27.6	23.4	19.6	13.8	11.4	9.6	2.5	2.8	C	0.285	0.276	0.234	0.196	0.063794	0.497841	0.181159	48.42105	6.157522
390	Sha1984	26	15	27	26.4	30.2	23.6	13.7	14	12.4	10.1	2.5	2.8	C	0.264	0.302	0.236	0.137	0.054739	0.540117	0.178571	53.0303	6.157522
391	Sha1984	26	16	27	32.2	15.8	11.2	9.4	11.4	9.6	7.8	2.4	2.6	C	0.322	0.158	0.112	0.094	0.081433	0.105527	0.210526	35.40373	5.309292
392	Sha1984	26	17	27	41.5	34.8	29.6	27.4	15.6	13.8	11.4	2.5	2.8	C	0.415	0.348	0.296	0.274	0.135265	0.987466	0.160256	37.59036	6.157522
393	Sha1984	26	18	27	22.8	19.8	15.4	13.2	12.8	10.4	8.8	2.5	2.9	C	0.228	0.198	0.154	0.132	0.040828	0.206235	0.195313	56.14035	6.605199
394	Sha1984	26	19	27	36.6	44.4	30.6	26.4	18.5	16.4	14.2	2.6	3.1	D	0.366	0.444	0.306	0.264	0.105209	1.376877	0.140541	50.54645	7.547676
395	Sha1984	26	20	27	20.4	24.8	20.2	18.4	14.8	12.6	10.8	2.5	2.8	C	0.204	0.248	0.202	0.184	0.032685	0.426479	0.168919	72.54902	6.157522
396	Sha1984	26	21	27	20.6	20.2	14.4	12.6	12.8	10.2	8.1	2.4	2.6	S	0.206	0.202	0.144	0.126	0.033329	0.186423	0.1875	62.13592	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
397	Sha1984	26	22	27	38.2	23.4	18.6	16.2	13.8	11.6	9.8	2.5	2.8	C	0.382	0.234	0.186	0.162	0.114608	0.333121	0.181159	36.12565	6.157522
398	Sha1984	26	23	27	20.6	23.6	18.8	16.4	13.8	11.8	9.9	2.5	2.8	C	0.206	0.236	0.188	0.164	0.033329	0.345945	0.181159	66.99029	6.157522
399	Sha1984	26	24	27	38.2	40.4	36.4	32.4	16.8	14.6	12.4	2.6	2.9	D	0.382	0.404	0.364	0.324	0.114608	1.525423	0.154762	43.97906	6.605199
400	Sha1984	26	25	27	33.1	35.2	29.8	26.8	15.6	13.6	11.8	2.5	2.8	C	0.331	0.352	0.298	0.268	0.086049	0.98081	0.160256	47.12991	6.157522
401	Sha1984	26	26	27	18.5	22.4	16.4	14.2	13.6	11.5	9.9	2.5	2.8	C	0.185	0.224	0.164	0.142	0.02688	0.267837	0.183824	73.51351	6.157522
402	Sha1984	26	27	27	28.2	32.4	24.8	22.6	14.8	12.6	10.2	2.5	2.8	C	0.282	0.324	0.248	0.226	0.062458	0.663145	0.168919	52.48227	6.157522
403	Sha1984	26	28	27	27.6	29.8	25.4	22.8	14.6	12.4	10.1	2.5	2.8	C	0.276	0.298	0.254	0.228	0.059828	0.647399	0.171233	52.89855	6.157522
404	Sha1984	26	29	27	18.4	20.4	16.6	14.6	13.8	11.6	9.8	2.5	2.8	C	0.184	0.204	0.166	0.146	0.02659	0.262926	0.181159	75	6.157522
405	Sha1984	26	30	27	16	18.6	14.4	12.6	12.6	10.6	8.9	2.4	2.6	S	0.16	0.186	0.144	0.126	0.020106	0.18512	0.190476	78.75	5.309292
406	Sha1984	26	31	27	32.1	36.4	28.8	24.8	14.8	12.8	10.9	2.5	2.8	C	0.321	0.364	0.288	0.248	0.080928	0.880946	0.168919	46.10592	6.157522
407	Sha1984	26	32	27	39.5	42.6	36.7	32.4	16.2	14.6	12.8	2.6	2.9	D	0.395	0.426	0.367	0.324	0.122542	1.577084	0.160494	41.01266	6.605199
408	Sha1984	26	33	27	18.4	22.8	16.2	14.4	12.8	10.4	8.4	2.4	2.6	S	0.184	0.228	0.162	0.144	0.02659	0.241908	0.1875	69.56522	5.309292
409	Sha1984	26	34	27	28	32.6	26.4	22.8	14.7	12.4	10.1	2.5	2.8	C	0.28	0.326	0.264	0.228	0.061575	0.709391	0.170068	52.5	6.157522
410	Sha1984	26	35	27	27.1	29.8	25.6	22.4	13.8	11.6	9.8	2.5	2.8	C	0.271	0.298	0.256	0.224	0.05768	0.609081	0.181159	50.92251	6.157522
411	Sha1984	26	36	27	21.1	24.6	18.4	16.3	12.8	10.6	8.6	2.5	2.8	C	0.211	0.246	0.184	0.163	0.034967	0.308739	0.195313	60.66351	6.157522
412	Sha1984	26	37	27	24	27.4	22.8	20.2	13.6	11.8	9.6	2.5	2.8	C	0.24	0.274	0.228	0.202	0.045239	0.500172	0.183824	56.66667	6.157522
413	Sha1984	26	38	27	48.7	50.2	44.2	36.8	18.1	16.4	14.3	2.6	3.1	D	0.487	0.502	0.442	0.368	0.186272	2.509308	0.143646	37.16632	7.547676
414	Sha1984	26	39	27	20.4	24.2	18.6	16.4	13.6	11.4	9.8	2.5	2.8	C	0.204	0.242	0.186	0.164	0.032685	0.334033	0.183824	66.66667	6.157522
415	Sha1984	26	40	27	38.7	42.4	34.6	28.4	16.4	14.2	12.6	2.6	3.1	D	0.387	0.424	0.346	0.284	0.117628	1.374185	0.158537	42.37726	7.547676
416	Sha1984	26	41	27	24.1	26.4	22.4	20.6	13.8	11.6	9.6	2.5	2.8	C	0.241	0.264	0.224	0.206	0.045617	0.475022	0.181159	57.26141	6.157522
417	Sha1984	26	42	27	18.7	20.4	16.6	14.4	12.8	10.6	8.3	2.5	2.8	C	0.187	0.204	0.166	0.144	0.027465	0.239456	0.195313	68.4492	6.157522
418	Sha1984	26	43	27	19	21.6	17.6	15.6	13.6	11.6	9.2	2.5	2.8	C	0.19	0.216	0.176	0.156	0.028353	0.295937	0.183824	71.57895	6.157522
419	Sha1984	26	44	27	31	34.2	28.4	26.6	14.6	12.6	10.2	2.5	2.8	C	0.31	0.342	0.284	0.266	0.075477	0.841729	0.171233	47.09677	6.157522
420	Sha1984	26	45	27	30	34.6	28.6	26.4	14.6	12.4	10.1	2.5	2.8	C	0.3	0.346	0.286	0.264	0.070686	0.838516	0.171233	48.66667	6.157522
421	Sha1984	26	46	27	22.3	26.2	20.4	18.6	12.6	10.4	8.8	2.5	2.8	C	0.223	0.262	0.204	0.186	0.039057	0.367163	0.198413	56.50224	6.157522
422	Sha1984	26	47	27	12.4	14.6	10.4	8.4	10.9	8.8	6.4	2.4	2.6	S	0.124	0.146	0.104	0.084	0.012076	0.082519	0.220183	87.90323	5.309292
423	Sha1984	27	1	27	30.8	32.6	28.4	25.7	16.2	14.6	12.4	2.5	2.8	C	0.308	0.326	0.284	0.257	0.074506	0.945915	0.154321	52.5974	6.157522
424	Sha1984	27	2	27	20.6	22.4	18.6	16.4	13.6	11.4	9.6	2.5	2.8	C	0.206	0.224	0.186	0.164	0.033329	0.321516	0.183824	66.01942	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
425	Sha1984	27	3	27	22.9	24.8	20.4	18.6	14.8	12.8	10.4	2.5	2.8	C	0.229	0.248	0.204	0.186	0.041187	0.43993	0.168919	64.62882	6.157522
426	Sha1984	27	4	27	19.5	21.6	16.6	13.5	12.4	10.7	8.9	2.5	2.8	C	0.195	0.216	0.166	0.135	0.029865	0.245257	0.201613	63.58974	6.157522
427	Sha1984	27	5	27	29.8	33.4	25.8	23.4	14.8	12.6	10.8	2.5	2.8	C	0.298	0.334	0.258	0.234	0.069746	0.71345	0.168919	49.66443	6.157522
428	Sha1984	27	6	27	35.5	38.6	32.4	28.6	17.4	15.6	13.8	2.6	2.9	D	0.355	0.386	0.324	0.286	0.09898	1.328744	0.149425	49.01408	6.605199
429	Sha1984	27	7	27	44.4	17.4	12.2	10.4	12.8	10.4	8.2	2.4	2.6	S	0.444	0.174	0.122	0.104	0.15483	0.136991	0.1875	28.82883	5.309292
430	Sha1984	27	8	27	24.2	26.6	22.1	18.4	14.8	12.6	10.8	2.5	2.8	C	0.242	0.266	0.221	0.184	0.045996	0.494761	0.168919	61.15702	6.157522
431	Sha1984	27	9	27	10.9	13.4	8.6	6.4	10.4	8.8	6.4	2.5	2.8	S	0.109	0.134	0.086	0.064	0.009331	0.05948	0.240385	95.41284	6.157522
432	Sha1984	27	10	27	15	18.6	13.4	10.2	12.8	10.6	8.8	2.4	2.6	S	0.15	0.186	0.134	0.102	0.017671	0.162098	0.1875	85.33333	5.309292
433	Sha1984	27	11	27	19.8	20.4	14.8	12.4	12.9	10.8	8.9	2.4	2.6	S	0.198	0.204	0.148	0.124	0.030791	0.204435	0.186047	65.15152	5.309292
434	Sha1984	27	12	27	29.2	32.6	26.4	24.6	14.8	12.6	10.8	2.5	2.8	C	0.292	0.326	0.264	0.246	0.066966	0.734905	0.168919	50.68493	6.157522
435	Sha1984	27	13	27	36.9	38.8	34.4	32.1	18.2	16.6	14.2	2.6	2.9	D	0.369	0.388	0.344	0.321	0.106941	1.579569	0.142857	49.32249	6.605199
436	Sha1984	27	14	27	20.3	24.4	18.4	16.2	13.5	11.6	9.8	2.5	2.8	C	0.203	0.244	0.184	0.162	0.032365	0.335884	0.185185	66.50246	6.157522
437	Sha1984	27	15	27	25.1	28.4	23.6	20.4	15.8	12.9	10.8	2.5	2.8	C	0.251	0.284	0.236	0.204	0.049481	0.582664	0.158228	62.94821	6.157522
438	Sha1984	27	16	27	16.8	20.6	14.8	12.4	13.8	11.6	9.2	2.4	2.6	S	0.168	0.206	0.148	0.124	0.022167	0.220823	0.173913	82.14286	5.309292
439	Sha1984	27	17	27	34.3	38.4	30.6	28.6	16.8	14.9	12.8	2.6	2.9	D	0.343	0.384	0.306	0.286	0.092401	1.177647	0.154762	48.97959	6.605199
440	Sha1984	27	18	27	22.3	28.6	20.4	18.4	14.6	12.4	10.1	2.5	2.8	C	0.223	0.286	0.204	0.184	0.039057	0.457918	0.171233	65.47085	6.157522
441	Sha1984	27	19	27	18.2	22.6	16.2	14.4	14.6	12.4	10	2.4	2.6	S	0.182	0.226	0.162	0.144	0.026016	0.286955	0.164384	80.21978	5.309292
442	Sha1984	27	20	27	32.4	36.4	29.4	26.2	16.2	13.8	11.8	2.5	2.8	C	0.324	0.364	0.294	0.262	0.082448	0.9879	0.154321	50	6.157522
443	Sha1984	27	21	27	25.9	28.6	22.6	20.4	14.8	12.4	10.6	2.5	2.8	C	0.259	0.286	0.226	0.204	0.052685	0.531934	0.168919	57.14286	6.157522
444	Sha1984	27	22	27	35	38.4	32.4	28.6	18.2	16.4	14.1	2.6	2.9	D	0.35	0.384	0.324	0.286	0.096211	1.393579	0.142857	52	6.605199
445	Sha1984	27	23	27	19.7	22.6	16.6	14.4	13.6	11.8	9.9	2.5	2.8	C	0.197	0.226	0.166	0.144	0.030481	0.281176	0.183824	69.03553	6.157522
446	Sha1984	27	24	27	36.4	38.4	32.4	28.6	18.4	16.8	14.6	2.6	2.9	D	0.364	0.384	0.324	0.286	0.104062	1.427569	0.141304	50.54945	6.605199
447	Sha1984	27	25	27	24.7	28.6	21.6	19.6	14.6	12.8	10.4	2.5	2.8	C	0.247	0.286	0.216	0.196	0.047916	0.514109	0.171233	59.10931	6.157522
448	Sha1984	27	26	27	23.1	26.4	20.4	18.4	14.6	12.4	10.1	2.5	2.8	C	0.231	0.264	0.204	0.184	0.04191	0.438278	0.171233	63.20346	6.157522
449	Sha1984	27	27	27	27	29.6	24.6	20.6	14.6	12.8	10.4	2.5	2.8	C	0.27	0.296	0.246	0.206	0.057256	0.623486	0.171233	54.07407	6.157522
450	Sha1984	27	28	27	17	21.4	15.6	12.8	13.5	11.6	9.4	2.4	2.6	S	0.17	0.214	0.156	0.128	0.022698	0.242227	0.177778	79.41176	5.309292
451	Sha1984	27	29	27	20.6	23.6	18.8	16.4	13.6	11.5	9.9	2.5	2.8	C	0.206	0.236	0.188	0.164	0.033329	0.337149	0.183824	66.01942	6.157522
452	Sha1984	27	30	27	21.5	25.2	18.6	15.6	14.6	12.4	10.1	2.5	2.8	C	0.215	0.252	0.186	0.156	0.036305	0.367197	0.171233	67.90698	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
453	Sha1984	28	1	27	21.8	23.4	18.4	16.4	14.8	12.6	10.8	2.5	2.8	C	0.218	0.234	0.184	0.164	0.037325	0.358031	0.168919	67.88991	6.157522
454	Sha1984	28	2	27	35.4	38.6	32.4	28.1	18.6	16.4	14.2	2.6	3.1	D	0.354	0.386	0.324	0.281	0.098423	1.390799	0.139785	52.54237	7.547676
455	Sha1984	28	3	27	17	21.4	15.6	13.4	14.4	11.5	9.1	2.4	2.6	S	0.17	0.214	0.156	0.134	0.022698	0.242505	0.166667	84.70588	5.309292
456	Sha1984	28	4	27	17.9	21.6	15.8	13.2	14.6	11.6	9.6	2.5	2.8	C	0.179	0.216	0.158	0.132	0.025165	0.248926	0.171233	81.56425	6.157522
457	Sha1984	28	5	27	26.6	29.4	24.2	22.4	14.8	12.8	10.8	2.5	2.8	C	0.266	0.294	0.242	0.224	0.055572	0.621395	0.168919	55.6391	6.157522
458	Sha1984	28	6	27	14.1	18.8	12.4	10.2	13.8	11.8	9.8	2.4	2.6	S	0.141	0.188	0.124	0.102	0.015615	0.165663	0.173913	97.87234	5.309292
459	Sha1984	28	7	27	15.4	19.4	13.2	11.4	13.8	11.6	9.9	2.4	2.6	S	0.154	0.194	0.132	0.114	0.018627	0.18271	0.173913	89.61039	5.309292
460	Sha1984	28	8	27	21.8	24.6	18.6	15.8	14.6	12.8	10.6	2.5	2.8	C	0.218	0.246	0.186	0.158	0.037325	0.375088	0.171233	66.97248	6.157522
461	Sha1984	28	9	27	36.5	38.4	32.4	28.6	18.4	16.6	14.6	2.6	3.1	D	0.365	0.384	0.324	0.286	0.104635	1.410574	0.141304	50.41096	7.547676
462	Sha1984	28	10	27	30.2	34.6	28.6	24.4	16.8	14.6	12.8	2.5	2.9	C	0.302	0.346	0.286	0.244	0.071631	0.967868	0.14881	55.62914	6.605199
463	Sha1984	28	11	27	26.7	29.4	24.4	20.6	15.6	13.6	11.4	2.5	2.9	C	0.267	0.294	0.244	0.206	0.05599	0.653375	0.160256	58.42697	6.605199
464	Sha1984	28	12	27	10.6	14.4	28.4	6.2	12.4	10.8	8.2	2.4	2.6	S	0.106	0.144	0.284	0.062	0.008825	0.490848	0.193548	116.9811	5.309292
465	Sha1984	28	13	27	39.7	42.4	36.6	28.4	13.6	16.8	14.8	2.6	3.2	D	0.397	0.424	0.366	0.284	0.123786	1.751058	0.191176	34.25693	8.042477
466	Sha1984	28	14	27	37.1	40.2	34.2	26.4	17.8	15.6	13.4	2.6	3.1	D	0.371	0.402	0.342	0.264	0.108103	1.427701	0.146067	47.97844	7.547676
467	Sha1984	28	15	27	20	24.6	18.6	16.2	13.4	11.8	9.4	2.5	2.8	C	0.2	0.246	0.186	0.162	0.031416	0.347761	0.186567	67	6.157522
468	Sha1984	28	16	27	28.5	32.4	24.2	24.1	16.8	14.6	12.2	2.5	2.8	C	0.285	0.324	0.242	0.241	0.063794	0.759319	0.14881	58.94737	6.157522
469	Sha1984	28	17	27	26.2	28.6	24.4	20.4	15.6	13.4	11.2	2.5	2.8	C	0.262	0.286	0.244	0.204	0.053913	0.634189	0.160256	59.54198	6.157522
470	Sha1984	28	18	27	18	24.4	16.8	14.2	13.9	11.8	9.6	2.5	2.8	C	0.18	0.244	0.168	0.142	0.025447	0.297487	0.179856	77.22222	6.157522
471	Sha1984	28	19	27	25.7	28.8	22.6	20.1	14.8	12.6	10.4	2.5	2.8	C	0.257	0.288	0.226	0.201	0.051875	0.540403	0.168919	57.58755	6.157522
472	Sha1984	28	20	27	20.3	24.4	18.6	16.4	13.6	11.8	9.6	2.5	2.8	C	0.203	0.244	0.186	0.164	0.032365	0.347254	0.183824	66.99507	6.157522
473	Sha1984	28	21	27	28.5	32.4	24.8	20.1	18.6	14.4	12.1	2.5	2.8	C	0.285	0.324	0.248	0.201	0.063794	0.737758	0.134409	65.26316	6.157522
474	Sha1984	28	22	27	33	36.6	28.6	24.4	16.4	14.8	12.8	2.5	2.8	C	0.33	0.366	0.286	0.244	0.08553	1.008714	0.152439	49.69697	6.157522
475	Sha1984	28	23	27	15.8	18.8	13.4	10.6	13.6	11.4	9.1	2.4	2.6	S	0.158	0.188	0.134	0.106	0.019607	0.176689	0.176471	86.07595	5.309292
476	Sha1984	29	1	27	18.9	21.4	16.4	12.4	13.6	11.4	9.2	2.5	2.8	C	0.189	0.214	0.164	0.124	0.028055	0.251827	0.183824	71.95767	6.157522
477	Sha1984	29	2	27	24.7	26.8	23.2	18.6	14.5	12.8	10.6	2.5	2.8	C	0.247	0.268	0.232	0.186	0.047916	0.53904	0.172414	58.70445	6.157522
478	Sha1984	29	3	27	11.7	15.4	9.4	8.6	12.4	10.2	8.1	2.5	2.6	S	0.117	0.154	0.094	0.086	0.010751	0.088731	0.201613	105.9829	5.309292
479	Sha1984	29	4	27	15.8	18.6	12.6	10.4	12.6	10.4	8.2	2.4	2.6	S	0.158	0.186	0.126	0.104	0.019607	0.148274	0.190476	79.74684	5.309292
480	Sha1984	29	5	27	15	18.4	12.4	10.2	12.8	10.2	8.1	2.4	2.6	S	0.15	0.184	0.124	0.102	0.017671	0.141214	0.1875	85.33333	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
481	Sha1984	29	6	27	13	15.6	11.2	9.4	11.6	9.8	7.4	2.4	2.6	S	0.13	0.156	0.112	0.094	0.013273	0.10692	0.206897	89.23077	5.309292
482	Sha1984	29	7	27	25	27.8	21.6	18.4	14.8	12.5	10.8	2.5	2.8	C	0.25	0.278	0.216	0.184	0.049087	0.487215	0.168919	59.2	6.157522
483	Sha1984	29	8	27	31.8	24.6	28.4	22.8	16.6	14.8	12.6	2.5	2.8	C	0.318	0.246	0.284	0.228	0.079423	0.842972	0.150602	52.20126	6.157522
484	Sha1984	29	9	27	16.7	19.8	14.6	12.4	12.4	10.8	8.6	2.4	2.6	S	0.167	0.198	0.146	0.124	0.021904	0.1977	0.193548	74.2515	5.309292
485	Sha1984	29	10	27	31.6	33.4	28.4	22.6	16.4	14.8	12.4	2.5	2.8	C	0.316	0.334	0.284	0.226	0.078427	0.940094	0.152439	51.89873	6.157522
486	Sha1984	29	11	27	14.2	18.6	12.2	10.4	10.6	3.8	6.4	2.4	2.6	S	0.142	0.186	0.122	0.104	0.015837	0.052203	0.226415	74.64789	5.309292
487	Sha1984	29	12	27	37.1	42.4	34.2	20.1	18.6	16.4	14.6	2.6	2.9	D	0.371	0.424	0.342	0.201	0.108103	1.477038	0.139785	50.13477	6.605199
488	Sha1984	29	13	27	22.8	26.4	18.6	14.6	13.8	11.8	9.9	2.5	2.8	C	0.228	0.264	0.186	0.146	0.040828	0.354329	0.181159	60.52632	6.157522
489	Sha1984	29	14	27	11.4	14.6	9.8	7.4	10.6	8.4	6.2	2.4	2.6	C	0.114	0.146	0.098	0.074	0.010207	0.0717	0.226415	92.98246	5.309292
490	Sha1984	29	15	27	23.3	28.4	18.6	14.4	14.8	12.6	10.2	2.5	2.8	C	0.233	0.284	0.186	0.144	0.042638	0.395471	0.168919	63.51931	6.157522
491	Sha1984	29	16	27	11.4	15.8	9.8	7.6	10.4	8.6	6.2	2.4	2.6	S	0.114	0.158	0.098	0.076	0.010207	0.077851	0.230769	91.22807	5.309292
492	Sha1984	29	17	27	22.7	26.6	18.4	14.4	13.6	11.8	9.8	2.5	2.8	C	0.227	0.266	0.184	0.144	0.040471	0.350498	0.183824	59.91189	6.157522
493	Sha1984	29	18	27	20.5	24.2	16.6	12.6	12.9	10.8	8.9	2.5	2.8	C	0.205	0.242	0.166	0.126	0.033006	0.261063	0.193798	62.92683	6.157522
494	Sha1984	29	19	27	25.1	28.8	22.4	18.1	14.8	12.6	10.2	2.5	2.8	C	0.251	0.288	0.224	0.181	0.049481	0.521865	0.168919	58.96414	6.157522
495	Sha1984	29	20	27	21.3	26.6	17.6	15.2	13.6	11.8	9.6	2.5	2.8	C	0.213	0.266	0.176	0.152	0.035633	0.336362	0.183824	63.84977	6.157522
496	Sha1984	29	21	27	19.1	23.4	16.6	13.6	12.8	10.8	8.9	2.5	2.8	C	0.191	0.234	0.166	0.136	0.028652	0.259383	0.195313	67.01571	6.157522
497	Sha1984	29	22	27	23.5	27.8	16.8	14.2	14.8	12.6	10.4	2.5	2.8	C	0.235	0.278	0.168	0.142	0.043374	0.346928	0.168919	62.97872	6.157522
498	Sha1984	29	23	27	19.5	23.8	16.8	13.9	14.6	12.4	10.1	2.5	2.8	C	0.195	0.238	0.168	0.139	0.029865	0.306551	0.171233	74.87179	6.157522
499	Sha1984	29	24	27	18.4	22.4	16.2	12.6	13.8	11.6	9.2	2.5	2.8	C	0.184	0.224	0.162	0.126	0.02659	0.259695	0.181159	75	6.157522
500	Sha1984	29	25	27	32	34.8	28.6	23.4	16.6	14.8	12.6	2.5	2.8	C	0.32	0.348	0.286	0.234	0.080425	0.974555	0.150602	51.875	6.157522
501	Sha1984	29	26	27	10.2	14.6	8.4	6.8	10.8	8.6	6.8	2.4	2.6	C	0.102	0.146	0.084	0.068	0.008171	0.060974	0.222222	105.8824	5.309292
502	Sha1984	29	27	27	27.3	31.8	24.6	18.4	14.6	12.8	10.9	2.5	2.8	C	0.273	0.318	0.246	0.184	0.058535	0.631743	0.171233	53.47985	6.157522
503	Sha1984	29	28	27	14.3	18.6	12.4	10.6	11.4	9.6	7.2	2.4	2.6	S	0.143	0.186	0.124	0.106	0.016061	0.134882	0.210526	79.72028	5.309292
504	Sha1984	29	29	27	18.1	22.5	16.2	14.4	12.6	10.8	8.6	2.5	2.8	C	0.181	0.225	0.162	0.144	0.02573	0.249291	0.198413	69.61326	6.157522
505	Sha1984	29	30	27	27.5	29.6	22.4	18.1	14.8	12.8	10.9	2.5	2.8	C	0.275	0.296	0.224	0.181	0.059396	0.537976	0.168919	53.81818	6.157522
506	Sha1984	29	31	27	20.5	24.8	16.8	14.4	12.8	10.8	8.9	2.5	2.8	C	0.205	0.248	0.168	0.144	0.033006	0.275867	0.195313	62.43902	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
507	Sha1984	29	32	27	26.9	30.2	22.4	18.4	14.8	12.6	10.8	2.5	2.8	C	0.269	0.302	0.224	0.184	0.056832	0.537294	0.168919	55.01859	6.157522
508	Sha1984	29	33	27	19.6	24.1	16.3	14.5	14.8	12.4	10.1	2.5	2.8	C	0.196	0.241	0.163	0.145	0.030172	0.300904	0.168919	75.5102	6.157522
509	Sha1984	29	34	27	44	46.4	38.8	24.2	18.8	16.6	14.8	2.6	3.2	D	0.44	0.464	0.388	0.242	0.152053	1.903569	0.138298	42.72727	8.042477
510	Sha1984	30	1	27	25.4	27.5	22.4	18.2	14.6	12.8	10.4	2.5	2.8	C	0.254	0.275	0.224	0.182	0.050671	0.518493	0.171233	57.48031	6.157522
511	Sha1984	30	2	27	23.3	26.2	19.5	16.4	13.6	11.6	9.8	2.5	2.8	C	0.233	0.262	0.195	0.164	0.042638	0.376026	0.183824	58.3691	6.157522
512	Sha1984	30	3	27	23.7	26.4	19.6	16.5	13.8	11.8	9.9	2.5	2.8	C	0.237	0.264	0.196	0.165	0.044115	0.387058	0.181159	58.22785	6.157522
513	Sha1984	30	4	27	27.2	30.6	24.4	19.8	14.4	12.6	10.8	2.5	2.8	C	0.272	0.306	0.244	0.198	0.058107	0.611877	0.173611	52.94118	6.157522
514	Sha1984	30	5	27	24	28.2	18.6	14.6	14.2	12.4	10.1	2.5	2.8	C	0.24	0.282	0.186	0.146	0.045239	0.388298	0.176056	59.16667	6.157522
515	Sha1984	30	6	27	20.1	24.4	18.2	16.4	13.6	11.5	9.2	2.5	2.8	C	0.201	0.244	0.182	0.164	0.031731	0.329562	0.183824	67.66169	6.157522
516	Sha1984	30	7	27	15.8	17.4	13.4	11.3	11.6	9.8	7.6	2.4	2.6	S	0.158	0.174	0.134	0.113	0.019607	0.147356	0.206897	73.41772	5.309292
517	Sha1984	30	8	27	31.8	33.8	28.6	22.1	15.8	13.8	11.4	2.5	2.8	C	0.318	0.338	0.286	0.221	0.079423	0.88563	0.158228	49.68553	6.157522
518	Sha1984	30	9	27	28.7	30.8	24.1	18.8	15.9	13.8	11.2	2.5	2.8	C	0.287	0.308	0.241	0.188	0.064692	0.654884	0.157233	55.4007	6.157522
519	Sha1984	30	10	27	11.2	14.4	9.2	7.4	10.8	8.6	6.5	2.4	2.6	S	0.112	0.144	0.092	0.074	0.009852	0.067621	0.222222	96.42857	5.309292
520	Sha1984	30	11	27	14.4	18.6	12.5	10.6	11.6	9.4	7.2	2.4	2.6	S	0.144	0.186	0.125	0.106	0.016286	0.133298	0.206897	80.55556	5.309292
521	Sha1984	30	12	27	33	36.4	28.6	22.4	16.8	14.8	12.6	2.6	2.9	D	0.33	0.364	0.286	0.224	0.08553	0.987752	0.154762	50.90909	6.605199
522	Sha1984	30	13	27	14.4	18.6	12.5	10.6	11.8	9.6	7.2	2.4	2.6	S	0.144	0.186	0.125	0.106	0.016286	0.136134	0.20339	81.94444	5.309292
523	Sha1984	30	14	27	18.5	24.8	16.4	14.4	12.8	10.8	8.6	2.5	2.8	C	0.185	0.248	0.164	0.144	0.02688	0.268357	0.195313	69.18919	6.157522
524	Sha1984	30	15	27	39.2	42.4	34.6	22.1	16.5	14.6	12.4	2.6	2.9	D	0.392	0.424	0.346	0.221	0.120687	1.352092	0.157576	42.09184	6.605199
525	Sha1984	30	16	27	18.8	26.2	16.8	14.6	12.6	10.8	8.6	2.5	2.8	C	0.188	0.262	0.168	0.146	0.027759	0.286781	0.198413	67.02128	6.157522
526	Sha1984	30	17	27	13.8	18.6	10.4	8.8	10.5	8.4	6.2	2.4	2.6	S	0.138	0.186	0.104	0.088	0.014957	0.094127	0.228571	76.08696	5.309292
527	Sha1984	30	18	27	20.5	24.6	18.6	14.1	13.6	11.8	9.6	2.5	2.8	C	0.205	0.246	0.186	0.141	0.033006	0.337933	0.183824	66.34146	6.157522
528	Sha1984	30	19	27	24.5	28.4	20.2	18.1	14.8	12.6	10.4	2.5	2.8	C	0.245	0.284	0.202	0.181	0.047144	0.456261	0.168919	60.40816	6.157522
529	Sha1984	30	20	27	35.7	38.4	31.4	26.6	15.8	13.8	11.6	2.6	2.9	D	0.357	0.384	0.314	0.266	0.100098	1.106603	0.164557	44.2577	6.605199
530	Sha1984	30	21	27	29.5	42.2	32.8	26.8	18.6	16.6	14.8	2.6	2.9	D	0.295	0.422	0.328	0.268	0.068349	1.478126	0.139785	63.05085	6.605199
531	Sha1984	31	1	27	16.2	18.6	14.4	12.2	12.5	10.4	8.1	2.4	2.6	S	0.162	0.186	0.144	0.122	0.020612	0.180276	0.192	77.16049	5.309292
532	Sha1984	31	2	27	19.8	22.4	16.8	13.6	14.8	12.6	10.2	2.5	2.8	C	0.198	0.224	0.168	0.136	0.030791	0.299467	0.168919	74.74747	6.157522
533	Sha1984	31	3	27	30.6	32.8	28.4	22.4	14.8	12.6	12.2	2.5	2.8	C	0.306	0.328	0.284	0.224	0.073542	0.792315	0.168919	48.36601	6.157522
534	Sha1984	31	4	27	30.2	32.4	28.2	20.8	18.8	12.8	12.3	2.5	2.8	C	0.302	0.324	0.282	0.208	0.071631	0.781353	0.132979	62.25166	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
535	Sha1984	31	5	27	34.5	36.8	28.8	21.6	18.4	16.4	14.2	2.6	2.9	D	0.345	0.368	0.288	0.216	0.093482	1.103123	0.141304	53.33333	6.605199
536	Sha1984	31	6	27	11.2	16.4	9.1	7.2	10.4	8.2	6.1	2.4	2.6	S	0.112	0.164	0.091	0.072	0.009852	0.069989	0.230769	92.85714	5.309292
537	Sha1984	31	7	27	15.8	18.6	13.6	10.8	13.6	11.8	9.8	2.4	2.6	S	0.158	0.186	0.136	0.108	0.019607	0.185731	0.176471	86.07595	5.309292
538	Sha1984	31	8	27	26.9	29.8	23.6	19.9	14.8	12.8	10.8	2.5	2.8	C	0.269	0.298	0.236	0.199	0.056832	0.588423	0.168919	55.01859	6.157522
539	Sha1984	31	9	27	18	24.4	16.2	14.1	13.8	11.8	9.9	2.5	2.8	C	0.18	0.244	0.162	0.141	0.025447	0.284816	0.181159	76.66667	6.157522
540	Sha1984	31	10	27	23.8	27.6	20.4	16.4	14.6	12.6	10.2	2.5	2.8	C	0.238	0.276	0.204	0.164	0.044488	0.444555	0.171233	61.34454	6.157522
541	Sha1984	31	11	27	16.8	31.4	14.2	12.6	12.5	10.4	8.1	2.4	2.6	S	0.168	0.314	0.142	0.126	0.022167	0.265639	0.192	74.40476	5.309292
542	Sha1984	31	12	27	17.4	22.6	14.8	12.8	13.6	11.5	9.2	2.4	2.6	S	0.174	0.226	0.148	0.128	0.023779	0.233443	0.176471	78.16092	5.309292
543	Sha1984	31	13	27	29.7	34.2	26.4	20.1	14.8	12.6	10.9	2.5	2.8	C	0.297	0.342	0.264	0.201	0.069279	0.719356	0.168919	49.83165	6.157522
544	Sha1984	31	14	27	27.2	29.8	24.6	22.4	14.6	12.4	10.4	2.5	2.8	C	0.272	0.298	0.246	0.224	0.058107	0.618494	0.171233	53.67647	6.157522
545	Sha1984	31	15	27	15.7	18.6	13.4	11.1	11.6	9.5	7.4	2.4	2.6	S	0.157	0.186	0.134	0.111	0.019359	0.14766	0.206897	73.88535	5.309292
546	Sha1984	31	16	27	17.1	22.6	14.8	12.2	12.6	10.4	8.2	2.4	2.6	S	0.171	0.226	0.148	0.122	0.022966	0.209072	0.190476	73.68421	5.309292
547	Sha1984	31	17	27	16.6	20.4	14.2	12.1	12.4	10.2	8.1	2.4	2.6	S	0.166	0.204	0.142	0.121	0.021642	0.182803	0.193548	74.6988	5.309292
548	Sha1984	31	18	27	29.8	34.6	25.5	20.8	14.8	12.9	10.8	2.5	2.8	C	0.298	0.346	0.255	0.208	0.069746	0.714415	0.168919	49.66443	6.157522
549	Sha1984	31	19	27	12.7	16.4	10.5	8.7	10.6	8.4	6.2	2.4	2.6	S	0.127	0.164	0.105	0.087	0.012668	0.086387	0.226415	83.46457	5.309292
550	Sha1984	31	20	27	28.8	32.6	26.8	22.4	14.8	12.8	10.8	2.5	2.8	C	0.288	0.326	0.268	0.224	0.065144	0.743507	0.168919	51.38889	6.157522
551	Sha1984	31	21	27	18.7	24.8	16.6	14.5	13.6	11.6	9.2	2.5	2.6	C	0.187	0.248	0.166	0.145	0.027465	0.292683	0.183824	72.72727	5.309292
552	Sha1984	31	22	27	41.8	46.6	34.8	24.1	18.8	16.8	14.6	2.6	3.1	D	0.418	0.466	0.348	0.241	0.137228	1.670564	0.138298	44.97608	7.547676
553	Sha1984	31	23	27	18	24.6	16.4	14.1	13.5	11.4	9.2	2.4	2.6	S	0.18	0.246	0.164	0.141	0.025447	0.280516	0.177778	75	5.309292
554	Sha1984	31	24	27	18.2	24.8	16.6	14.4	12.6	10.8	8.9	2.4	2.6	S	0.182	0.248	0.166	0.144	0.026016	0.27209	0.190476	69.23077	5.309292
555	Sha1984	31	25	27	21.7	26.6	18.4	16.7	14.8	12.6	10.2	2.5	2.8	C	0.217	0.266	0.184	0.167	0.036984	0.386058	0.168919	68.20276	6.157522
556	Sha1984	31	26	27	22.5	26.8	20.6	18.5	14.8	12.8	10.6	2.5	2.8	C	0.225	0.268	0.206	0.185	0.039761	0.462096	0.168919	65.77778	6.157522
557	Sha1984	31	27	27	27.6	22.4	15.6	13.5	11.8	9.8	7.6	2.4	2.6	S	0.276	0.224	0.156	0.135	0.059828	0.212621	0.20339	42.75362	5.309292
558	Sha1984	31	28	27	14	18.6	12.4	10.2	10.5	8.4	6.2	2.4	2.6	S	0.14	0.186	0.124	0.102	0.015394	0.117107	0.228571	75	5.309292
559	Sha1984	31	29	27	36	40.1	32.2	28.1	18.7	16.8	14.6	2.6	2.9	D	0.36	0.401	0.322	0.281	0.101788	1.439316	0.139037	51.94444	6.605199
560	Sha1984	31	30	27	35.3	29.6	22.4	18.3	14.8	12.8	10.8	2.5	2.8	C	0.353	0.296	0.224	0.183	0.097868	0.539196	0.168919	41.92635	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
561	Sha1984	31	31	27	48	52.4	44.2	26.8	18.7	16.8	14.8	2.6	3.2	D	0.48	0.524	0.442	0.268	0.180956	2.480285	0.139037	38.95833	8.042477
562	Sha1984	31	32	27	26.9	29.8	22.4	18.8	14.8	12.6	10.9	2.5	2.8	C	0.269	0.298	0.224	0.188	0.056832	0.53579	0.168919	55.01859	6.157522
563	Sha1984	31	33	27	27.5	31.4	23.6	19.2	15.6	14.4	11.2	2.5	2.8	C	0.275	0.314	0.236	0.192	0.059396	0.675274	0.160256	56.72727	6.157522
564	Sha1984	31	34	27	24.8	29.6	21.4	18.6	14.7	12.8	10.6	2.5	2.8	C	0.248	0.296	0.214	0.186	0.048305	0.511696	0.170068	59.27419	6.157522
565	Sha1984	31	35	27	28	32.4	24.8	19.6	15.6	13.6	11.4	2.5	2.8	C	0.28	0.324	0.248	0.196	0.061575	0.693238	0.160256	55.71429	6.157522
566	Sha1984	31	36	27	31.8	34.6	27.4	20.8	16.8	14.6	12.2	2.5	2.8	C	0.318	0.346	0.274	0.208	0.079423	0.885399	0.14881	52.83019	6.157522
567	Sha1984	32	1	27	18.7	24.2	14.4	14.4	10.8	8.6	6.8	2.4	2.6	S	0.187	0.242	0.144	0.144	0.027465	0.182644	0.222222	57.75401	5.309292
568	Sha1984	32	2	27	18.2	23.6	16.1	13.6	10.6	8.4	6.2	2.4	2.6	S	0.182	0.236	0.161	0.136	0.026016	0.195585	0.226415	58.24176	5.309292
569	Sha1984	32	3	27	22.2	26.4	18.4	15.6	14.4	12.2	10.1	2.5	2.8	C	0.222	0.264	0.184	0.156	0.038708	0.366436	0.173611	64.86486	6.157522
570	Sha1984	32	4	27	17.1	23.2	15.4	13.4	11.5	9.4	7.2	2.4	2.6	S	0.171	0.232	0.154	0.134	0.022966	0.205048	0.208696	67.25146	5.309292
571	Sha1984	32	5	27	20.5	24.6	18.2	14.8	13.7	11.6	9.8	2.5	2.8	C	0.205	0.246	0.182	0.148	0.033006	0.326336	0.182482	66.82927	6.157522
572	Sha1984	32	6	27	31.5	34.4	28.4	24.2	16.8	14.8	12.2	2.5	2.8	C	0.315	0.344	0.284	0.242	0.077931	0.967736	0.14881	53.33333	6.157522
573	Sha1984	32	7	27	24	28.6	21.6	18.6	15.6	13.8	11.2	2.5	2.8	C	0.24	0.286	0.216	0.186	0.045239	0.547373	0.160256	65	6.157522
574	Sha1984	32	8	27	17	21.4	15.2	13.4	11.6	9.4	7.2	2.4	2.6	S	0.17	0.214	0.152	0.134	0.022698	0.192158	0.206897	68.23529	5.309292
575	Sha1984	32	9	27	16.4	18.8	14.2	12.8	10.8	8.8	6.4	2.4	2.6	S	0.164	0.188	0.142	0.128	0.021124	0.152495	0.222222	65.85366	5.309292
576	Sha1984	32	10	27	12.7	16.4	10.6	8.7	9.8	7.8	5.6	2.4	2.6	S	0.127	0.164	0.106	0.087	0.012668	0.081078	0.244898	77.16535	5.309292
577	Sha1984	32	11	27	23.8	27.6	19.8	15.9	14.8	12.6	10.4	2.5	2.8	C	0.238	0.276	0.198	0.159	0.044488	0.425979	0.168919	62.18487	6.157522
578	Sha1984	32	12	27	12.2	18.8	10.1	8.4	9.8	7.8	5.4	2.4	2.6	S	0.122	0.188	0.101	0.084	0.01169	0.084953	0.244898	80.32787	5.309292
579	Sha1984	32	13	27	11.2	15.8	9.1	8.2	9.8	7.4	5.2	2.4	2.6	S	0.112	0.158	0.091	0.082	0.009852	0.062781	0.244898	87.5	5.309292
580	Sha1984	32	14	27	18.7	23.8	16.4	13.7	10.7	8.6	6.6	2.5	2.8	C	0.187	0.238	0.164	0.137	0.027465	0.206007	0.233645	57.21925	6.157522
581	Sha1984	32	15	27	40	44.2	38.2	28.1	18.8	16.8	4.8	2.6	3.1	D	0.4	0.442	0.382	0.281	0.125664	1.886887	0.138298	47	7.547676
582	Sha1984	32	16	27	18.1	22.8	16.2	13.4	10.6	18.4	6.2	2.4	2.6	S	0.181	0.228	0.162	0.134	0.02573	0.421295	0.226415	58.56354	5.309292
583	Sha1984	32	17	27	24.5	28.6	20.4	18.1	14.8	12.8	10.6	2.5	2.8	C	0.245	0.286	0.204	0.181	0.047144	0.470855	0.168919	60.40816	6.157522
584	Sha1984	32	18	27	11.8	15.8	9.4	7.8	9.8	8.8	5.7	2.4	2.6	S	0.118	0.158	0.094	0.078	0.010936	0.076478	0.244898	83.05085	5.309292
585	Sha1984	32	19	27	25.1	28.9	21.2	16.4	14.8	12.6	10.8	2.5	2.8	C	0.251	0.289	0.212	0.164	0.049481	0.478626	0.168919	58.96414	6.157522
586	Sha1984	32	20	27	27.3	31.2	24.3	21.4	14.8	12.8	10.9	2.5	2.8	C	0.273	0.312	0.243	0.214	0.058535	0.635584	0.168919	54.21245	6.157522
587	Sha1984	32	21	27	15.1	17.8	12.4	10.2	11.6	9.4	7.1	2.4	2.6	S	0.151	0.178	0.124	0.102	0.017908	0.127466	0.206897	76.82119	5.309292
588	Sha1984	32	22	27	10.5	14.2	8.3	6.8	9.8	7.8	5.1	2.4	2.6	S	0.105	0.142	0.083	0.068	0.008659	0.053444	0.244898	93.33333	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
589	Sha1984	32	23	27	31.7	34.6	26.8	24.6	16.4	14.4	12.2	2.5	2.8	C	0.317	0.346	0.268	0.246	0.078924	0.88127	0.152439	51.73502	6.157522
590	Sha1984	32	24	27	28.7	32.6	24.6	20.7	15.6	13.6	11.4	2.5	2.8	C	0.287	0.326	0.246	0.207	0.064692	0.696409	0.160256	54.3554	6.157522
591	Sha1984	32	25	27	26.9	28.8	22.6	18.9	13.8	11.7	9.8	2.5	2.8	C	0.269	0.288	0.226	0.189	0.056832	0.494636	0.181159	51.30112	6.157522
592	Sha1984	32	26	27	40.2	44.4	28.6	26.8	18.8	16.8	14.8	2.6	3.1	D	0.402	0.444	0.286	0.268	0.126923	1.310989	0.138298	46.76617	7.547676
593	Sha1984	32	27	27	34.7	38.4	28.8	22.4	16.9	14.9	12.8	2.6	3.1	D	0.347	0.384	0.288	0.224	0.094569	1.03256	0.153846	48.70317	7.547676
594	J4-1990	33	1	21	28.4	32.4	25.2	16.1	10.1	9.8	8.4	2.6	2.8	C	0.284	0.324	0.252	0.161	0.063347	0.493773	0.257426	35.56338	6.157522
595	J4-1990	33	2	21	27.8	29.4	24.1	15.8	12.4	10.8	9.4	2.6	2.4	D	0.278	0.294	0.241	0.158	0.060699	0.485928	0.209677	44.60432	4.523893
596	J4-1990	33	3	21	26.7	28.6	22.8	14.9	13.6	11.1	9.6	2.7	3.3	D	0.267	0.286	0.228	0.149	0.05599	0.453234	0.198529	50.93633	8.552986
597	J4-1990	33	4	21	30.7	33.2	27.8	19.4	13.9	11.4	9.8	2.6	3.4	D	0.307	0.332	0.278	0.194	0.074023	0.681955	0.18705	45.27687	9.079203
598	J4-1990	33	5	21	20.5	24.1	18.4	14.1	10.1	9.9	8.7	2.5	2.9	C	0.205	0.241	0.184	0.141	0.033006	0.276528	0.247525	49.26829	6.605199
599	J4-1990	33	6	21	29.9	32.3	24.9	15.6	12.2	10.4	8.6	2.5	2.9	C	0.299	0.323	0.249	0.156	0.070215	0.512781	0.204918	40.80268	6.605199
600	J4-1990	33	7	21	28.5	31.4	23.9	16	10.4	9.9	10.2	2.6	2.8	C	0.285	0.314	0.239	0.16	0.063794	0.45704	0.25	36.49123	6.157522
601	J4-1990	33	8	21	23.8	27.4	21.4	12.9	10.8	9.8	9.1	2.6	2.9	C	0.238	0.274	0.214	0.129	0.044488	0.352648	0.240741	45.37815	6.605199
602	J4-1990	33	9	21	21.8	24.6	19.1	12.1	10.4	9.9	8.8	2.4	2.6	C	0.218	0.246	0.191	0.121	0.037325	0.2865	0.230769	47.70642	5.309292
603	J4-1990	33	10	21	24.8	27.3	21.3	13.1	10.9	10.1	9.4	2.6	2.8	C	0.248	0.273	0.213	0.131	0.048305	0.361149	0.238532	43.95161	6.157522
604	J4-1990	33	11	21	23.6	26.9	20.4	12.7	9.9	9.1	8.6	2.4	2.6	I	0.236	0.269	0.204	0.127	0.043744	0.303698	0.242424	41.94915	5.309292
605	J4-1990	33	12	21	22.5	25.8	19.5	11.8	10.8	10.4	9.3	2.6	2.9	C	0.225	0.258	0.195	0.118	0.039761	0.316635	0.240741	48	6.605199
606	J4-1990	33	13	21	24.2	27.4	21.6	12.9	10.4	9.2	8.1	2.5	2.9	C	0.242	0.274	0.216	0.129	0.045996	0.3352	0.240385	42.97521	6.605199
607	J4-1990	33	14	21	26	29.2	23.3	14.5	10.5	9.4	8.4	2.5	2.9	C	0.26	0.292	0.233	0.145	0.053093	0.397985	0.238095	40.38462	6.605199
608	J4-1990	33	15	21	23.6	27.1	20.4	14.2	10.3	9.8	8.8	2.5	2.8	C	0.236	0.271	0.204	0.142	0.043744	0.333621	0.242718	43.64407	6.157522
609	J4-1990	33	16	21	29.5	31.8	25.8	16.1	10.4	9.6	9.3	2.5	2.6	I	0.295	0.318	0.258	0.161	0.068349	0.494237	0.240385	35.25424	5.309292
610	J4-1990	33	17	21	17.8	19.9	14.2	11.1	8.4	7.8	6.9	2.4	2.5	S	0.178	0.199	0.142	0.111	0.024885	0.135364	0.285714	47.19101	4.908739
611	J4-1990	33	18	21	31.8	34.1	28.9	17.6	13.4	11.4	10.2	2.8	3.4	D	0.318	0.341	0.289	0.176	0.079423	0.718284	0.208955	42.13836	9.079203
612	J4-1990	33	19	21	30.6	33.8	27.8	17.1	10.9	10.4	9.8	2.6	2.9	C	0.306	0.338	0.278	0.171	0.073542	0.616179	0.238532	35.62092	6.605199
613	J4-1990	33	20	21	22.7	25.1	19.1	12.1	9.5	8.9	9.1	2.4	2.6	I	0.227	0.251	0.191	0.121	0.040471	0.260456	0.252632	41.85022	5.309292
614	J4-1990	33	21	21	24	26.3	20.4	13.4	9.5	8.4	6.4	2.4	2.6	I	0.24	0.263	0.204	0.134	0.045239	0.278836	0.252632	39.58333	5.309292
615	J4-1990	34	1	21	19.5	21.6	17.2	11.8	9.1	8.4	7.2	2.4	2.6	I	0.195	0.216	0.172	0.118	0.029865	0.196728	0.263736	46.66667	5.309292
616	J4-1990	34	2	21	13.3	21.4	16.4	10.9	10.4	8.9	6.9	2.5	2.9	C	0.133	0.214	0.164	0.109	0.013893	0.19253	0.240385	78.19549	6.605199

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
617	J4-1990	34	3	21	27.8	29.9	25.1	14.2	10.9	9.2	8.4	2.6	2.9	C	0.278	0.299	0.251	0.142	0.060699	0.435429	0.238532	39.20863	6.605199
618	J4-1990	34	4	21	21.8	24.1	19.6	12.6	8.9	8.4	7.7	2.4	2.6	I	0.218	0.241	0.196	0.126	0.037325	0.250282	0.269663	40.82569	5.309292
619	J4-1990	34	5	21	24.5	26.4	22.1	13.8	10.2	9.4	8.3	2.5	2.9	C	0.245	0.264	0.221	0.138	0.047144	0.349578	0.245098	41.63265	6.605199
620	J4-1990	34	6	21	19.5	22.1	16.8	11.6	8.9	8.5	7.8	2.5	2.6	I	0.195	0.221	0.168	0.116	0.029865	0.194928	0.280899	45.64103	5.309292
621	J4-1990	34	7	21	24.3	26.3	21.4	12.8	10.1	9.6	8.2	2.6	2.9	C	0.243	0.263	0.214	0.128	0.046377	0.337705	0.257426	41.56379	6.605199
622	J4-1990	34	8	21	27.5	29.8	25.4	13.9	11.9	10.4	8.5	2.9	3.4	D	0.275	0.298	0.254	0.139	0.059396	0.498514	0.243697	43.27273	9.079203
623	J4-1990	34	9	21	18.5	22.1	16.2	11.4	10.6	8.8	7.2	2.5	2.9	C	0.185	0.221	0.162	0.114	0.02688	0.192155	0.235849	57.2973	6.605199
624	J4-1990	34	10	21	18.6	21.9	16.1	11.1	10.4	8.9	6.4	2.6	2.9	C	0.186	0.219	0.161	0.111	0.027172	0.191022	0.25	55.91398	6.605199
625	J4-1990	34	11	21	22.6	25.1	20.1	12.2	10.1	8.8	7.2	2.6	2.9	C	0.226	0.251	0.201	0.122	0.040115	0.275872	0.257426	44.69027	6.605199
626	J4-1990	34	12	21	18	21.9	15.9	11	9.9	8.2	6.8	2.7	2.9	C	0.18	0.219	0.159	0.11	0.025447	0.173012	0.272727	55	6.605199
627	J4-1990	34	13	21	17.2	20.6	14.4	9.6	8.4	7.9	7.1	2.4	2.6	I	0.172	0.206	0.144	0.096	0.023235	0.139187	0.285714	48.83721	5.309292
628	J4-1990	34	14	21	17.5	21.2	14.5	9.8	8.2	7.6	7.3	2.4	2.6	I	0.175	0.212	0.145	0.098	0.024053	0.137932	0.292683	46.85714	5.309292
629	J4-1990	34	15	21	28.7	31.1	26.4	14.1	11.4	10.9	9.2	2.9	3.4	D	0.287	0.311	0.264	0.141	0.064692	0.564139	0.254386	39.72125	9.079203
630	J4-1990	34	16	21	21.5	24.2	19.1	12.4	10	8.9	7.1	2.5	2.9	C	0.215	0.242	0.191	0.124	0.036305	0.256143	0.25	46.51163	6.605199
631	J4-1990	34	17	21	25.7	29.9	23.4	13.5	10.9	10.4	8.4	2.6	2.8	C	0.257	0.299	0.234	0.135	0.051875	0.444687	0.238532	42.41245	6.157522
632	J4-1990	34	18	21	20.8	22.8	18.6	11.9	9.9	8.1	7.8	2.5	2.9	C	0.208	0.228	0.186	0.119	0.033979	0.21686	0.252525	47.59615	6.605199
633	J4-1990	34	19	21	22.5	25.2	20.1	12.1	11.4	10.6	9.4	2.6	2.9	D	0.225	0.252	0.201	0.121	0.039761	0.332661	0.22807	50.66667	6.605199
634	J4-1990	34	20	21	30.8	32.9	28.7	14.8	12.5	11.4	10.6	2.9	3.4	D	0.308	0.329	0.287	0.148	0.074506	0.685872	0.232	40.58442	9.079203
635	J4-1990	34	21	21	18.7	21.5	15.6	11.1	9.2	8.4	7.2	2.4	2.6	I	0.187	0.215	0.156	0.111	0.027465	0.17141	0.26087	49.19786	5.309292
636	J4-1990	34	22	21	17.5	20.6	14.4	9.8	9.4	8.6	6.8	2.4	2.6	I	0.175	0.206	0.144	0.098	0.024053	0.151957	0.255319	53.71429	5.309292
637	J4-1990	35	1	21	39.4	41.2	34.8	14.8	13.4	11.6	10.4	2.9	3.2	D	0.394	0.412	0.348	0.148	0.121922	1.02656	0.216418	34.01015	8.042477
638	J4-1990	35	2	21	31.8	33.4	29.2	13.4	11.9	10.8	7.2	2.8	3.4	D	0.318	0.334	0.292	0.134	0.079423	0.66525	0.235294	37.42138	9.079203
639	J4-1990	35	3	21	26.7	24.6	24.7	12.5	11.4	10.4	6.8	2.9	3.1	D	0.267	0.246	0.247	0.125	0.05599	0.435875	0.254386	42.69663	7.547676
640	J4-1990	35	4	21	18.8	21.4	16.4	11.8	8.6	7.2	5.7	2.4	2.6	I	0.188	0.214	0.164	0.118	0.027759	0.15768	0.27907	45.74468	5.309292
641	J4-1990	35	5	21	20.2	23.5	19.4	11.9	9.2	8.4	6.1	2.5	2.9	C	0.202	0.235	0.194	0.119	0.032047	0.241826	0.271739	45.54455	6.605199
642	J4-1990	35	6	21	22.2	24.6	20.2	12	9.4	8.5	6.4	2.6	2.8	C	0.222	0.246	0.202	0.12	0.038708	0.264957	0.276596	42.34234	6.157522
643	J4-1990	35	7	21	24.5	26.2	21.3	12.1	9.7	8.6	6.6	2.9	3.3	D	0.245	0.262	0.213	0.121	0.047144	0.298051	0.298969	39.59184	8.552986
644	J4-1990	35	8	21	21	23.4	19.2	11.8	8.4	7.3	5.8	2.4	2.6	I	0.21	0.234	0.192	0.118	0.034636	0.206533	0.285714	40	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
645	J4-1990	35	9	21	32.1	35.1	29.8	13.1	11.8	10.5	8.4	2.9	3.4	D	0.321	0.351	0.298	0.131	0.080928	0.681146	0.245763	36.76012	9.079203
646	J4-1990	35	10	21	17.8	20.6	15.1	10.2	8.4	7	5.4	2.4	2.6	I	0.178	0.206	0.151	0.102	0.024885	0.131987	0.285714	47.19101	5.309292
647	J4-1990	35	11	21	26.5	29.8	24.3	12.4	7.9	6.9	4.8	2.4	2.7	I	0.265	0.298	0.243	0.124	0.055155	0.30743	0.303797	29.81132	5.725553
648	J4-1990	35	12	21	22.5	25.1	20.1	11.8	10.1	9.1	7.8	2.5	2.9	C	0.225	0.251	0.201	0.118	0.039761	0.284133	0.247525	44.88889	6.605199
649	J4-1990	35	13	21	26	28	24.3	12.4	9.9	8.6	6.1	2.6	2.8	C	0.26	0.28	0.243	0.124	0.053093	0.371462	0.262626	38.07692	6.157522
650	J4-1990	35	14	21	27.2	29.8	25.1	12.6	10.1	8.9	6.4	2.5	2.9	C	0.272	0.298	0.251	0.126	0.058107	0.415539	0.247525	37.13235	6.605199
651	J4-1990	35	15	21	18	21.4	16.3	10.3	9.7	8.8	6.6	2.4	2.6	I	0.18	0.214	0.163	0.103	0.025447	0.187395	0.247423	53.88889	5.309292
652	J4-1990	35	16	21	38.8	40.2	35.6	14.9	11.8	10.6	9.8	2.8	3.4	D	0.388	0.402	0.356	0.149	0.118237	0.95844	0.237288	30.41237	9.079203
653	J4-1990	35	17	21	26.7	29.4	24.3	12.4	9.8	8.6	7.2	2.6	2.3	C	0.267	0.294	0.243	0.124	0.05599	0.380508	0.265306	36.70412	4.154756
654	J4-1990	35	18	21	11.5	14.1	9.4	8.3	7.5	5.4	3.4	2.4	2.6	S	0.115	0.141	0.094	0.083	0.010387	0.043906	0.32	65.21739	5.309292
655	J4-1990	35	19	21	26	28.9	24.2	12.1	9.9	8.4	6.9	2.5	2.9	C	0.26	0.289	0.242	0.121	0.053093	0.365513	0.252525	38.07692	6.605199
656	J4-1990	35	20	21	25.5	28.1	23.4	11.8	9.8	8.8	7.4	2.5	2.8	C	0.255	0.281	0.234	0.118	0.051071	0.359293	0.255102	38.43137	6.157522
657	J4-1990	35	21	21	15.7	17.6	13.8	9.4	8.9	7.2	6	2.4	2.8	S	0.157	0.176	0.138	0.094	0.019359	0.109316	0.269663	56.6879	6.157522
658	J4-1990	35	22	21	27.5	29.8	25.4	12	9.7	8.9	7.8	2.5	2.9	C	0.275	0.298	0.254	0.12	0.059396	0.42088	0.257732	35.27273	6.605199
659	J4-1990	35	23	21	26.7	23.7	24.6	12	9.8	8.4	6.9	2.4	2.6	C	0.267	0.237	0.246	0.12	0.05599	0.343758	0.244898	36.70412	5.309292
660	J4-1990	36	1	21	25.2	27.4	23.6	13.8	10.2	8.6	6.2	2.6	3	C	0.252	0.274	0.236	0.138	0.049876	0.356751	0.254902	40.47619	7.068583
661	J4-1990	36	2	21	40	42.3	38.6	29.8	7.4	11.4	7.4	2.6	3.2	D	0.4	0.423	0.386	0.298	0.125664	1.288887	0.351351	18.5	8.042477
662	J4-1990	36	3	21	24.6	26.8	21.4	13.6	9.9	8.3	7.3	2.5	2.9	C	0.246	0.268	0.214	0.136	0.047529	0.297153	0.252525	40.2439	6.605199
663	J4-1990	36	4	21	29.5	32.1	26.8	14.1	10.1	9.9	8.1	2.6	3	C	0.295	0.321	0.268	0.141	0.068349	0.531604	0.257426	34.23729	7.068583
664	J4-1990	36	5	21	19	22.4	16.8	11.2	8.5	6.4	5.8	2.4	2.6	I	0.19	0.224	0.168	0.112	0.028353	0.147124	0.282353	44.73684	5.309292
665	J4-1990	36	6	21	25.5	27.6	22.9	12.8	10.4	9.6	8.4	2.6	2.9	C	0.255	0.276	0.229	0.128	0.051071	0.379912	0.25	40.78431	6.605199
666	J4-1990	36	7	21	17	19.8	15.2	10.4	8.6	7.4	6.4	2.4	2.6	I	0.17	0.198	0.152	0.104	0.022698	0.137972	0.27907	50.58824	5.309292
667	J4-1990	36	8	21	25	26.9	23.4	8.6	12.9	11.1	9.2	2.6	3.4	D	0.25	0.269	0.234	0.086	0.049087	0.434125	0.20155	51.6	9.079203
668	J4-1990	36	9	21	21.2	23.8	18.8	12.9	10.3	9.8	8.1	2.5	2.9	C	0.212	0.238	0.188	0.129	0.035299	0.275371	0.242718	48.58491	6.605199
669	J4-1990	36	10	21	29	32.1	26.7	10.3	12.8	10.4	8.9	2.7	3.3	D	0.29	0.321	0.267	0.103	0.066052	0.542917	0.210938	44.13793	8.552986
670	J4-1990	36	11	21	32.6	36.4	29.8	12.8	13.4	11.9	10.4	2.6	3.6	D	0.326	0.364	0.298	0.128	0.083469	0.785234	0.19403	41.10429	10.17876
671	J4-1990	36	12	21	27.5	30.4	25.1	13.4	10.9	10.2	9.1	2.6	2.9	C	0.275	0.304	0.251	0.134	0.059396	0.483836	0.238532	39.63636	6.605199
672	J4-1990	36	13	21	24.2	29.3	21.9	10.9	10.9	10.2	9.4	2.4	2.8	C	0.242	0.293	0.219	0.109	0.045996	0.386633	0.220183	45.04132	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
673	J4-1990	36	14	21	31.5	33.4	29.4	12.9	12.9	11.8	10.5	2.9	3.4	D	0.315	0.334	0.294	0.129	0.077931	0.732057	0.224806	40.95238	9.079203
674	J4-1990	36	15	21	23.5	27.1	20.9	10.4	10.4	9.8	8.4	2.4	2.8	C	0.235	0.271	0.209	0.104	0.043374	0.332225	0.230769	44.25532	6.157522
675	J4-1990	36	16	21	27.5	31.2	25.2	10.6	10.6	9.9	8.3	2.4	2.9	C	0.275	0.312	0.252	0.106	0.059396	0.469891	0.226415	38.54545	6.605199
676	J4-1990	36	17	21	27.5	30.6	25.4	10.2	10.2	9.6	8.6	2.6	2.8	C	0.275	0.306	0.254	0.102	0.059396	0.455033	0.254902	37.09091	6.157522
677	J4-1990	36	18	21	13.5	17.8	11.1	3.6	8.6	7.2	5.4	2.4	2.5	I	0.135	0.178	0.111	0.036	0.014314	0.077532	0.27907	63.7037	4.908739
678	J4-1990	36	19	21	16.8	19.4	13.9	8.2	8.2	7.4	6.3	2.4	2.6	I	0.168	0.194	0.139	0.082	0.022167	0.117831	0.292683	48.80952	5.309292
679	J4-1990	36	20	21	19.5	21.5	16.9	11.9	11.9	10.6	9.2	2.8	3.5	D	0.195	0.215	0.169	0.119	0.029865	0.242306	0.235294	61.02564	9.621128
680	J4-1990	36	21	21	19	20.7	13.6	8.1	8.1	7.6	6.4	2.4	2.6	I	0.19	0.207	0.136	0.081	0.028353	0.122757	0.296296	42.63158	5.309292
681	J4-1990	36	22	21	40.5	43.3	38.2	13.6	13.6	12.8	11.3	2.9	3.4	D	0.405	0.433	0.382	0.136	0.128825	1.323123	0.213235	33.58025	9.079203
682	J4-1990	36	23	21	26.2	29.4	24.7	12.9	12.9	11.6	10.4	2.9	3.6	D	0.262	0.294	0.247	0.129	0.053913	0.527069	0.224806	49.23664	10.17876
683	J4-1990	36	24	21	27.5	30.1	25.2	10.8	10.8	10.1	9.2	2.6	2.9	C	0.275	0.301	0.252	0.108	0.059396	0.471034	0.240741	39.27273	6.605199
684	J4-1990	36	25	21	20.2	23.4	17.3	10.6	10.6	9.8	8.4	2.7	2.8	C	0.202	0.234	0.173	0.106	0.032047	0.238229	0.254717	52.47525	6.157522
685	J4-1990	36	26	21	23.6	27.1	20.9	10.4	10.4	8.8	7.4	2.6	2.8	C	0.236	0.271	0.209	0.104	0.043744	0.298325	0.25	44.0678	6.157522
686	J4-1990	36	27	21	23	26.8	21.1	10.2	10.2	8.4	6.9	2.6	2.9	S	0.23	0.268	0.211	0.102	0.041548	0.286228	0.254902	44.34783	6.605199
687	J4-1990	37	1	21	30	32.1	28.6	18.1	10.4	9.2	5.9	2.6	2.9	C	0.3	0.321	0.286	0.181	0.070686	0.557563	0.25	34.66667	6.605199
688	J4-1990	37	2	21	12	14.8	10.2	9.1	7.4	5.3	4.2	2.5	2.6	S	0.12	0.148	0.102	0.091	0.01131	0.049813	0.337838	61.66667	5.309292
689	J4-1990	37	3	21	16	19.1	14.3	10.2	8.1	7.2	5.6	2.4	2.7	I	0.16	0.191	0.143	0.102	0.020106	0.121279	0.296296	50.625	5.725553
690	J4-1990	37	4	21	23.3	26.6	21.4	11.8	8.4	7.6	5.4	2.4	2.8	I	0.233	0.266	0.214	0.118	0.042638	0.266481	0.285714	36.0515	6.157522
691	J4-1990	37	5	21	15.5	18.1	13.4	10.2	8.6	6.4	4.6	2.4	2.8	I	0.155	0.181	0.134	0.102	0.018869	0.096333	0.27907	55.48387	6.157522
692	J4-1990	37	6	21	18.3	21.2	16.2	11.2	8.4	7.8	4.5	2.4	2.9	I	0.183	0.212	0.162	0.112	0.026302	0.165879	0.285714	45.90164	6.605199
693	J4-1990	37	7	21	11.5	14.6	9.4	8.1	8.2	6.3	4.1	2.4	2.8	I	0.115	0.146	0.094	0.081	0.010387	0.052136	0.292683	71.30435	6.157522
694	J4-1990	37	8	21	19.2	22.3	16.8	11.1	7.6	5.4	4.6	2.3	2.9	S	0.192	0.223	0.168	0.111	0.028953	0.123662	0.302632	39.58333	6.605199
695	J4-1990	37	9	21	32.5	36.1	29.1	16.9	11.9	10.4	8.9	2.9	3.4	D	0.325	0.361	0.291	0.169	0.082958	0.677419	0.243697	36.61538	9.079203
696	J4-1990	37	10	21	33.8	37.2	30.3	19.4	10.2	9.8	8.6	2.8	3.1	C	0.338	0.372	0.303	0.194	0.089727	0.696898	0.27451	30.17751	7.547676
697	J4-1990	37	11	21	23.5	26.1	21.4	11.6	10.4	9.9	7.8	2.8	3	C	0.235	0.261	0.214	0.116	0.043374	0.343106	0.269231	44.25532	7.068583
698	J4-1990	37	12	21	14.5	17.4	11.9	9.4	7.9	7	6.2	2.4	2.6	S	0.145	0.174	0.119	0.094	0.016513	0.087741	0.303797	54.48276	5.309292
699	J4-1990	37	13	21	12.8	15.6	10.4	8.6	7.4	5.6	4.9	2.5	2.7	S	0.128	0.156	0.104	0.086	0.012868	0.054975	0.337838	57.8125	5.725553
700	J4-1990	37	14	21	19.2	21.4	16.4	11.7	8.1	7.4	5.3	2.4	2.6	I	0.192	0.214	0.164	0.117	0.028953	0.161833	0.296296	42.1875	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
701	J4-1990	37	15	21	39.2	42.1	35.9	19.8	12.8	11.8	10.2	2.9	3.4	D	0.392	0.421	0.359	0.198	0.120687	1.130611	0.226563	32.65306	9.079203
702	J4-1990	37	16	21	30.2	34.1	28.8	15.1	12.6	11.4	9.4	2.8	3.5	D	0.302	0.341	0.288	0.151	0.071631	0.702641	0.222222	41.72185	9.621128
703	J4-1990	37	17	21	20	22.4	19.2	12.2	8.4	7.1	6.8	2.6	2.8	I	0.2	0.224	0.192	0.122	0.031416	0.19751	0.309524	42	6.157522
704	J4-1990	37	18	21	14	16.4	12.4	9.6	8.1	7.4	6.4	2.4	2.7	I	0.14	0.164	0.124	0.096	0.015394	0.094556	0.296296	57.85714	5.725553
705	J4-1990	37	19	21	24.5	26.8	21.3	11.9	10.1	9.4	7.2	2.9	3	C	0.245	0.268	0.213	0.119	0.047144	0.329099	0.287129	41.22449	7.068583
706	J4-1990	37	20	21	33.8	36.4	29.9	12.4	12.4	11.6	9.4	2.9	3.6	D	0.338	0.364	0.299	0.124	0.089727	0.767533	0.233871	36.68639	10.17876
707	J4-1990	37	21	21	19.5	21.8	17.4	11	8.5	7.2	6.2	2.5	2.9	I	0.195	0.218	0.174	0.11	0.029865	0.170332	0.294118	43.58974	6.605199
708	J4-1990	37	22	21	16	18.4	14.8	11.1	8.1	6.9	5.9	2.4	2.8	I	0.16	0.184	0.148	0.111	0.020106	0.120843	0.296296	50.625	6.157522
709	J4-1990	37	23	21	11.5	13.2	9.4	8.4	7.3	6.1	5.2	2.4	2.6	S	0.115	0.132	0.094	0.084	0.010387	0.047769	0.328767	63.47826	5.309292
710	J4-1990	37	24	21	12.5	15.3	10.2	8.6	7.4	6.3	5.4	2.5	2.7	S	0.125	0.153	0.102	0.086	0.012272	0.059723	0.337838	59.2	5.725553
711	J4-1990	37	25	21	24	26.8	20.4	11.8	10.1	9.2	7.1	2.6	2.8	C	0.24	0.268	0.204	0.118	0.045239	0.303733	0.257426	42.08333	6.157522
712	J4-1990	37	26	21	28.4	32.2	24.2	11.9	10.9	9.8	8.9	2.7	2.9	C	0.284	0.322	0.242	0.119	0.063347	0.451681	0.247706	38.38028	6.605199
713	J4-1990	37	27	21	22.2	25.6	19.2	10.4	10.8	9.9	8.4	2.8	2.9	C	0.222	0.256	0.192	0.104	0.038708	0.290034	0.259259	48.64865	6.605199
714	J4-1990	37	28	21	14.8	17.4	11.9	9.4	8.6	7.5	6.3	2.4	2.9	I	0.148	0.174	0.119	0.094	0.017203	0.094008	0.27907	58.10811	6.605199
715	J4-1990	37	29	21	19.8	21.8	16.8	10.4	10.4	9.9	8.8	2.8	3	C	0.198	0.218	0.168	0.104	0.030791	0.221906	0.269231	52.52525	7.068583
716	J4-1990	37	30	21	12.2	16.7	10.1	9.2	8.3	6.5	5.4	2.9	2.6	S	0.122	0.167	0.101	0.092	0.01169	0.065649	0.349398	68.03279	5.309292
717	J4-1990	37	31	21	15.2	17.4	13.2	10.2	8.4	7.1	5.2	2.5	2.8	S	0.152	0.174	0.132	0.102	0.018146	0.102582	0.297619	55.26316	6.157522
718	J4-1990	37	32	21	15.5	17.8	12.9	9.2	8.4	7	5.4	2.6	2.9	S	0.155	0.178	0.129	0.092	0.018869	0.09778	0.309524	54.19355	6.605199
719	J4-1990	37	33	21	25.5	27.6	21.4	11.4	10.1	8.4	6.9	2.6	3	C	0.255	0.276	0.214	0.114	0.051071	0.299471	0.257426	39.60784	7.068583
720	J4-1990	37	34	21	23.5	26.4	20.6	15.2	10.2	8.2	6.5	2.7	3.1	C	0.235	0.264	0.206	0.152	0.043374	0.281809	0.264706	43.40426	7.547676
721	J4-1990	37	35	21	17	21.2	15.6	11.4	9.9	8	5.2	2.6	3	C	0.17	0.212	0.156	0.114	0.022698	0.162613	0.262626	58.23529	7.068583
722	J4-1990	37	36	21	17.2	20.6	15.2	11.6	9.8	8.1	5.3	2.7	2.9	C	0.172	0.206	0.152	0.116	0.023235	0.157249	0.27551	56.97674	6.605199
723	J4-1990	37	37	21	18.8	21.4	16.4	12.1	10.1	8.3	6.1	2.6	3.1	C	0.188	0.214	0.164	0.121	0.027759	0.182549	0.257426	53.7234	7.547676
724	J4-1990	37	38	21	33.3	36.4	30.6	18.1	12.4	10.6	9.4	2.9	3.4	D	0.333	0.364	0.306	0.181	0.087092	0.748994	0.233871	37.23724	9.079203
725	J4-1990	37	39	21	19.5	22.2	17.2	11.9	9.8	8.8	6.5	2.4	2.9	C	0.195	0.222	0.172	0.119	0.029865	0.209397	0.244898	50.25641	6.605199
726	J4-1990	37	40	21	24.5	26.9	21.9	12.2	9.9	8.7	7.4	2.5	2.9	C	0.245	0.269	0.219	0.122	0.047144	0.317834	0.252525	40.40816	6.605199
727	J4-1990	37	41	21	31.2	35.6	29.8	16.9	11.9	10.8	8.9	2.8	3.6	D	0.312	0.356	0.298	0.169	0.076454	0.721721	0.235294	38.14103	10.17876
728	J4-1990	37	42	21	26.5	28.4	24.2	17.4	10.2	9.1	7.2	2.9	3.1	C	0.265	0.284	0.242	0.174	0.055155	0.411184	0.284314	38.49057	7.547676

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
729	J4-1990	37	43	21	16.5	18.8	14.3	11.4	7.8	6.9	6.4	2.6	2.9	S	0.165	0.188	0.143	0.114	0.021382	0.11754	0.333333	47.27273	6.605199
730	J4-1990	38	1	21	26	29.2	24.3	14.1	10.1	8.2	5.8	2.6	3.1	C	0.26	0.292	0.243	0.141	0.053093	0.366388	0.257426	38.84615	7.547676
731	J4-1990	38	2	21	27.3	29.5	25.1	13.2	12.9	10.4	8.2	2.8	3.6	D	0.273	0.295	0.251	0.132	0.058535	0.48526	0.217054	47.25275	10.17876
732	J4-1990	38	3	21	28.5	30.2	24.9	14.3	10.4	9.6	7.2	2.9	3.1	C	0.285	0.302	0.249	0.143	0.063794	0.451958	0.278846	36.49123	7.547676
733	J4-1990	38	4	21	22.2	27.4	17.4	11.4	10.1	8.9	6.4	2.8	3.2	C	0.222	0.274	0.174	0.114	0.038708	0.243692	0.277228	45.4955	8.042477
734	J4-1990	38	5	21	16.8	19.5	14.2	10.4	8.9	6.4	5.1	2.6	2.9	I	0.168	0.195	0.142	0.104	0.022167	0.108487	0.292135	52.97619	6.605199
735	J4-1990	38	6	21	10	12.4	9.1	8.2	7.9	5.2	4.8	2.5	2.8	S	0.1	0.124	0.091	0.082	0.007854	0.03759	0.316456	79	6.157522
736	J4-1990	38	7	21	15.5	17.8	13.2	10.8	7.8	6.1	5.6	2.6	2.9	S	0.155	0.178	0.132	0.108	0.018869	0.090264	0.333333	50.32258	6.605199
737	J4-1990	38	8	21	20.6	22.4	17.9	13.1	10.1	8.9	6.8	2.8	2.9	C	0.206	0.224	0.179	0.131	0.033329	0.22776	0.277228	49.02913	6.605199
738	J4-1990	38	9	21	20.4	22.5	18.4	12.2	9.9	8.8	6.8	2.7	3.1	C	0.204	0.225	0.184	0.122	0.032685	0.231458	0.272727	48.52941	7.547676
739	J4-1990	38	10	21	23.5	25.2	20.2	14.1	10.2	8.9	7.4	2.6	3.9	C	0.235	0.252	0.202	0.141	0.043374	0.287292	0.254902	43.40426	11.94591
740	J4-1990	38	11	21	22.5	25	19.8	13.8	10.2	8.8	7.4	2.4	2.8	C	0.225	0.25	0.198	0.138	0.039761	0.274571	0.235294	45.33333	6.157522
741	J4-1990	38	12	21	23.7	25.1	21.2	12.4	10.1	9.1	7.2	2.6	3.1	C	0.237	0.251	0.212	0.124	0.044115	0.307509	0.257426	42.61603	7.547676
742	J4-1990	38	13	21	21.5	24.8	18.9	12.1	9.7	8.9	6.8	2.8	3	C	0.215	0.248	0.189	0.121	0.036305	0.25517	0.28866	45.11628	7.068583
743	J4-1990	38	14	21	15	17.3	13.4	9.4	7.3	6.4	5.4	2.8	2.8	S	0.15	0.173	0.134	0.094	0.017671	0.092647	0.383562	48.66667	6.157522
744	J4-1990	38	15	21	12.5	15.4	10.1	8.1	7.1	6.3	5.8	2.7	2.6	S	0.125	0.154	0.101	0.081	0.012272	0.058618	0.380282	56.8	5.309292
745	J4-1990	38	16	21	18.5	21.2	16.2	11.2	9.6	7.8	6.2	2.5	2.6	I	0.185	0.212	0.162	0.112	0.02688	0.165879	0.260417	51.89189	5.309292
746	J4-1990	38	17	21	39.2	42.1	36.4	17.5	13.1	11.9	10.9	2.9	3.4	D	0.392	0.421	0.364	0.175	0.120687	1.149354	0.221374	33.41837	9.079203
747	J4-1990	38	18	21	18.8	21.3	16.5	10.8	9.2	7.9	5.4	2.4	2.7	I	0.188	0.213	0.165	0.108	0.027759	0.171593	0.26087	48.93617	5.725553
748	J4-1990	38	19	21	15.2	16.9	13.5	9.6	9.1	7.8	4.2	2.4	2.8	I	0.152	0.169	0.135	0.096	0.018146	0.113003	0.263736	59.86842	6.157522
749	J4-1990	38	20	21	15.2	17.4	13.4	9.9	9.6	7.7	5.4	2.5	2.9	I	0.152	0.174	0.134	0.099	0.018146	0.112788	0.260417	63.15789	6.605199
750	J4-1990	38	21	21	20.4	22.6	18.4	12.1	9.8	8.1	6.2	2.6	2.8	I	0.204	0.226	0.184	0.121	0.032685	0.213267	0.265306	48.03922	6.157522
751	J4-1990	38	22	21	30.5	32.4	27.8	14.1	12.9	10.9	9.7	2.9	3.4	D	0.305	0.324	0.278	0.141	0.073062	0.619224	0.224806	42.29508	9.079203
752	J4-1990	38	23	21	31.7	32.2	29.4	12.4	13.4	11.2	10.2	2.8	3.5	D	0.317	0.322	0.294	0.124	0.078924	0.681438	0.208955	42.27129	9.621128
753	J4-1990	38	24	21	25.6	27.4	22.6	11.6	10.8	9.8	8.2	2.7	2.9	C	0.256	0.274	0.226	0.116	0.051472	0.375655	0.25	42.1875	6.605199
754	J4-1990	38	25	21	23.5	25.4	21.4	10.1	10.4	9.6	7.9	2.8	2.9	C	0.235	0.254	0.214	0.101	0.043374	0.324088	0.269231	44.25532	6.605199
755	J4-1990	38	26	21	35.5	37.3	31.2	19.3	13.2	11.8	10.4	2.9	3.4	D	0.355	0.373	0.312	0.193	0.09898	0.873873	0.219697	37.1831	9.079203
756	J4-1990	38	27	21	23	25.3	19.8	11.4	11.1	9.2	7.9	2.6	3.1	C	0.23	0.253	0.198	0.114	0.041548	0.281585	0.234234	48.26087	7.547676

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
757	J4-1990	38	28	21	28.2	31.4	24.8	14.1	10.8	9.8	8.4	2.7	3	C	0.282	0.314	0.248	0.141	0.062458	0.467578	0.25	38.29787	7.068583
758	J4-1990	38	29	21	29	32.2	25.9	13.2	10.9	10.1	8.7	2.6	3.1	C	0.29	0.322	0.259	0.132	0.066052	0.514863	0.238532	37.58621	7.547676
759	J4-1990	38	30	21	23.5	27.1	20.4	13.6	10.4	9.8	7.8	2.9	3	C	0.235	0.271	0.204	0.136	0.043374	0.331481	0.278846	44.25532	7.068583
760	J4-1990	38	31	21	17.3	19.4	15.2	10.2	8.8	8	6.9	2.6	2.8	I	0.173	0.194	0.152	0.102	0.023506	0.147085	0.295455	50.86705	6.157522
761	J4-1990	39	1	21	24	26.4	22.1	11.6	10.6	9.4	8.2	2.8	3.1	C	0.24	0.264	0.221	0.116	0.045239	0.342702	0.264151	44.16667	7.547676
762	J4-1990	39	2	21	27.8	29.4	21.9	12.1	11.2	9.2	8.8	2.9	2.8	C	0.278	0.294	0.219	0.121	0.060699	0.352758	0.258929	40.28777	6.157522
763	J4-1990	39	3	21	28.2	31.2	23.8	15.1	11.4	10.4	8.9	2.9	3.2	C	0.282	0.312	0.238	0.151	0.062458	0.472011	0.254386	40.42553	8.042477
764	J4-1990	39	4	21	20.5	24.3	18.4	14.6	10.8	9.1	7.4	2.9	3.1	C	0.205	0.243	0.184	0.146	0.033006	0.257045	0.268519	52.68293	7.547676
765	J4-1990	39	5	21	10.2	12.6	8.9	7.2	7.8	7.2	5.2	2.6	2.8	S	0.102	0.126	0.089	0.072	0.008171	0.04971	0.333333	76.47059	6.157522
766	J4-1990	39	6	21	16.5	18.6	14.8	10.4	8.2	6.4	4.5	2.4	2.9	S	0.165	0.186	0.148	0.104	0.021382	0.111445	0.292683	49.69697	6.605199
767	J4-1990	39	7	21	13.8	17.4	12.2	10.9	7.6	7.1	5.2	2.5	2.8	S	0.138	0.174	0.122	0.109	0.014957	0.094512	0.328947	55.07246	6.157522
768	J4-1990	39	8	21	18.5	21.2	15.8	11.4	9.2	8.2	6.9	2.6	2.9	I	0.185	0.212	0.158	0.114	0.02688	0.169375	0.282609	49.72973	6.605199
769	J4-1990	39	9	21	19.2	21.8	16.9	12.1	9.4	8.4	7.2	2.5	2.8	I	0.192	0.218	0.169	0.121	0.028953	0.193972	0.265957	48.95833	6.157522
770	J4-1990	39	10	21	34.8	37.2	29.6	15.3	13.4	12.5	10.4	2.7	3.3	D	0.348	0.372	0.296	0.153	0.095115	0.838179	0.201493	38.50575	8.552986
771	J4-1990	39	11	21	27.8	31.1	25.4	13.1	12.9	11.9	9.9	2.6	3.4	D	0.278	0.311	0.254	0.131	0.060699	0.579383	0.20155	46.40288	9.079203
772	J4-1990	39	12	21	32.8	36.4	29.8	14.8	12.8	11.8	10.1	2.6	3.2	D	0.328	0.364	0.298	0.148	0.084496	0.787161	0.203125	39.02439	8.042477
773	J4-1990	39	13	21	10.2	12.6	9.6	7.4	7.8	6.4	4.2	2.4	2.9	S	0.102	0.126	0.096	0.074	0.008171	0.048771	0.307692	76.47059	6.605199
774	J4-1990	39	14	21	9.2	11.1	8.4	6.9	7.4	6.1	4.3	2.5	2.8	S	0.092	0.111	0.084	0.069	0.006648	0.036176	0.337838	80.43478	6.157522
775	J4-1990	39	15	21	11.2	12.9	10.3	6.9	7.4	6.2	4.5	2.4	2.9	S	0.112	0.129	0.103	0.069	0.009852	0.05181	0.324324	66.07143	6.605199
776	J4-1990	39	16	21	17.2	20.2	15.2	11.2	8.4	7.3	5.3	2.4	2.9	I	0.172	0.202	0.152	0.112	0.023235	0.139287	0.285714	48.83721	6.605199
777	J4-1990	39	17	21	14.6	17.8	12.7	9.2	7.3	6.1	6.1	2.6	2.3	S	0.146	0.178	0.127	0.092	0.016742	0.083573	0.356164	50	4.154756
778	J4-1990	39	18	21	22.3	24.5	26.8	12.4	11.9	10.8	9.4	2.8	3.1	C	0.223	0.245	0.268	0.124	0.039057	0.512751	0.235294	53.36323	7.547676
779	J4-1990	39	19	21	17.2	21.1	16.1	11.3	8.6	7.5	6.9	2.8	2.9	I	0.172	0.211	0.161	0.113	0.023235	0.158036	0.325581	50	6.605199
780	J4-1990	39	20	21	10.8	12.3	9.8	7.2	7.5	6.4	4.8	2.9	3	S	0.108	0.123	0.098	0.072	0.009161	0.049201	0.386667	69.44444	7.068583
781	J4-1990	39	21	21	9.5	11.5	8.4	6.4	7.2	6	4.9	2.7	2.9	S	0.095	0.115	0.084	0.064	0.007088	0.035771	0.375	75.78947	6.605199
782	J4-1990	39	22	21	15.5	18.1	13.4	10.2	6.9	5.9	4.8	2.6	2.8	S	0.155	0.181	0.134	0.102	0.018869	0.088807	0.376812	44.51613	6.157522
783	J4-1990	39	23	21	7.5	10.2	6.2	5.4	7.1	5.8	4.9	2.7	2.9	S	0.075	0.102	0.062	0.054	0.004418	0.021787	0.380282	94.66667	6.605199
784	J4-1990	39	24	21	38.2	42.3	31.4	14.4	14.2	13.4	11.4	2.9	3.5	D	0.382	0.423	0.314	0.144	0.114608	1.041995	0.204225	37.17277	9.621128

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
785	J4-1990	39	25	21	20.2	23.4	18.6	11.4	10.9	9.8	7.4	2.8	2.9	C	0.202	0.234	0.186	0.114	0.032047	0.264435	0.256881	53.9604	6.605199
786	J4-1990	39	26	21	20.5	24.1	18.4	11.1	10.6	9.2	7.8	2.7	2.8	C	0.205	0.241	0.184	0.111	0.033006	0.247872	0.254717	51.70732	6.157522
787	J4-1990	39	27	21	22	23.4	18.5	11	10.5	9.4	7.2	2.5	2.9	C	0.22	0.234	0.185	0.11	0.038013	0.250713	0.238095	47.72727	6.605199
788	J4-1990	39	28	21	23.5	26.1	21.2	12.4	10.8	9.8	8.1	2.6	2.9	C	0.235	0.261	0.212	0.124	0.043374	0.337731	0.240741	45.95745	6.605199
789	J4-1990	39	29	21	36.5	39.2	28.1	13.4	12.8	11.9	10.4	2.9	3.4	D	0.365	0.392	0.281	0.134	0.104635	0.759326	0.226563	35.06849	9.079203
790	J4-1990	39	30	21	21.2	23.8	18.4	10.4	11.2	9.9	8.4	2.6	3.1	C	0.212	0.238	0.184	0.104	0.035299	0.262919	0.232143	52.83019	7.547676
791	J4-1990	39	31	21	22.3	24.2	18.5	10.2	11.4	10.1	8.6	2.5	2.8	C	0.223	0.242	0.185	0.102	0.039057	0.272175	0.219298	51.12108	6.157522
792	J4-1990	39	32	21	19.6	21.4	17.8	11	10.8	9.8	8.1	2.9	3.1	C	0.196	0.214	0.178	0.11	0.030172	0.236849	0.268519	55.10204	7.547676
793	J4-1990	39	33	21	16	19.2	14.6	10.4	10.8	7.9	6.8	2.9	2.6	I	0.16	0.192	0.146	0.104	0.020106	0.137478	0.268519	67.5	5.309292
794	J4-1990	40	1	21	20.2	22.4	18.1	9.8	11.8	8.8	6.9	2.9	3.4	C	0.202	0.224	0.181	0.098	0.032047	0.219813	0.245763	58.41584	9.079203
795	J4-1990	40	2	21	21.8	24.1	16.8	9.6	11.6	8.4	7.3	2.8	3.3	C	0.218	0.241	0.168	0.096	0.037325	0.198133	0.241379	53.21101	8.552986
796	J4-1990	40	3	21	10.6	12.4	9.4	7.2	7.1	6	5.4	2.4	2.9	S	0.106	0.124	0.094	0.072	0.008825	0.043907	0.338028	66.98113	6.605199
797	J4-1990	40	4	21	13.5	16.2	9.8	9	9	6.8	6.2	2.6	2.9	I	0.135	0.162	0.098	0.09	0.014314	0.064765	0.288889	66.66667	6.605199
798	J4-1990	40	5	21	24.2	26.1	21.2	10.1	10.9	9.1	8.4	2.7	3.1	C	0.242	0.261	0.212	0.101	0.045996	0.307443	0.247706	45.04132	7.547676
799	J4-1990	40	6	21	37.8	39.2	25.4	11.4	13.1	11.4	10.2	3.2	3.6	D	0.378	0.392	0.254	0.114	0.112221	0.633797	0.244275	34.65608	10.17876
800	J4-1990	40	7	21	21	24.2	16.6	9.5	11.7	8.4	7.4	2.9	3.2	C	0.21	0.242	0.166	0.095	0.034636	0.195516	0.247863	55.71429	8.042477
801	J4-1990	40	8	21	19.5	22.1	18	9.6	9	6.6	5.8	2.8	2.9	I	0.195	0.221	0.18	0.096	0.029865	0.162124	0.311111	46.15385	6.605199
802	J4-1990	40	9	21	8.2	10.2	5.9	4.8	8.1	6	5.1	2.6	2.9	S	0.082	0.102	0.059	0.048	0.005281	0.020917	0.320988	98.78049	6.605199
803	J4-1990	40	10	21	25.5	28.2	21.4	13.2	10.8	9.4	8.5	2.6	3	C	0.255	0.282	0.214	0.132	0.051071	0.34469	0.240741	42.35294	7.068583
804	J4-1990	40	11	21	26.8	28.6	21.8	13.7	10.9	9.9	8.4	2.7	3.1	C	0.268	0.286	0.218	0.137	0.05641	0.37667	0.247706	40.67164	7.547676
805	J4-1990	40	12	21	15.5	17.2	13.2	9.1	8.8	7.4	5.9	2.9	3	S	0.155	0.172	0.132	0.091	0.018869	0.10419	0.329545	56.77419	7.068583
806	J4-1990	40	13	21	18.5	22	16.8	9.9	10.2	8.5	6.1	2.8	3.1	C	0.185	0.22	0.168	0.099	0.02688	0.190371	0.27451	55.13514	7.547676
807	J4-1990	40	14	21	16.8	18.8	14.2	11	10.4	8.8	5.8	2.9	3.2	C	0.168	0.188	0.142	0.11	0.022167	0.147561	0.278846	61.90476	8.042477
808	J4-1990	40	15	21	10.8	13.2	9.8	8.4	8.9	7.2	5.6	2.6	2.9	S	0.108	0.132	0.098	0.084	0.009161	0.059278	0.292135	82.40741	6.605199
809	J4-1990	40	16	21	19	21.1	17.4	12.6	9.1	7.9	5.9	2.7	3	I	0.19	0.211	0.174	0.126	0.028353	0.187692	0.296703	47.89474	7.068583
810	J4-1990	40	17	21	23.6	26.2	20.9	11.1	11.1	8.9	8.4	2.9	3.1	C	0.236	0.262	0.209	0.111	0.043744	0.29788	0.261261	47.0339	7.547676
811	J4-1990	40	18	21	32.7	38.1	25.4	12.1	12.4	10.3	10.4	3.1	3.4	D	0.327	0.381	0.254	0.121	0.083982	0.563395	0.25	37.92049	9.079203
812	J4-1990	40	19	21	36	38.4	26.2	12.4	13.4	10.1	9.9	2.9	3.4	D	0.36	0.384	0.262	0.124	0.101788	0.578291	0.216418	37.22222	9.079203

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
813	J4-1990	40	20	21	31.8	37.2	24.9	12.8	11.9	10.4	9.8	2.7	3.4	D	0.318	0.372	0.249	0.128	0.079423	0.548316	0.226891	37.42138	9.079203
814	J4-1990	40	21	21	17.5	21.4	12.9	10.1	9.4	9.2	8.1	2.6	2.5	I	0.175	0.214	0.129	0.101	0.024053	0.147597	0.276596	53.71429	4.908739
815	J4-1990	40	22	21	28.5	31.2	22.4	11.8	10.1	9.9	9.2	2.7	2.9	C	0.285	0.312	0.224	0.118	0.063794	0.404287	0.267327	35.4386	6.605199
816	J4-1990	40	23	21	15	18.1	12.8	9.6	8.9	7.4	5.9	2.6	2.8	I	0.15	0.181	0.128	0.096	0.017671	0.104143	0.292135	59.33333	6.157522
817	J4-1990	40	24	21	29.3	31.4	21.4	10.9	10.9	9.6	9.4	2.9	3.5	D	0.293	0.314	0.214	0.109	0.067426	0.369025	0.266055	37.20137	9.621128
818	J4-1990	40	25	21	23.5	27.4	19.6	10.6	10.1	9.7	8.4	2.9	3.1	C	0.235	0.274	0.196	0.106	0.043374	0.304704	0.287129	42.97872	7.547676
819	J4-1990	40	26	21	30.5	34.1	28.4	11.9	11.8	10.9	10.4	2.8	3.4	D	0.305	0.341	0.284	0.119	0.073062	0.646438	0.237288	38.68852	9.079203
820	J4-1990	40	27	21	9.5	11.2	6.6	6.1	7.9	6.4	5.2	2.4	2.7	S	0.095	0.112	0.066	0.061	0.007088	0.028223	0.303797	83.15789	5.725553
821	J4-1990	40	28	21	30.2	36.4	28.2	12.1	11.6	10.4	9.8	2.9	3.4	D	0.302	0.364	0.282	0.121	0.071631	0.633348	0.25	38.4106	9.079203
822	J4-1990	40	29	21	26.6	29.9	21.9	11.1	10.1	9.8	8.4	2.7	3	C	0.266	0.299	0.219	0.111	0.055572	0.376591	0.267327	37.96992	7.068583
823	J4-1990	40	30	21	18	20.9	14.8	9.9	9.9	9.2	5.6	2.6	3.1	C	0.18	0.209	0.148	0.099	0.025447	0.169921	0.262626	55	7.547676
824	J4-1990	40	31	21	19.2	21.4	17.1	10.1	10.1	9.4	6.2	2.8	3.2	C	0.192	0.214	0.171	0.101	0.028953	0.212821	0.277228	52.60417	8.042477
825	J4-1990	40	32	21	24.5	29.8	19.2	9.9	10.8	9.7	7.8	2.9	3.1	C	0.245	0.298	0.192	0.099	0.047144	0.31243	0.268519	44.08163	7.547676
826	J4-1990	40	33	21	25.5	26.2	19.6	12.1	10.4	9.8	8.6	3.4	3.1	C	0.255	0.262	0.196	0.121	0.051071	0.303962	0.326923	40.78431	7.547676
827	J4-1990	40	34	21	20.4	22.3	14.3	9.4	9.9	8.4	7.9	3	2.8	C	0.204	0.223	0.143	0.094	0.032685	0.154335	0.30303	48.52941	6.157522
828	J4-1990	40	35	21	18	19.6	11.2	8.6	8.9	7.9	5.4	2.8	2.6	I	0.18	0.196	0.112	0.086	0.025447	0.099262	0.314607	49.44444	5.309292
829	J4-1990	40	36	21	15.2	17.4	10.4	7.3	7.8	5.8	4.9	2.8	2.5	I	0.152	0.174	0.104	0.073	0.018146	0.059879	0.358974	51.31579	4.908739
830	J4-1990	40	37	21	22.2	24.2	17.3	10.1	10.2	9.4	8.2	3.1	2.9	C	0.222	0.242	0.173	0.101	0.038708	0.231918	0.303922	45.94595	6.605199
831	J4-1990	40	38	21	21.2	23.3	16.8	9.6	10.4	9.9	8.6	3.2	3.1	C	0.212	0.233	0.168	0.096	0.035299	0.228599	0.307692	49.0566	7.547676
832	J4-1990	40	39	21	14.8	17.3	11.4	8.1	9.4	7.9	5.1	2.7	2.5	I	0.148	0.173	0.114	0.081	0.017203	0.091492	0.287234	63.51351	4.908739
833	J4-1990	40	40	21	24.6	27.2	18.8	9.6	10.2	9.4	8.9	3.3	3.2	C	0.246	0.272	0.188	0.096	0.047529	0.276331	0.323529	41.46341	8.042477
834	J4-1990	40	41	21	19.5	22.1	12.3	8.2	9.1	8	5.6	2.8	2.8	I	0.195	0.221	0.123	0.082	0.029865	0.12156	0.307692	46.66667	6.157522
835	Oluw1991	41	1	20	15.4	17.8	13.2	11.4	12.6	10.8	8.4	2.5	2.8	C	0.154	0.178	0.132	0.114	0.018627	0.161695	0.198413	81.81818	6.157522
836	Oluw1991	41	2	20	11.2	13.5	9.2	7.4	11.6	9.8	7.6	2.4	2.6	S	0.112	0.135	0.092	0.074	0.009852	0.073835	0.206897	103.5714	5.309292
837	Oluw1991	41	3	20	6.6	8.8	6.4	5.2	9.8	7.4	5.2	2.4	2.6	S	0.066	0.088	0.064	0.052	0.003421	0.025991	0.244898	148.4848	5.309292
838	Oluw1991	41	4	20	23.8	26.4	19.2	15.6	15.6	13.4	11.2	2.6	2.8	D	0.238	0.264	0.192	0.156	0.044488	0.423583	0.166667	65.54622	6.157522
839	Oluw1991	41	5	20	17.8	20.1	15.4	13.8	12.8	10.6	8.6	2.5	2.8	C	0.178	0.201	0.154	0.138	0.024885	0.214109	0.195313	71.91011	6.157522
840	Oluw1991	41	6	20	14.4	16.8	12.2	10.2	12.8	10.4	8.1	2.4	2.6	S	0.144	0.168	0.122	0.102	0.016286	0.133636	0.1875	88.88889	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
841	Oluw1991	41	7	20	20	23.2	18.1	16.1	14.6	12.6	10.7	2.5	2.8	C	0.2	0.232	0.181	0.161	0.031416	0.347662	0.171233	73	6.157522
842	Oluw1991	41	8	20	9.1	11.4	7.2	5.1	10.6	8.5	6.2	2.4	2.6	S	0.091	0.114	0.072	0.051	0.006504	0.040426	0.226415	116.4835	5.309292
843	Oluw1991	41	9	20	12.5	14.6	10.4	8.2	13.8	11.4	9.2	2.4	2.6	S	0.125	0.146	0.104	0.082	0.012272	0.106404	0.173913	110.4	5.309292
844	Oluw1991	41	10	20	21.5	23.4	18.6	16.4	15.9	13.8	11.4	2.5	2.8	C	0.215	0.234	0.186	0.164	0.036305	0.397477	0.157233	73.95349	6.157522
845	Oluw1991	41	11	20	19	22.2	17.2	15.1	14.6	12.4	10.2	2.5	2.8	C	0.19	0.222	0.172	0.151	0.028353	0.309083	0.171233	76.84211	6.157522
846	Oluw1991	41	12	20	23	25.6	19.4	17.2	15.5	13.4	11.2	2.6	2.9	D	0.23	0.256	0.194	0.172	0.041548	0.430908	0.167742	67.3913	6.605199
847	Oluw1991	41	13	20	15.8	17.4	13.6	11.8	12.9	10.8	8.6	2.5	2.8	C	0.158	0.174	0.136	0.118	0.019607	0.167079	0.193798	81.64557	6.157522
848	Oluw1991	41	14	20	19	21.6	17.2	15.6	14.6	12.4	10.2	2.5	2.8	C	0.19	0.216	0.172	0.156	0.028353	0.307309	0.171233	76.84211	6.157522
849	Oluw1991	41	15	20	27.9	29.4	24.4	20.8	14.8	12.6	10.8	2.6	2.9	D	0.279	0.294	0.244	0.208	0.061136	0.606698	0.175676	53.04659	6.605199
850	Oluw1991	41	16	20	23.5	15.6	11.4	9.5	16.6	14.8	12.6	2.6	2.9	D	0.235	0.156	0.114	0.095	0.043374	0.16534	0.156627	70.6383	6.605199
851	Oluw1991	41	17	20	15.5	17.8	13.2	11.5	12.8	10.6	8.8	2.5	2.8	C	0.155	0.178	0.132	0.115	0.018869	0.159019	0.195313	82.58065	6.157522
852	Oluw1991	41	18	20	13.4	15.8	11.3	9.4	13.6	11.4	9.1	2.5	2.8	C	0.134	0.158	0.113	0.094	0.014103	0.126657	0.183824	101.4925	6.157522
853	Oluw1991	41	19	20	14.3	16.6	12.4	10.6	14.4	12.3	10.2	2.5	2.8	C	0.143	0.166	0.124	0.106	0.016061	0.161483	0.173611	100.6993	6.157522
854	Oluw1991	41	20	20	15.5	17.4	13.6	11.2	12.8	10.4	8.2	2.5	2.8	C	0.155	0.174	0.136	0.112	0.018869	0.159012	0.195313	82.58065	6.157522
855	Oluw1991	41	21	20	19.2	21.8	17.4	15.6	13.6	10.6	8.4	2.5	2.8	C	0.192	0.218	0.174	0.156	0.028953	0.267745	0.183824	70.83333	6.157522
856	Oluw1991	41	22	20	22.1	25.2	20.2	18.1	14.8	12.8	10.6	2.6	2.9	D	0.221	0.252	0.202	0.181	0.03836	0.434765	0.175676	66.96833	6.605199
857	Oluw1991	41	23	20	12.5	15.6	10.4	8.5	13.6	11.4	9.2	2.5	2.8	C	0.125	0.156	0.104	0.085	0.012272	0.111658	0.183824	108.8	6.157522
858	Oluw1991	41	24	20	17.9	19.8	15.7	13.9	13.8	11.2	9	2.5	2.8	C	0.179	0.198	0.157	0.139	0.025165	0.230351	0.181159	77.09497	6.157522
859	Oluw1991	41	25	20	23.2	25.4	19.6	17.4	16.6	14.2	12.1	2.6	2.9	D	0.232	0.254	0.196	0.174	0.042273	0.461824	0.156627	71.55172	6.605199
860	Oluw1991	41	26	20	14.4	16.8	12.2	10.4	14.4	12.1	10	2.5	2.8	C	0.144	0.168	0.122	0.104	0.016286	0.156133	0.173611	100	6.157522
861	Oluw1991	41	27	20	12.3	15.2	10.4	8.3	13.6	11.5	9.2	2.4	2.6	S	0.123	0.152	0.104	0.083	0.011882	0.110277	0.176471	110.5691	5.309292
862	Oluw1991	41	28	20	14.5	16.8	12.5	10.4	14.2	12.8	10.4	2.4	2.6	S	0.145	0.168	0.125	0.104	0.016513	0.170132	0.169014	97.93103	5.309292
863	Oluw1991	42	1	20	14.7	16.8	12.4	10.4	14.6	12.6	10.4	2.5	2.8	C	0.147	0.168	0.124	0.104	0.016972	0.165831	0.171233	99.31973	6.157522
864	Oluw1991	42	2	20	37	39.6	34.2	28.8	17.8	15.4	13.6	2.6	2.9	D	0.37	0.396	0.342	0.288	0.107521	1.426451	0.146067	48.10811	6.605199
865	Oluw1991	42	3	20	21.4	24.6	19.2	16.4	15.5	13.6	11.2	2.6	2.9	D	0.214	0.246	0.192	0.164	0.035968	0.41812	0.167742	72.42991	6.605199
866	Oluw1991	42	4	20	14.6	18.4	12.4	10.6	14.8	12.8	10.4	2.5	2.8	C	0.146	0.184	0.124	0.106	0.016742	0.178603	0.168919	101.3699	6.157522
867	Oluw1991	42	5	20	18.6	22.8	16.6	14.2	15.8	13.4	11.1	2.5	2.8	C	0.186	0.228	0.166	0.142	0.027172	0.319891	0.158228	84.94624	6.157522
868	Oluw1991	42	6	20	27.8	29.6	24.8	21.4	16.6	13.8	11.6	2.6	2.9	D	0.278	0.296	0.248	0.214	0.060699	0.685405	0.156627	59.71223	6.605199

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
869	Oluw1991	42	7	20	30.7	32.8	27.9	24.2	17.8	15.4	13.2	2.6	2.9	D	0.307	0.328	0.279	0.242	0.074023	0.962595	0.146067	57.98046	6.605199
870	Oluw1991	42	8	20	18.5	22.6	16.4	14.4	13.4	11.8	9.6	2.5	2.8	C	0.185	0.226	0.164	0.144	0.02688	0.277098	0.186567	72.43243	6.157522
871	Oluw1991	42	9	20	23	25.4	20.2	16.6	16.6	14.8	12.2	2.6	2.9	D	0.23	0.254	0.202	0.166	0.041548	0.494573	0.156627	72.17391	6.605199
872	Oluw1991	42	10	20	14	18.2	12.1	10.2	13.8	11.6	9.9	2.5	2.8	C	0.14	0.182	0.121	0.102	0.015394	0.15502	0.181159	98.57143	6.157522
873	Oluw1991	42	11	20	32.5	36.6	28.4	23.4	20.4	18.8	16.4	2.6	2.9	D	0.325	0.366	0.284	0.234	0.082958	1.258354	0.127451	62.76923	6.605199
874	Oluw1991	42	12	20	21.5	24.6	18.6	16.5	15.6	13.8	11.4	2.5	2.9	D	0.215	0.246	0.186	0.165	0.036305	0.408476	0.160256	72.55814	6.605199
875	Oluw1991	42	13	20	16.4	19.3	14.2	12.4	14.8	12.8	10.8	2.5	2.8	C	0.164	0.193	0.142	0.124	0.021124	0.223314	0.168919	90.2439	6.157522
876	Oluw1991	42	14	20	16.4	19.2	14.3	12.3	14.6	12.6	10.8	2.5	2.8	C	0.164	0.192	0.143	0.123	0.021124	0.220663	0.171233	89.02439	6.157522
877	Oluw1991	42	15	20	16.3	19.5	14.3	12.3	14.8	12.6	10.8	2.5	2.8	C	0.163	0.195	0.143	0.123	0.020867	0.222578	0.168919	90.79755	6.157522
878	Oluw1991	42	16	20	18	21.2	16.2	14.1	15.6	13.2	11.1	2.5	2.8	C	0.18	0.212	0.162	0.141	0.025447	0.293395	0.160256	86.66667	6.157522
879	Oluw1991	42	17	20	19.8	23.2	17.6	15.8	15.8	13.6	11.4	2.5	2.8	C	0.198	0.232	0.176	0.158	0.030791	0.36084	0.158228	79.79798	6.157522
880	Oluw1991	42	18	20	16.2	18.8	14.2	12.8	14.6	12.8	10.4	2.5	2.8	C	0.162	0.188	0.142	0.128	0.020612	0.221812	0.171233	90.12346	6.157522
881	Oluw1991	42	19	20	16.2	19.2	14.1	12.2	14.8	12.6	10.5	2.5	2.8	C	0.162	0.192	0.141	0.122	0.020612	0.216512	0.168919	91.35802	6.157522
882	Oluw1991	42	20	20	21.1	24.6	18.4	16.2	15.4	13.4	11.2	2.5	2.8	C	0.211	0.246	0.184	0.162	0.034967	0.389723	0.162338	72.98578	6.157522
883	Oluw1991	42	21	20	28.9	32.8	24.6	22.2	15.6	13.8	11.8	2.5	2.8	C	0.289	0.328	0.246	0.222	0.065597	0.720637	0.160256	53.97924	6.157522
884	Oluw1991	42	22	20	16.8	18.8	14.6	12.8	14.8	12.6	10.4	2.5	2.8	C	0.168	0.188	0.146	0.128	0.022167	0.225946	0.168919	88.09524	6.157522
885	Oluw1991	42	23	20	11.4	15.4	9.2	7.4	13.8	11.4	9.2	2.4	2.6	S	0.114	0.154	0.092	0.074	0.010207	0.094084	0.173913	121.0526	5.309292
886	Oluw1991	42	24	20	20.4	22.3	18.4	15.6	14.6	12.8	10.6	2.5	2.8	C	0.204	0.223	0.184	0.156	0.032685	0.351002	0.171233	71.56863	6.157522
887	Oluw1991	42	25	20	27	29.8	24.3	18.6	14.8	12.6	10.8	2.6	2.9	D	0.27	0.298	0.243	0.186	0.057256	0.593095	0.175676	54.81481	6.605199
888	Oluw1991	42	26	20	24.2	27.6	21.4	18.2	15.6	13.6	11.8	2.6	2.9	D	0.242	0.276	0.214	0.182	0.045996	0.52069	0.166667	64.46281	6.605199
889	Oluw1991	42	27	20	14.2	18.2	12.1	10.4	13.8	11.8	9.6	2.5	2.8	C	0.142	0.182	0.121	0.104	0.015837	0.158329	0.181159	97.1831	6.157522
890	Oluw1991	42	28	20	8.5	12.6	6.4	4.8	8.9	6.9	4.8	2.4	2.6	S	0.085	0.126	0.064	0.048	0.005675	0.031218	0.269663	104.7059	5.309292
891	Oluw1991	42	29	20	20.9	22.8	18.6	16.8	15.4	13.4	11.2	2.5	2.8	C	0.209	0.228	0.186	0.168	0.034307	0.383423	0.162338	73.68421	6.157522
892	Oluw1991	42	30	20	7.2	11.6	5.2	4.6	8.9	6.8	4.4	2.4	2.6	S	0.072	0.116	0.052	0.046	0.004072	0.023488	0.269663	123.6111	5.309292
893	Oluw1991	42	31	20	21.9	23.8	18.6	14.9	15.8	13.6	11.6	2.5	2.8	C	0.219	0.238	0.186	0.149	0.037668	0.386719	0.158228	72.14612	6.157522
894	Oluw1991	42	32	20	42.3	44.6	38.3	28.6	18.6	16.4	14.2	2.6	2.9	D	0.423	0.446	0.383	0.286	0.140531	1.862241	0.139785	43.97163	6.605199
895	Oluw1991	42	33	20	11.3	15.4	10.2	8.6	13.6	11.8	9.4	2.4	2.6	S	0.113	0.154	0.102	0.086	0.010029	0.112337	0.176471	120.354	5.309292
896	Oluw1991	42	34	20	11.5	15.8	10.4	8.8	13.4	11.6	9.5	2.4	2.6	S	0.115	0.158	0.104	0.088	0.010387	0.115359	0.179104	116.5217	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
897	Oluw1991	43	1	20	18.8	22.4	16.4	14.3	15.6	73.6	11.4	2.5	2.8	C	0.188	0.224	0.164	0.143	0.027759	1.716904	0.160256	82.97872	6.157522
898	Oluw1991	43	2	20	14.1	18.2	12.2	10.4	14.4	12.3	10.2	2.5	2.8	C	0.141	0.182	0.122	0.104	0.015615	0.166603	0.173611	102.1277	6.157522
899	Oluw1991	43	3	20	16.6	18.8	14.4	12.2	14.6	12.6	10.8	2.5	2.8	C	0.166	0.188	0.144	0.122	0.021642	0.219645	0.171233	87.95181	6.157522
900	Oluw1991	43	4	20	18.5	21.4	16.5	14.5	15.5	13.4	11.2	2.5	2.8	C	0.185	0.214	0.165	0.145	0.02688	0.308224	0.16129	83.78378	6.157522
901	Oluw1991	43	5	20	16.3	18.2	14.3	12.4	14.4	12.2	10.1	2.5	2.8	C	0.163	0.182	0.143	0.124	0.020867	0.20808	0.173611	88.34356	6.157522
902	Oluw1991	43	6	20	10.5	12.6	8.4	6.5	13.4	11.4	9.4	2.4	2.6	S	0.105	0.126	0.084	0.065	0.008659	0.072113	0.179104	127.619	5.309292
903	Oluw1991	43	7	20	14.4	16.4	12.5	10.4	13.6	11.6	9.8	2.4	2.6	S	0.144	0.164	0.125	0.104	0.016286	0.152166	0.176471	94.44444	5.309292
904	Oluw1991	43	8	20	19.2	22.6	17.2	15.5	15.6	13.8	11.8	2.5	2.8	C	0.192	0.226	0.172	0.155	0.028953	0.349428	0.160256	81.25	6.157522
905	Oluw1991	43	9	20	16.4	18.8	14.4	12.2	14.8	12.6	10.8	2.5	2.8	C	0.164	0.188	0.144	0.122	0.021124	0.219645	0.168919	90.2439	6.157522
906	Oluw1991	43	10	20	19.6	23.2	17.4	15.4	14.8	12.8	12.4	2.5	2.8	C	0.196	0.232	0.174	0.154	0.030172	0.332831	0.168919	75.5102	6.157522
907	Oluw1991	43	11	20	22.2	25.6	19.4	17.2	16.6	14.6	12.8	2.5	2.8	C	0.222	0.256	0.194	0.172	0.038708	0.469497	0.150602	74.77477	6.157522
908	Oluw1991	43	12	20	18.2	22.4	16.2	14.4	15.6	13.4	11.2	2.5	2.8	C	0.182	0.224	0.162	0.144	0.026016	0.308517	0.160256	85.71429	6.157522
909	Oluw1991	43	13	20	18.5	22.8	16.6	14.5	15.6	13.8	11.4	2.5	2.8	C	0.185	0.228	0.166	0.145	0.02688	0.330995	0.160256	84.32432	6.157522
910	Oluw1991	43	14	20	18.4	22.6	16.4	14.2	15.4	13.2	11.1	2.5	2.8	C	0.184	0.226	0.164	0.142	0.02659	0.308986	0.162338	83.69565	6.157522
911	Oluw1991	43	15	20	27.5	29.6	25.6	20.6	18.6	16.8	14.6	2.6	2.9	D	0.275	0.296	0.256	0.206	0.059396	0.862484	0.139785	67.63636	6.605199
912	Oluw1991	43	16	20	17.1	21.2	15.2	13.1	15.4	13.2	11	2.5	2.8	C	0.171	0.212	0.152	0.131	0.022966	0.266993	0.162338	90.05848	6.157522
913	Oluw1991	43	17	20	24.8	27.6	22.4	20.6	13.8	11.4	11.1	2.6	2.9	D	0.248	0.276	0.224	0.206	0.048305	0.476501	0.188406	55.64516	6.605199
914	Oluw1991	43	18	20	30.1	32.4	26.8	22.2	18.8	16.4	14.2	2.6	2.9	D	0.301	0.324	0.268	0.222	0.071158	0.947913	0.138298	62.45847	6.605199
915	Oluw1991	43	19	20	28.2	30.6	26.4	22.1	18.6	17.2	15.4	2.6	2.9	D	0.282	0.306	0.264	0.221	0.062458	0.948458	0.139785	65.95745	6.605199
916	Oluw1991	43	20	20	18.5	22.4	16.4	14.2	15.6	13.6	11.4	2.5	2.8	C	0.185	0.224	0.164	0.142	0.02688	0.316747	0.160256	84.32432	6.157522
917	Oluw1991	43	21	20	17.7	19.8	15.6	13.4	14.4	12.2	10.1	2.5	2.8	C	0.177	0.198	0.156	0.134	0.024606	0.246739	0.173611	81.35593	6.157522
918	Oluw1991	43	22	20	23.9	25.8	21.6	19.6	16.6	14.8	12.9	2.5	2.8	C	0.239	0.258	0.216	0.196	0.044863	0.564929	0.150602	69.45607	6.157522
919	Oluw1991	43	23	20	22.1	24.4	19.6	17.2	15.8	13.6	11.8	2.5	2.8	C	0.221	0.244	0.196	0.172	0.03836	0.432213	0.158228	71.49321	6.157522
920	Oluw1991	43	24	20	23.8	26.4	20.6	18.6	16.9	14.8	12.8	2.6	2.9	D	0.238	0.264	0.206	0.186	0.044488	0.530894	0.153846	71.0084	6.605199
921	Oluw1991	43	25	20	18.1	22.2	16.4	14.2	14.6	12.8	10.9	2.5	2.8	C	0.181	0.222	0.164	0.142	0.02573	0.29662	0.171233	80.66298	6.157522
922	Oluw1991	43	26	20	14.6	18.4	12.5	10.6	13.4	11.8	9.6	2.4	2.6	S	0.146	0.184	0.125	0.106	0.016742	0.166188	0.179104	91.78082	5.309292
923	Oluw1991	43	27	20	19.6	22.4	17.6	15.6	16.6	14.2	12.1	2.5	2.8	C	0.196	0.224	0.176	0.156	0.030172	0.368811	0.150602	84.69388	6.157522
924	Oluw1991	44	1	20	19.9	22.4	17.8	15.8	16.4	14.6	12.4	2.5	2.8	C	0.199	0.224	0.178	0.158	0.031103	0.385812	0.152439	82.41206	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
925	Oluw1991	44	2	20	14.5	16.8	12.4	10.5	12.8	10.4	8.2	2.4	2.6	S	0.145	0.168	0.124	0.105	0.016513	0.137161	0.1875	88.27586	5.309292
926	Oluw1991	44	3	20	18.9	21.6	16.8	14.9	14.8	12.8	10.4	2.5	2.8	C	0.189	0.216	0.168	0.149	0.028055	0.30453	0.168919	78.30688	6.157522
927	Oluw1991	44	4	20	19.1	23.4	17.2	15.1	15.6	13.6	11.8	2.5	2.8	C	0.191	0.234	0.172	0.151	0.028652	0.348736	0.160256	81.67539	6.157522
928	Oluw1991	44	5	20	12.3	14.85	10.2	8.3	13.4	11.4	9.6	2.4	2.6	S	0.123	0.1485	0.102	0.083	0.011882	0.10529	0.179104	108.9431	5.309292
929	Oluw1991	44	6	20	14.9	16.8	12.8	10.9	12.6	10.4	8.6	2.4	2.6	S	0.149	0.168	0.128	0.109	0.017437	0.143815	0.190476	84.56376	5.309292
930	Oluw1991	44	7	20	21.7	25.6	19.7	16.6	16.8	14.6	12.8	2.5	2.8	C	0.217	0.256	0.197	0.166	0.036984	0.474588	0.14881	77.41935	6.157522
931	Oluw1991	44	8	20	15.6	19.6	13.4	11.2	14.8	12.6	10.4	2.5	2.8	C	0.156	0.196	0.134	0.112	0.019113	0.202512	0.168919	94.87179	6.157522
932	Oluw1991	44	9	20	27.2	29.4	25.1	23.4	18.6	16.8	14.4	2.6	2.9	D	0.272	0.294	0.251	0.234	0.058107	0.864683	0.139785	68.38235	6.605199
933	Oluw1991	44	10	20	12.5	15.6	10.4	8.4	13.8	11.8	9.6	2.4	2.6	S	0.125	0.156	0.104	0.084	0.012272	0.115315	0.173913	110.4	5.309292
934	Oluw1991	44	11	20	20.3	23.4	18.3	16.2	16.4	14.6	12.8	2.5	2.8	C	0.203	0.234	0.183	0.162	0.032365	0.41081	0.152439	80.78818	6.157522
935	Oluw1991	44	12	20	11.1	13.2	9.2	7.1	13.6	11.8	9.9	2.4	2.6	S	0.111	0.132	0.092	0.071	0.009677	0.086994	0.176471	122.5225	5.309292
936	Oluw1991	44	13	20	12.4	14.8	10.2	8.4	14.6	14.6	10.9	2.4	2.6	S	0.124	0.148	0.102	0.084	0.012076	0.13488	0.164384	117.7419	5.309292
937	Oluw1991	44	14	20	11.8	13.6	9.2	7.6	13.8	11.8	9.9	2.4	2.6	S	0.118	0.136	0.092	0.076	0.010936	0.089785	0.173913	116.9492	5.309292
938	Oluw1991	44	15	20	12.6	15.8	10.4	8.6	13.9	12.8	9.9	2.4	2.6	S	0.126	0.158	0.104	0.086	0.012469	0.126709	0.172662	110.3175	5.309292
939	Oluw1991	44	16	20	13.2	15.9	11.2	9.8	13.8	11.8	9.9	2.4	2.6	S	0.132	0.159	0.112	0.098	0.013685	0.131387	0.173913	104.5455	5.309292
940	Oluw1991	44	17	20	23.6	25.6	21.4	19.6	16.4	14.6	12.8	2.6	2.9	D	0.236	0.256	0.214	0.196	0.043744	0.548756	0.158537	69.49153	6.605199
941	Oluw1991	44	18	20	26.6	29.8	24.4	22.4	16.6	14.8	12.9	2.6	2.9	D	0.266	0.298	0.244	0.224	0.055572	0.730608	0.156627	62.40602	6.605199
942	Oluw1991	44	19	20	17.6	19.5	15.6	13.4	14.8	12.4	10.2	2.4	2.8	C	0.176	0.195	0.156	0.134	0.024328	0.24887	0.162162	84.09091	6.157522
943	Oluw1991	44	20	20	30.4	32.8	28.4	24.2	18.6	16.8	14.6	2.6	2.9	D	0.304	0.328	0.284	0.242	0.072583	1.074866	0.139785	61.18421	6.605199
944	Oluw1991	44	21	20	18.1	22.4	16.2	14.1	15.6	13.8	11.9	2.5	2.8	C	0.181	0.224	0.162	0.141	0.02573	0.316182	0.160256	86.18785	6.157522
945	Oluw1991	44	22	20	12.5	14.6	10.4	8.6	13.8	11.6	9.6	2.4	2.6	S	0.125	0.146	0.104	0.086	0.012272	0.109291	0.173913	110.4	5.309292
946	Oluw1991	44	23	20	21.3	25.2	19.4	16.2	16.6	14.8	12.4	2.6	2.9	D	0.213	0.252	0.194	0.162	0.035633	0.465521	0.156627	77.93427	6.605199
947	Oluw1991	44	24	20	19.8	23.6	17.4	15.2	16.8	14.8	12.9	2.5	2.8	C	0.198	0.236	0.174	0.152	0.030791	0.387277	0.14881	84.84848	6.157522
948	Oluw1991	44	25	20	18.4	22.4	16.6	14.8	14.6	12.8	10.4	2.5	2.8	C	0.184	0.224	0.166	0.148	0.02659	0.305453	0.171233	79.34783	6.157522
949	Oluw1991	44	26	20	18.1	22.1	16.2	14.1	15.8	13.6	11.9	2.5	2.8	C	0.181	0.221	0.162	0.141	0.02573	0.309223	0.158228	87.29282	6.157522
950	Oluw1991	44	27	20	14.4	18.1	12.4	10.6	14.8	12.4	10.2	2.4	2.6	S	0.144	0.181	0.124	0.106	0.016286	0.171245	0.162162	102.7778	5.309292
951	Oluw1991	44	28	20	13.3	15.6	11.2	9.4	14.2	12.2	10.1	2.4	2.6	S	0.133	0.156	0.112	0.094	0.013893	0.133105	0.169014	106.7669	5.309292
952	Oluw1991	44	29	20	25.4	27.8	23.2	19.6	14.9	12.8	12.4	2.5	2.8	C	0.254	0.278	0.232	0.196	0.050671	0.554589	0.167785	58.66142	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
953	Oluw1991	45	1	20	21	24.4	19.2	17.4	15.4	13.2	11.1	2.5	2.8	C	0.21	0.244	0.192	0.174	0.034636	0.40997	0.162338	73.33333	6.157522
954	Oluw1991	45	2	20	21.7	24.8	18.8	16.4	15.8	13.6	11.4	2.5	2.8	C	0.217	0.248	0.188	0.164	0.036984	0.409055	0.158228	72.81106	6.157522
955	Oluw1991	45	3	20	13	17.6	11.2	9.1	13.8	11.8	9.4	2.4	2.6	S	0.13	0.176	0.112	0.091	0.013273	0.13814	0.173913	106.1538	5.309292
956	Oluw1991	45	4	20	20.5	22.6	18.3	16.2	14.6	12.6	10.8	2.5	2.8	C	0.205	0.226	0.183	0.162	0.033006	0.348465	0.171233	71.21951	6.157522
957	Oluw1991	45	5	20	22.5	24.6	20.4	18.2	16.6	14.6	12.6	2.5	2.8	C	0.225	0.246	0.204	0.182	0.039761	0.497094	0.150602	73.77778	6.157522
958	Oluw1991	45	6	20	9.8	11.4	7.6	6.2	9.9	7.8	5.4	2.4	2.6	S	0.098	0.114	0.076	0.062	0.007543	0.040784	0.242424	101.0204	5.309292
959	Oluw1991	45	7	20	16.2	18.4	14.2	12.4	14.8	12.4	10.2	2.4	2.6	S	0.162	0.184	0.142	0.124	0.020612	0.210829	0.162162	91.35802	5.309292
960	Oluw1991	45	8	20	13.8	17.6	11.4	9.6	13.8	11.8	9.9	2.4	2.6	S	0.138	0.176	0.114	0.096	0.014957	0.142377	0.173913	100	5.309292
961	Oluw1991	45	9	20	25.6	27.6	22.6	20.4	16.8	14.4	12.2	2.5	2.8	C	0.256	0.276	0.226	0.204	0.051472	0.607137	0.14881	65.625	6.157522
962	Oluw1991	45	10	20	33.6	36.4	28.6	22.4	18.8	16.6	14.8	2.6	2.9	D	0.336	0.364	0.286	0.224	0.088668	1.107884	0.138298	55.95238	6.605199
963	Oluw1991	45	11	20	21	24.2	19.2	17.1	15.8	18.8	11	2.5	2.8	C	0.21	0.242	0.192	0.171	0.034636	0.578957	0.158228	75.2381	6.157522
964	Oluw1991	45	12	20	18.1	22.4	16.2	14.2	14.8	12.6	10.8	2.4	2.6	S	0.181	0.224	0.162	0.142	0.02573	0.289155	0.162162	81.76796	5.309292
965	Oluw1991	45	13	20	25	27.1	23.2	18.4	16.8	14.4	12	2.5	2.8	C	0.25	0.271	0.232	0.184	0.049087	0.608073	0.14881	67.2	6.157522
966	Oluw1991	45	14	20	19.9	21.4	17.4	15.6	14.6	12.8	10.9	2.5	2.8	C	0.199	0.214	0.174	0.156	0.031103	0.320419	0.171233	73.36683	6.157522
967	Oluw1991	45	15	20	15.6	17.8	13.5	11.5	13.6	11.6	9.8	2.4	2.6	S	0.156	0.178	0.135	0.115	0.019113	0.178885	0.176471	87.17949	5.309292
968	Oluw1991	45	16	20	29.5	32.6	26.8	24.5	17.4	15.4	13.2	2.6	2.9	D	0.295	0.326	0.268	0.245	0.068349	0.914386	0.149425	58.98305	6.605199
969	Oluw1991	45	17	20	22.3	24.6	18.8	16.6	15.6	13.8	11.9	2.5	2.8	C	0.223	0.246	0.188	0.166	0.039057	0.414478	0.160256	69.95516	6.157522
970	Oluw1991	45	18	20	11.4	13.8	9.2	7.4	12.6	10.4	8.2	2.4	2.6	S	0.114	0.138	0.092	0.074	0.010207	0.079471	0.190476	110.5263	5.309292
971	Oluw1991	45	19	20	24.5	26.6	21.4	19.4	15.8	13.8	11.9	2.5	2.8	C	0.245	0.266	0.214	0.194	0.047144	0.526707	0.158228	64.4898	6.157522
972	Oluw1991	45	20	20	13.5	17.4	11.4	9.5	13.8	11.6	9.6	2.4	2.6	S	0.135	0.174	0.114	0.095	0.014314	0.13861	0.173913	102.2222	5.309292
973	Oluw1991	45	21	20	20.9	24.8	18.6	16.4	14.8	12.8	10.8	2.5	2.8	C	0.209	0.248	0.186	0.164	0.034307	0.37998	0.168919	70.8134	6.157522
974	Oluw1991	45	22	20	15	17.4	13.2	11.1	13.6	11.4	9.2	2.4	2.6	S	0.15	0.174	0.132	0.111	0.017671	0.16757	0.176471	90.66667	5.309292
975	Oluw1991	45	23	20	15.7	17.8	13.6	11.4	15.8	11.8	9.9	2.4	2.6	S	0.157	0.178	0.136	0.114	0.019359	0.18329	0.151899	100.6369	5.309292
976	Oluw1991	45	24	20	29.2	32.6	24.6	21.6	16.8	15.4	13.6	2.5	2.8	C	0.292	0.326	0.246	0.216	0.066966	0.796255	0.14881	57.53425	6.157522
977	Oluw1991	46	1	20	10.7	12.8	8.6	6.6	9.8	7.8	5.4	2.4	2.6	S	0.107	0.128	0.086	0.066	0.008992	0.051382	0.244898	91.58879	5.309292
978	Oluw1991	46	2	20	12.5	14.6	10.4	8.7	9.9	7.9	5.6	2.4	2.6	S	0.125	0.146	0.104	0.087	0.012272	0.07461	0.242424	79.2	5.309292
979	Oluw1991	46	3	20	9.2	11.4	7.1	5.2	8.6	6.8	4.8	2.4	2.6	S	0.092	0.114	0.071	0.052	0.006648	0.031923	0.27907	93.47826	5.309292
980	Oluw1991	46	4	20	10.5	12.8	8.4	6.4	9.8	7.6	5.6	2.4	2.6	S	0.105	0.128	0.084	0.064	0.008659	0.048453	0.244898	93.33333	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
981	Oluw1991	46	5	20	31.7	34.8	28.4	24.6	18.6	16.4	14.4	2.6	2.9	D	0.317	0.348	0.284	0.246	0.078924	1.082488	0.139785	58.67508	6.605199
982	Oluw1991	46	6	20	18	22.2	16.2	14.1	14.4	12.4	10.4	2.5	2.8	C	0.18	0.222	0.162	0.141	0.025447	0.282658	0.173611	80	6.157522
983	Oluw1991	46	7	20	15.9	19.8	13.6	11.4	13.6	11.8	9.8	2.4	2.6	S	0.159	0.198	0.136	0.114	0.019856	0.194906	0.176471	85.53459	5.309292
984	Oluw1991	46	8	20	15	17.6	13.2	11.1	13.6	11.6	9.4	2.4	2.6	S	0.15	0.176	0.132	0.111	0.017671	0.171573	0.176471	90.66667	5.309292
985	Oluw1991	46	9	20	14.5	16.8	12.4	10.4	13.4	11.2	9.1	2.4	2.6	S	0.145	0.168	0.124	0.104	0.016513	0.147405	0.179104	92.41379	5.309292
986	Oluw1991	46	10	20	16.6	20.2	14.4	12.6	14.8	12.4	10.2	2.4	2.6	S	0.166	0.202	0.144	0.126	0.021642	0.226632	0.162162	89.15663	5.309292
987	Oluw1991	46	11	20	20.7	22.4	18.6	16.4	16.6	14.6	12.4	2.5	2.8	C	0.207	0.224	0.186	0.164	0.033654	0.411766	0.150602	80.19324	6.157522
988	Oluw1991	46	12	20	15.3	17.6	13.4	11.3	13.8	11.8	9.4	2.4	2.6	S	0.153	0.176	0.134	0.113	0.018385	0.17851	0.173913	90.19608	5.309292
989	Oluw1991	46	13	20	16	19.2	14.1	12.4	13.6	11.8	9.9	2.4	2.6	S	0.16	0.192	0.141	0.124	0.020106	0.203525	0.176471	85	5.309292
990	Oluw1991	46	14	20	25.6	27.8	23.2	19.6	16.8	14.8	12.4	2.5	2.8	C	0.256	0.278	0.232	0.196	0.051472	0.641244	0.14881	65.625	6.157522
991	Oluw1991	46	15	20	22.2	25.2	18.4	16.2	15.6	13.8	11.4	2.5	2.8	C	0.222	0.252	0.184	0.162	0.038708	0.406754	0.160256	70.27027	6.157522
992	Oluw1991	46	16	20	19.5	21.4	17.5	15.6	14.8	12.8	10.8	2.5	2.8	C	0.195	0.214	0.175	0.156	0.029865	0.322758	0.168919	75.89744	6.157522
993	Oluw1991	46	17	20	30.2	32.4	28.2	24.5	18.4	16.4	14.4	2.6	2.9	D	0.302	0.324	0.282	0.245	0.071631	1.037091	0.141304	60.92715	6.605199
994	Oluw1991	46	18	20	25.5	29.6	22.5	20.4	16.2	14.8	12.6	2.5	2.8	C	0.255	0.296	0.225	0.204	0.051071	0.64267	0.154321	63.52941	6.157522
995	Oluw1991	46	19	20	22.2	24.2	20.1	18.2	15.6	13.8	11.4	2.5	2.8	C	0.222	0.242	0.201	0.182	0.038708	0.457551	0.160256	70.27027	6.157522
996	Oluw1991	46	20	20	28.5	32.4	26.4	22.4	17.8	15.8	13.6	2.5	2.8	C	0.285	0.324	0.264	0.224	0.063794	0.897473	0.140449	62.45614	6.157522
997	Oluw1991	46	21	20	21.3	23.6	18.9	16.3	14.6	12.9	10.8	2.5	2.8	C	0.213	0.236	0.189	0.163	0.035633	0.380188	0.171233	68.5446	6.157522
998	Oluw1991	46	22	20	24.5	28.4	22.5	19.5	15.6	13.6	11.8	2.5	2.8	C	0.245	0.284	0.225	0.195	0.047144	0.571778	0.160256	63.67347	6.157522
999	Oluw1991	46	23	20	14.6	18.5	12.4	10.6	13.8	11.6	9.5	2.4	2.6	S	0.146	0.185	0.124	0.106	0.016742	0.16242	0.173913	94.52055	5.309292
1000	Oluw1991	46	24	20	13.6	17.8	11.6	9.6	13.4	11.4	9.2	2.4	2.6	S	0.136	0.178	0.116	0.096	0.014527	0.141353	0.179104	98.52941	5.309292
1001	Oluw1991	46	25	20	23.2	25.8	19.2	15.2	15.4	13.8	11.6	2.5	2.8	C	0.232	0.258	0.192	0.152	0.042273	0.428345	0.162338	66.37931	6.157522
1002	Oluw1991	46	26	20	18.6	22.6	16.4	14.6	14.6	12.4	10.2	2.5	2.8	C	0.186	0.226	0.164	0.146	0.027172	0.292129	0.171233	78.49462	6.157522
1003	Oluw1991	46	27	20	22.5	24.5	20.4	18.5	15.8	13.9	11.8	2.5	2.8	C	0.225	0.245	0.204	0.185	0.039761	0.474371	0.158228	70.22222	6.157522
1004	Oluw1991	46	28	20	21.4	26.4	18.2	16.2	14.8	12.8	10.9	2.5	2.8	C	0.214	0.264	0.182	0.162	0.035968	0.382748	0.168919	69.15888	6.157522
1005	Oluw1991	46	29	20	21	24.6	19.4	17.4	14.6	12.8	10.8	2.5	2.8	C	0.21	0.246	0.194	0.174	0.034636	0.404362	0.171233	69.52381	6.157522
1006	Oluw1991	46	30	20	20.8	24.4	18.6	16.6	14.8	12.6	10.8	2.5	2.8	C	0.208	0.244	0.186	0.166	0.033979	0.371886	0.168919	71.15385	6.157522
1007	Oluw1991	46	31	20	15.7	19.8	13.7	11.6	13.6	11.8	9.8	2.4	2.6	S	0.157	0.198	0.137	0.116	0.019359	0.197303	0.176471	86.6242	5.309292
1008	Oluw1991	46	32	20	17.6	21.6	15.4	13.6	11.9	11.9	9.9	2.4	2.6	S	0.176	0.216	0.154	0.136	0.024328	0.249258	0.201681	67.61364	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1009	Oluw1991	47	1	20	20.8	26.6	20.6	18.8	15.6	13.6	11.6	2.5	2.8	C	0.208	0.266	0.206	0.188	0.033979	0.491067	0.160256	75	6.157522
1010	Oluw1991	47	2	20	25.8	27.8	23.2	21.6	16.8	14.8	12.4	2.5	2.8	C	0.258	0.278	0.232	0.216	0.052279	0.657207	0.14881	65.11628	6.157522
1011	Oluw1991	47	3	20	14.5	18.4	12.5	10.4	13.4	11.4	9.4	2.4	2.6	S	0.145	0.184	0.125	0.104	0.016513	0.159928	0.179104	92.41379	5.309292
1012	Oluw1991	47	4	20	20.9	22.8	18.6	16.9	14.85	12.8	10.9	2.5	2.8	C	0.209	0.228	0.186	0.169	0.034307	0.366819	0.16835	71.05263	6.157522
1013	Oluw1991	47	5	20	16.5	20.4	14.5	12.4	13.8	11.6	9.8	2.4	2.6	S	0.165	0.204	0.145	0.124	0.021382	0.214239	0.173913	83.63636	5.309292
1014	Oluw1991	47	6	20	27.8	29.8	24.6	22.8	16.4	14.4	12.4	2.5	2.8	C	0.278	0.298	0.246	0.228	0.060699	0.721659	0.152439	58.99281	6.157522
1015	Oluw1991	47	7	20	28.6	32.6	24.8	22.5	16.8	14.8	12.8	2.5	2.8	C	0.286	0.326	0.248	0.225	0.064242	0.780577	0.14881	58.74126	6.157522
1016	Oluw1991	47	8	20	13.5	16.4	11.5	9.4	13.2	11.2	9.1	2.4	2.6	S	0.135	0.164	0.115	0.094	0.014314	0.129941	0.181818	97.77778	5.309292
1017	Oluw1991	47	9	20	14.8	18.4	12.8	10.6	13.4	11.4	9.4	2.4	2.6	S	0.148	0.184	0.128	0.106	0.017203	0.165085	0.179104	90.54054	5.309292
1018	Oluw1991	47	10	20	32.7	34.8	28.4	24.7	18.6	16.6	14.8	2.6	2.9	D	0.327	0.348	0.284	0.247	0.083982	1.096761	0.139785	56.88073	6.605199
1019	Oluw1991	47	11	20	12.7	16.6	10.7	8.5	12.4	10.4	8.2	2.4	2.6	S	0.127	0.166	0.107	0.085	0.012668	0.109694	0.193548	97.6378	5.309292
1020	Oluw1991	47	12	20	19.5	22.8	19.5	15.4	14.2	12.2	10.1	2.5	2.8	C	0.195	0.228	0.195	0.154	0.029865	0.363791	0.176056	72.82051	6.157522
1021	Oluw1991	47	13	20	15.1	17.2	13.2	11.1	13.6	11.6	9.6	2.4	2.6	S	0.151	0.172	0.132	0.111	0.017908	0.169459	0.176471	90.06623	5.309292
1022	Oluw1991	47	14	20	19.4	23.4	17.2	15.1	14.8	12.8	10.4	2.6	2.8	C	0.194	0.234	0.172	0.151	0.029559	0.328222	0.175676	76.28866	6.157522
1023	Oluw1991	47	15	20	21.1	24.2	19.2	16.2	14.8	12.8	10.9	2.6	2.8	C	0.211	0.242	0.192	0.162	0.034967	0.389162	0.175676	70.14218	6.157522
1024	Oluw1991	47	16	20	23.5	27.4	21.4	18.6	15.6	13.6	11.6	2.6	2.8	C	0.235	0.274	0.214	0.186	0.043374	0.521353	0.166667	66.38298	6.157522
1025	Oluw1991	47	17	20	12.2	16.6	10.1	8.1	12.4	10.2	8.1	2.4	2.6	S	0.122	0.166	0.101	0.081	0.01169	0.100033	0.193548	101.6393	5.309292
1026	Oluw1991	47	18	20	22.5	26.8	18.5	16.4	15.6	13.8	11.7	2.5	2.8	C	0.225	0.268	0.185	0.164	0.039761	0.425628	0.160256	69.33333	6.157522
1027	Oluw1991	47	19	20	20.8	24.6	16.8	14.2	10.48	12.9	10.9	2.5	2.8	C	0.208	0.246	0.168	0.142	0.033979	0.326874	0.23855	50.38462	6.157522
1028	Oluw1991	47	20	20	18.2	22.4	16.2	14.1	14.4	12.2	10.1	2.5	2.8	C	0.182	0.224	0.162	0.141	0.026016	0.279524	0.173611	79.12088	6.157522
1029	Oluw1991	47	21	20	14.7	16.8	12.4	10.4	13.6	11.8	9.8	2.4	2.6	S	0.147	0.168	0.124	0.104	0.016972	0.155302	0.176471	92.51701	5.309292
1030	Oluw1991	47	22	20	28.9	22.8	24.85	21.6	13.4	11.4	9.4	2.5	2.8	C	0.289	0.228	0.2485	0.216	0.065597	0.515797	0.186567	46.36678	6.157522
1031	Oluw1991	47	23	20	26.2	29.7	24.2	20.4	16.8	14.6	12.8	2.5	2.8	C	0.262	0.297	0.242	0.204	0.053913	0.695808	0.14881	64.12214	6.157522
1032	Oluw1991	47	24	20	17.1	19.4	15.2	13.1	13.8	11.8	9.8	2.4	2.6	S	0.171	0.194	0.152	0.131	0.022966	0.227388	0.173913	80.70175	5.309292
1033	Oluw1991	47	25	20	18.9	21.8	16.8	14.2	14.6	12.8	10.4	2.4	2.6	S	0.189	0.218	0.168	0.142	0.028055	0.302571	0.164384	77.24868	5.309292
1034	Oluw1991	47	26	20	16.1	18.4	14.3	12.2	14.4	12.2	10.2	2.4	2.6	S	0.161	0.184	0.143	0.122	0.020358	0.208463	0.166667	89.44099	5.309292
1035	Oluw1991	47	27	20	20	24.5	18.2	16.4	15.6	13.6	11.4	2.5	2.8	C	0.2	0.245	0.182	0.164	0.031416	0.390614	0.160256	78	6.157522
1036	Oluw1991	47	28	20	16.2	19.4	14.1	12.2	14.8	12.4	10.2	2.4	2.6	S	0.162	0.194	0.141	0.122	0.020612	0.214328	0.162162	91.35802	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1037	Oluw1991	47	29	20	25.5	27.6	21.4	19.5	16.2	14.2	12.1	2.5	2.8	C	0.255	0.276	0.214	0.195	0.051071	0.552772	0.154321	63.52941	6.157522
1038	Oluw1991	47	30	20	24.2	28.4	22.1	18.8	15.6	13.6	11.8	2.5	2.8	C	0.242	0.284	0.221	0.188	0.045996	0.554301	0.160256	64.46281	6.157522
1039	Oluw1991	47	31	20	20.8	22.6	18.4	16.6	15.8	13.8	11.4	2.5	2.8	C	0.208	0.226	0.184	0.166	0.033979	0.386674	0.158228	75.96154	6.157522
1040	Oluw1991	48	1	20	17.4	19.8	15.4	13.4	14.6	12.8	10.6	2.5	2.8	C	0.174	0.198	0.154	0.134	0.023779	0.254719	0.171233	83.90805	6.157522
1041	Oluw1991	48	2	20	17.7	19.9	15.8	13.7	14.8	12.9	10.8	2.5	2.8	C	0.177	0.199	0.158	0.137	0.024606	0.267181	0.168919	83.61582	6.157522
1042	Oluw1991	48	3	20	19.7	22.4	16.8	14.7	15.4	13.2	11.1	2.5	2.8	C	0.197	0.224	0.168	0.147	0.030481	0.319106	0.162338	78.17259	6.157522
1043	Oluw1991	48	4	20	19.3	22.1	16.4	14.2	14.6	12.8	10.9	2.5	2.8	C	0.193	0.221	0.164	0.142	0.029255	0.295878	0.171233	75.64767	6.157522
1044	Oluw1991	48	5	20	12.6	15.6	10.6	8.4	12.4	10.2	8.1	2.4	2.6	S	0.126	0.156	0.106	0.084	0.012469	0.101922	0.193548	98.4127	5.309292
1045	Oluw1991	48	6	20	10	14.4	8.4	6.8	11.6	9.6	7.6	2.4	2.6	S	0.1	0.144	0.084	0.068	0.007854	0.067336	0.206897	116	5.309292
1046	Oluw1991	48	7	20	11.9	13.8	9.4	7.9	11.8	9.8	7.8	2.4	2.6	S	0.119	0.138	0.094	0.079	0.011122	0.077776	0.20339	99.15966	5.309292
1047	Oluw1991	48	8	20	24.2	26.4	20.4	18.2	15.8	13.8	11.4	2.5	2.8	C	0.242	0.264	0.204	0.182	0.045996	0.486439	0.158228	65.28926	6.157522
1048	Oluw1991	48	9	20	12.4	14.6	10.6	8.4	12.6	10.4	8.5	2.4	2.6	S	0.124	0.146	0.106	0.084	0.012076	0.099809	0.190476	101.6129	5.309292
1049	Oluw1991	48	10	20	15.1	17.2	13.2	11.1	13.8	11.8	9.4	2.4	2.6	S	0.151	0.172	0.132	0.111	0.017908	0.172381	0.173913	91.39073	5.309292
1050	Oluw1991	48	11	20	17.4	21.8	15.4	13.2	14.6	12.8	10.6	2.5	2.8	C	0.174	0.218	0.154	0.132	0.023779	0.267768	0.171233	83.90805	6.157522
1051	Oluw1991	48	12	20	15.8	19.4	13.8	11.6	13.4	11.7	9.8	2.4	2.6	S	0.158	0.194	0.138	0.116	0.019607	0.194914	0.179104	84.81013	5.309292
1052	Oluw1991	48	13	20	17.7	21.9	15.2	13.4	14.8	12.8	10.7	2.4	2.6	S	0.177	0.219	0.152	0.134	0.024606	0.265289	0.162162	83.61582	5.309292
1053	Oluw1991	48	14	20	11.7	15.8	9.8	7.6	11.6	9.6	7.8	2.4	2.6	S	0.117	0.158	0.098	0.076	0.010751	0.086904	0.206897	99.1453	5.309292
1054	Oluw1991	48	15	20	15.5	17.8	13.6	11.4	13.8	11.8	9.8	2.4	2.6	S	0.155	0.178	0.136	0.114	0.018869	0.18329	0.173913	89.03226	5.309292
1055	Oluw1991	48	16	20	20.5	24.6	18.4	16.5	15.6	13.6	11.2	2.5	2.8	C	0.205	0.246	0.184	0.165	0.033006	0.397286	0.160256	76.09756	6.157522
1056	Oluw1991	48	17	20	14.7	16.8	12.7	10.6	12.8	10.8	8.4	2.4	2.6	S	0.147	0.168	0.127	0.106	0.016972	0.146993	0.1875	87.07483	5.309292
1057	Oluw1991	48	18	20	15	19.4	13.4	11.2	13.6	11.4	9.3	2.4	2.6	S	0.15	0.194	0.134	0.112	0.017671	0.182061	0.176471	90.66667	5.309292
1058	Oluw1991	48	19	20	11.4	15.6	9.6	7.4	11.4	9.2	7.2	2.4	2.6	S	0.114	0.156	0.096	0.074	0.010207	0.080296	0.210526	100	5.309292
1059	Oluw1991	48	20	20	17.6	21.6	15.4	13.6	14.8	12.4	10.2	2.4	2.6	S	0.176	0.216	0.154	0.136	0.024328	0.259731	0.162162	84.09091	5.309292
1060	Oluw1991	48	21	20	20.5	24.6	18.4	16.5	15.6	13.6	11.4	2.5	2.8	C	0.205	0.246	0.184	0.165	0.033006	0.397286	0.160256	76.09756	6.157522
1061	Oluw1991	48	22	20	9.2	13.4	7.2	5.6	9.8	7.8	5.6	2.4	2.6	S	0.092	0.134	0.072	0.056	0.006648	0.042707	0.244898	106.5217	5.309292
1062	Oluw1991	48	23	20	15.7	19.8	13.8	11.9	13.8	11.8	9.6	2.4	2.6	S	0.157	0.198	0.138	0.119	0.019359	0.200091	0.173913	87.89809	5.309292
1063	Oluw1991	48	24	20	11.5	14.5	9.5	7.4	11.8	9.4	7.1	2.4	2.6	S	0.115	0.145	0.095	0.074	0.010387	0.077028	0.20339	102.6087	5.309292
1064	Oluw1991	48	25	20	19.4	23.6	17.6	15.4	14.8	12.8	10.6	2.4	2.6	S	0.194	0.236	0.176	0.154	0.029559	0.340659	0.162162	76.28866	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1065	Oluw1991	48	26	20	19	21.1	17.41	15.1	14.6	12.4	10.2	2.4	2.6	S	0.19	0.211	0.1741	0.151	0.028353	0.306071	0.164384	76.84211	5.309292
1066	Oluw1991	48	27	20	12.2	15.6	10.2	8.1	10.6	8.6	6.8	2.4	2.6	S	0.122	0.156	0.102	0.081	0.01169	0.081631	0.226415	86.88525	5.309292
1067	Oluw1991	48	28	20	14	18.4	12.1	10.4	12.8	10.4	8.1	2.4	2.6	S	0.14	0.184	0.121	0.104	0.015394	0.140541	0.1875	91.42857	5.309292
1068	Oluw1991	48	29	20	22.6	26.1	20.2	18.4	16.8	14.4	12.1	2.4	2.6	S	0.226	0.261	0.202	0.184	0.040115	0.499877	0.142857	74.33628	5.309292
1069	Oluw1991	48	30	20	15.5	19.4	13.5	11.4	13.6	11.8	9.8	2.4	2.6	S	0.155	0.194	0.135	0.114	0.018869	0.19081	0.176471	87.74194	5.309292
1070	Oluw1991	48	31	20	17.3	21.6	15.3	13.4	14.8	12.8	110.4	2.4	2.6	S	0.173	0.216	0.153	0.134	0.023506	0.265147	0.162162	85.54913	5.309292
1071	Oluw1991	48	32	20	9.3	13.6	7.4	5.6	10.8	8.8	6.4	2.4	2.6	S	0.093	0.136	0.074	0.056	0.006793	0.05015	0.222222	116.129	5.309292
1072	Oluw1993	49	1	18	27.1	29.1	25.2	23.2	16.8	14.8	12.4	2.5	2.8	C	0.271	0.291	0.252	0.232	0.05768	0.760437	0.14881	61.99262	6.157522
1073	Oluw1993	49	2	18	29	32.1	27.4	24.1	16.6	14.6	12.6	2.6	2.9	D	0.29	0.321	0.274	0.241	0.066052	0.881848	0.156627	57.24138	6.605199
1074	Oluw1993	49	3	18	23.5	25.6	21.5	19.5	15.4	13.4	11.4	2.5	2.8	C	0.235	0.256	0.215	0.195	0.043374	0.505977	0.162338	65.53191	6.157522
1075	Oluw1993	49	4	18	20.4	22.4	18.4	16.4	14.8	12.8	10.8	2.5	2.8	C	0.204	0.224	0.184	0.164	0.032685	0.35604	0.168919	72.54902	6.157522
1076	Oluw1993	49	5	18	23	25.1	21	19.1	15.2	13.2	11.2	2.5	2.8	C	0.23	0.251	0.21	0.191	0.041548	0.47669	0.164474	66.08696	6.157522
1077	Oluw1993	49	6	18	27	29.6	25.8	23.6	16.1	14.1	12.1	2.5	2.8	C	0.27	0.296	0.258	0.236	0.057256	0.755934	0.15528	59.62963	6.157522
1078	Oluw1993	49	7	18	28	32.1	26.1	24	16.2	14.2	12.2	2.5	2.8	C	0.28	0.321	0.261	0.24	0.061575	0.805082	0.154321	57.85714	6.157522
1079	Oluw1993	49	8	18	17.2	19.4	15.2	13.4	14.4	12.4	10.4	2.5	2.8	C	0.172	0.194	0.152	0.134	0.023235	0.24024	0.173611	83.72093	6.157522
1080	Oluw1993	49	9	18	14.9	18.9	12.8	10.9	13.2	11.2	9.2	2.4	2.6	S	0.149	0.189	0.128	0.109	0.017437	0.165869	0.181818	88.5906	5.309292
1081	Oluw1993	49	10	18	23.5	27.5	21.5	19.6	15.4	13.4	11.4	2.5	2.8	C	0.235	0.275	0.215	0.196	0.043374	0.524359	0.162338	65.53191	6.157522
1082	Oluw1993	49	11	18	30.2	32.4	28.6	24.2	17.4	15.4	13.4	2.6	2.9	D	0.302	0.324	0.286	0.242	0.071631	0.989229	0.149425	57.61589	6.605199
1083	Oluw1993	49	12	18	32.5	34.6	28.5	23.8	18.6	16.6	14.6	2.6	2.9	D	0.325	0.346	0.285	0.238	0.082958	1.089205	0.139785	57.23077	6.605199
1084	Oluw1993	49	13	18	18	22.2	16.1	14	15.1	13.1	11.1	2.5	2.8	C	0.18	0.222	0.161	0.14	0.025447	0.295917	0.165563	83.88889	6.157522
1085	Oluw1993	49	14	18	22.5	24.6	20.5	18.5	14.8	12.8	10.8	2.5	2.8	C	0.225	0.246	0.205	0.185	0.039761	0.440394	0.168919	65.77778	6.157522
1086	Oluw1993	49	15	18	30	32.2	28.4	24.2	17.4	15.2	13.2	2.6	2.9	D	0.3	0.322	0.284	0.242	0.070686	0.964738	0.149425	58	6.605199
1087	Oluw1993	49	16	18	16	20.1	14.8	12.3	13.2	11.2	9.2	2.5	2.8	C	0.16	0.201	0.148	0.123	0.020106	0.209863	0.189394	82.5	6.157522
1088	Oluw1993	50	1	18	14.5	16.6	12.5	10.5	14.2	12.1	10.1	2.4	2.6	S	0.145	0.166	0.125	0.105	0.016513	0.160101	0.169014	97.93103	5.309292
1089	Oluw1993	50	2	18	25.9	27.8	23.8	21.9	15.8	13.8	11.8	2.5	2.8	C	0.259	0.278	0.238	0.219	0.052685	0.635535	0.158228	61.00386	6.157522
1090	Oluw1993	50	3	18	16	19	14.1	12.2	13.8	11.8	9.8	2.4	2.6	S	0.16	0.19	0.141	0.122	0.020106	0.201585	0.173913	86.25	5.309292
1091	Oluw1993	50	4	18	18	21.2	16.1	14.1	15.2	13.2	11.2	2.5	2.8	C	0.18	0.212	0.161	0.141	0.025447	0.291163	0.164474	84.44444	6.157522
1092	Oluw1993	50	5	18	17.5	19.6	15.5	13.4	14.6	12.6	10.6	2.5	2.8	C	0.175	0.196	0.155	0.134	0.024053	0.251478	0.171233	83.42857	6.157522
1093	Oluw1993	50	6	18	17.3	19.8	15.3	13.3	14.2	12.2	10.2	2.5	2.8	C	0.173	0.198	0.153	0.133	0.023506	0.240391	0.176056	82.08092	6.157522
1094	Oluw1993	50	7	18	17.7	20.1	15.7	13.1	14.8	12.8	10.8	2.5	2.8	C	0.177	0.201	0.157	0.131	0.024606	0.261645	0.168919	83.61582	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1095	Oluw1993	50	8	18	27.4	29.4	25.4	23.2	16.4	14.4	12.4	2.6	2.9	D	0.274	0.294	0.254	0.232	0.058965	0.750823	0.158537	59.85401	6.605199
1096	Oluw1993	50	9	18	18.9	22.8	16.8	16.8	15.6	13.6	11.6	2.5	2.8	C	0.189	0.228	0.168	0.168	0.028055	0.343771	0.160256	82.53968	6.157522
1097	Oluw1993	50	10	18	19.7	21.7	17.6	15.7	15.9	13.9	11.9	2.5	2.8	C	0.197	0.217	0.176	0.157	0.030481	0.355972	0.157233	80.71066	6.157522
1098	Oluw1993	50	11	18	17	20.1	15.2	13.2	14.2	12.1	10.1	2.4	2.6	S	0.17	0.201	0.152	0.132	0.022698	0.237965	0.169014	83.52941	5.309292
1099	Oluw1993	50	12	18	17.3	19.8	15.1	12.8	14.2	12.2	10.2	2.5	2.8	C	0.173	0.198	0.151	0.128	0.023506	0.234423	0.176056	82.08092	6.157522
1100	Oluw1993	50	13	18	15.2	18.2	13.1	11.2	11.4	11.4	9.4	2.4	2.6	S	0.152	0.182	0.131	0.112	0.018146	0.170583	0.210526	75	5.309292
1101	Oluw1993	50	14	18	25.5	27.5	22.4	20.5	13.6	13.6	11.6	2.5	2.8	C	0.255	0.275	0.224	0.205	0.051071	0.566745	0.183824	53.33333	6.157522
1102	Oluw1993	50	15	18	27.5	29.6	25.4	21.5	13.8	13.8	11.9	2.5	2.8	C	0.275	0.296	0.254	0.215	0.059396	0.707943	0.181159	50.18182	6.157522
1103	Oluw1993	51	1	18	15.5	18.6	13.5	11.5	13.8	11.8	9.8	2.4	2.6	S	0.155	0.186	0.135	0.115	0.018869	0.186468	0.173913	89.03226	5.309292
1104	Oluw1993	51	2	18	19.5	21.6	17.5	15.4	13.9	11.9	9.9	2.5	2.8	C	0.195	0.216	0.175	0.154	0.029865	0.300438	0.179856	71.28205	6.157522
1105	Oluw1993	51	3	18	22.5	24.6	19.6	17.5	14.8	12.8	10.9	2.5	2.8	C	0.225	0.246	0.196	0.175	0.039761	0.410175	0.168919	65.77778	6.157522
1106	Oluw1993	51	4	18	27.7	29.7	25.6	24.6	16.8	14.8	12.8	2.5	2.8	C	0.277	0.297	0.256	0.246	0.060263	0.795983	0.14881	60.64982	6.157522
1107	Oluw1993	51	5	18	12.4	16.4	10.3	8.4	12.1	10.1	8.1	2.4	2.6	S	0.124	0.164	0.103	0.084	0.012076	0.100992	0.198347	97.58065	5.309292
1108	Oluw1993	51	6	18	23.8	27.6	21.8	19.8	15.8	13.8	11.8	2.5	2.8	C	0.238	0.276	0.218	0.198	0.044488	0.551817	0.158228	66.38655	6.157522
1109	Oluw1993	51	7	18	25.3	28.2	23.3	19.9	16.1	14.1	12.1	2.5	2.8	C	0.253	0.282	0.233	0.199	0.050273	0.620669	0.15528	63.63636	6.157522
1110	Oluw1993	51	8	18	24.1	26.2	22.1	20	16	14	12	2.5	2.8	C	0.241	0.262	0.221	0.2	0.045617	0.557124	0.15625	66.39004	6.157522
1111	Oluw1993	51	9	18	19.3	21.2	17.2	15.3	13.4	11.4	9.9	2.5	2.8	C	0.193	0.212	0.172	0.153	0.029255	0.278588	0.186567	69.43005	6.157522
1112	Oluw1993	51	10	18	15.3	19.6	13.3	11.1	13.8	11.8	9.8	2.4	2.6	S	0.153	0.196	0.133	0.111	0.018385	0.18766	0.173913	90.19608	5.309292
1113	Oluw1993	51	11	18	26.5	32.4	24.5	22.5	16.4	14.4	12.4	2.5	2.8	C	0.265	0.324	0.245	0.225	0.055155	0.745879	0.152439	61.88679	6.157522
1114	Oluw1993	51	12	18	18	22.1	16.1	14	13.6	11.6	9.6	2.5	2.8	C	0.18	0.221	0.161	0.14	0.025447	0.261361	0.183824	75.55556	6.157522
1115	Oluw1993	51	13	18	33	36.2	29.4	24.1	18.4	16.4	14.4	2.5	2.9	D	0.33	0.362	0.294	0.241	0.08553	1.148233	0.13587	55.75758	6.605199
1116	Oluw1993	52	1	18	20.8	24.8	18.6	16.4	14.8	12.8	10.8	2.5	2.8	C	0.208	0.248	0.186	0.164	0.033979	0.37998	0.168919	71.15385	6.157522
1117	Oluw1993	52	2	18	18.1	22.4	16.2	14.1	13.8	11.8	9.8	2.5	2.8	C	0.181	0.224	0.162	0.141	0.02573	0.270359	0.181159	76.24309	6.157522
1118	Oluw1993	52	3	18	19.1	23.2	16.8	14.4	13.4	11.4	9.4	2.5	2.8	C	0.191	0.232	0.168	0.144	0.028652	0.279732	0.186567	70.15707	6.157522
1119	Oluw1993	52	4	18	19.5	23.4	16.9	14.5	13.8	11.8	9.9	2.5	2.8	C	0.195	0.234	0.169	0.145	0.029865	0.293516	0.181159	70.76923	6.157522
1120	Oluw1993	52	5	18	15.7	18.6	13.7	11.5	12.8	10.8	8.8	2.4	2.6	S	0.157	0.186	0.137	0.115	0.019359	0.173742	0.1875	81.52866	5.309292
1121	Oluw1993	52	6	18	20.7	24.8	18.2	16.2	14.9	12.9	10.9	2.5	2.8	C	0.207	0.248	0.182	0.162	0.033654	0.371905	0.167785	71.98068	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1122	Oluw1993	52	7	18	21	25.1	17.8	15.6	15.2	13.2	11.2	2.5	2.8	C	0.21	0.251	0.178	0.156	0.034636	0.369892	0.164474	72.38095	6.157522
1123	Oluw1993	52	8	18	14.5	17.5	12.4	10.5	12.7	10.7	8.7	2.4	2.6	S	0.145	0.175	0.124	0.105	0.016513	0.14448	0.188976	87.58621	5.309292
1124	Oluw1993	52	9	18	16.7	19.6	14.7	12.6	13.8	11.8	9.8	2.4	2.6	S	0.167	0.196	0.147	0.126	0.021904	0.217371	0.173913	82.63473	5.309292
1125	Oluw1993	52	10	18	17.8	21.1	15.8	13.8	13.6	11.6	9.6	2.5	2.8	C	0.178	0.211	0.158	0.138	0.024885	0.248144	0.183824	76.40449	6.157522
1126	Oluw1993	52	11	18	27	29.1	25.2	23.2	16.8	14.8	12.8	2.5	2.8	C	0.27	0.291	0.252	0.232	0.057256	0.760437	0.14881	62.22222	6.157522
1127	Oluw1993	52	12	18	18.1	22.1	16.1	14.2	13.9	11.9	9.9	2.5	2.8	C	0.181	0.221	0.161	0.142	0.02573	0.268999	0.179856	76.79558	6.157522
1128	Oluw1993	52	13	18	10.1	14.2	8.1	6	12.2	10.2	8.2	2.4	2.6	S	0.101	0.142	0.081	0.06	0.008012	0.06677	0.196721	120.7921	5.309292
1129	J4-1996	53	1	15	24.3	26.8	21.6	16.1	10.4	9.4	6.4	2.6	2.9	C	0.243	0.268	0.216	0.161	0.046377	0.349904	0.25	42.79835	6.605199
1130	J4-1996	53	2	15	21.6	24.1	18.8	12.2	10.5	9.6	6.6	2.6	2.9	C	0.216	0.241	0.188	0.122	0.036644	0.269349	0.247619	48.61111	6.605199
1131	J4-1996	53	3	15	32.2	34.8	29.4	18.4	11.9	10.4	7.8	2.8	3.4	D	0.322	0.348	0.294	0.184	0.081433	0.681637	0.235294	36.95652	9.079203
1132	J4-1996	53	4	15	10.2	12.4	8.1	6.2	8.4	6.2	3.8	2.3	2.6	S	0.102	0.124	0.081	0.062	0.008171	0.036898	0.27381	82.35294	5.309292
1133	J4-1996	53	5	15	22.5	24.8	19.6	13.5	8.6	6.4	6.5	2.4	2.6	S	0.225	0.248	0.196	0.135	0.039761	0.195527	0.27907	38.22222	5.309292
1134	J4-1996	53	6	15	29.3	32.1	26.5	18.6	11.6	10.1	7.4	2.8	3.4	D	0.293	0.321	0.265	0.186	0.067426	0.553342	0.241379	39.59044	9.079203
1135	J4-1996	53	7	15	16	18.9	13.7	9.6	9.4	8.3	6.9	2.4	2.8	I	0.16	0.189	0.137	0.096	0.020106	0.13039	0.255319	58.75	6.157522
1136	J4-1996	53	8	15	18	20.3	15.8	11.2	10.4	9.2	6.8	2.6	2.8	C	0.18	0.203	0.158	0.112	0.025447	0.184988	0.25	57.77778	6.157522
1137	J4-1996	53	9	15	18.6	20.5	15.9	11.1	9.6	8.9	6.4	2.4	2.6	I	0.186	0.205	0.159	0.111	0.027172	0.181124	0.25	51.6129	5.309292
1138	J4-1996	53	10	15	15.5	17.7	13.3	9.5	9.6	8.4	5.6	2.5	2.6	I	0.155	0.177	0.133	0.095	0.018869	0.122172	0.260417	61.93548	5.309292
1139	J4-1996	53	11	15	26.5	28.2	22.4	16.1	9.7	8.6	6.2	2.4	2.6	I	0.265	0.282	0.224	0.161	0.055155	0.344643	0.247423	36.60377	5.309292
1140	J4-1996	53	12	15	28.7	31.2	26.1	18.5	10.3	9.2	6.9	2.6	2.8	C	0.287	0.312	0.261	0.185	0.064692	0.486592	0.252427	35.8885	6.157522
1141	J4-1996	53	13	15	12.2	14.8	10.1	7.6	7.4	6.5	4.4	2.4	2.6	S	0.122	0.148	0.101	0.076	0.01169	0.058269	0.324324	60.65574	5.309292
1142	J4-1996	53	14	15	24.2	26.9	22.8	16.4	10.5	9.3	7.4	2.5	2.8	C	0.242	0.269	0.228	0.164	0.045996	0.373967	0.238095	43.38843	6.157522
1143	J4-1996	53	15	15	14.8	17.1	11.9	9.6	9.6	8.2	6.2	2.5	2.6	I	0.148	0.171	0.119	0.096	0.017203	0.102079	0.260417	64.86486	5.309292
1144	J4-1996	53	16	15	15.5	17.2	12.6	9.8	9.7	8.4	6.3	2.3	2.6	I	0.155	0.172	0.126	0.098	0.018869	0.112916	0.237113	62.58065	5.309292
1145	J4-1996	53	17	15	13.2	16.3	10.3	8.4	10.4	9.1	6.6	2.6	2.8	C	0.132	0.163	0.103	0.084	0.013685	0.090603	0.25	78.78788	6.157522
1146	J4-1996	53	18	15	10.5	13.5	8.2	6.4	7.7	6.4	5.2	2.4	2.5	S	0.105	0.135	0.082	0.064	0.008659	0.041232	0.311688	73.33333	4.908739
1147	J4-1996	53	19	15	21.3	23.6	19.4	12.1	10.5	9.6	7.4	2.6	2.8	C	0.213	0.236	0.194	0.121	0.035633	0.277567	0.247619	49.29577	6.157522
1148	J4-1996	53	20	15	10.8	13.4	8.3	6.4	10.9	9.9	8.4	2.6	2.8	C	0.108	0.134	0.083	0.064	0.009161	0.064287	0.238532	100.9259	6.157522
1149	J4-1996	53	21	15	14.5	16.6	12.1	8.4	10.3	8.9	6.2	2.6	2.9	C	0.145	0.166	0.121	0.084	0.016513	0.108551	0.252427	71.03448	6.605199

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1150	J4-1996	53	22	15	15	17.4	12.6	8.8	7.4	5.6	3.9	2.4	2.6	S	0.15	0.174	0.126	0.088	0.017671	0.074421	0.324324	49.33333	5.309292
1151	J4-1996	53	23	15	26.2	28.6	24.1	16.4	9.9	8.9	6.2	2.6	2.8	C	0.262	0.286	0.241	0.164	0.053913	0.397286	0.262626	37.78626	6.157522
1152	J4-1996	53	24	15	18.2	21.3	16.8	11.5	10.1	8.9	6.4	2.6	2.8	C	0.182	0.213	0.168	0.115	0.026016	0.199787	0.257426	55.49451	6.157522
1153	J4-1996	53	25	15	21.2	23.9	19.2	13.6	9.4	8.1	6.4	2.4	2.6	I	0.212	0.239	0.192	0.136	0.035299	0.236522	0.255319	44.33962	5.309292
1154	J4-1996	53	26	15	15.6	17.4	12.6	8.7	9.3	8.2	7.2	2.4	2.6	I	0.156	0.174	0.126	0.087	0.019113	0.108786	0.258065	59.61538	5.309292
1155	J4-1996	53	27	15	19.2	21.4	16.7	11.4	10.5	9.4	7.8	2.6	2.8	C	0.192	0.214	0.167	0.114	0.028953	0.209606	0.247619	54.6875	6.157522
1156	J4-1996	53	28	15	14.6	17.2	12	8	10.1	8.9	6.3	2.6	2.8	C	0.146	0.172	0.12	0.08	0.016742	0.109026	0.257426	69.17808	6.157522
1157	J4-1996	53	29	15	20	22.7	16.9	11.3	10.4	9.1	8.4	2.6	2.8	C	0.2	0.227	0.169	0.113	0.031416	0.212677	0.25	52	6.157522
1158	J4-1996	53	30	15	18.8	21.3	16.5	11.1	10.6	9.6	8.6	2.6	2.8	C	0.188	0.213	0.165	0.111	0.027759	0.209343	0.245283	56.38298	6.157522
1159	J4-1996	53	31	15	22.4	24.6	20.1	13.8	10.7	9.9	8.9	2.6	2.8	C	0.224	0.246	0.201	0.138	0.039408	0.312526	0.242991	47.76786	6.157522
1160	J4-1996	53	32	15	18	21.5	15.4	10.9	9.4	8.8	7.2	2.4	2.6	I	0.18	0.215	0.154	0.109	0.025447	0.176209	0.255319	52.22222	5.309292
1161	J4-1996	53	33	15	19.8	21.4	17.6	14.2	10.4	8.9	6.8	2.5	2.8	C	0.198	0.214	0.176	0.142	0.030791	0.221193	0.240385	52.52525	6.157522
1162	J4-1996	53	34	15	11.5	14.2	9.4	8.2	9.8	7.8	5.4	2.5	2.7	C	0.115	0.142	0.094	0.082	0.010387	0.06354	0.255102	85.21739	5.725553
1163	J4-1996	53	35	15	13.5	16.1	10.2	8.9	9.8	7.9	5.5	2.5	2.6	C	0.135	0.161	0.102	0.089	0.014314	0.078032	0.255102	72.59259	5.309292
1164	J4-1996	53	36	15	19	22.1	16.9	13.1	10.2	8.8	6.2	2.5	2.8	C	0.19	0.221	0.169	0.131	0.028353	0.207628	0.245098	53.68421	6.157522
1165	J4-1996	53	37	15	15	17.5	13.4	11.2	9.8	7.9	6.4	2.5	2.8	I	0.15	0.175	0.134	0.112	0.017671	0.118915	0.255102	65.33333	6.157522
1166	J4-1996	53	38	15	20	23.4	17.3	14.6	9.9	7.6	6.8	2.5	2.8	C	0.2	0.234	0.173	0.146	0.031416	0.194777	0.252525	49.5	6.157522
1167	J4-1996	53	39	15	23.4	26.8	19.2	17.1	11.1	9.6	8.4	2.5	2.8	C	0.234	0.268	0.192	0.171	0.043005	0.312301	0.225225	47.4359	6.157522
1168	J4-1996	53	40	15	14.5	17.3	12.4	10.4	9.9	7.6	6.4	2.4	2.7	I	0.145	0.173	0.124	0.104	0.016513	0.101721	0.242424	68.27586	5.725553
1169	J4-1996	53	41	15	15.7	18.1	13.4	11.1	9.9	7.8	6.8	2.4	2.7	I	0.157	0.181	0.134	0.111	0.019359	0.119363	0.242424	63.05732	5.725553
1170	J4-1996	53	42	15	15.5	18	13.1	10.9	9.8	7.9	6.6	2.4	2.7	I	0.155	0.18	0.131	0.109	0.018869	0.116777	0.244898	63.22581	5.725553
1171	J4-1996	53	43	15	13.6	15.2	10.4	9.2	7.4	6.8	5.2	2.4	2.6	S	0.136	0.152	0.104	0.092	0.014527	0.066609	0.324324	54.41176	5.309292
1172	J4-1996	53	44	15	20	23.3	19.6	17.2	9.9	8.4	6.8	2.5	2.9	C	0.2	0.233	0.196	0.172	0.031416	0.261186	0.252525	49.5	6.605199
1173	J4-1996	53	45	15	29.2	26.8	24.8	20.1	11.4	10.4	9.4	2.5	3.2	D	0.292	0.268	0.248	0.201	0.066966	0.487694	0.219298	39.0411	8.042477
1174	J4-1996	53	46	15	25.2	27.6	23.6	19.6	11.6	10.4	9.2	2.5	3.1	D	0.252	0.276	0.236	0.196	0.049876	0.459289	0.215517	46.03175	7.547676
1175	J4-1996	53	47	15	18.5	23.4	16.4	13.6	9.9	8.2	7.4	2.5	2.8	C	0.185	0.234	0.164	0.136	0.02688	0.194105	0.252525	53.51351	6.157522
1176	J4-1996	53	48	15	23.2	26.8	20.6	18.2	11.1	9.9	8.9	2.5	2.8	C	0.232	0.268	0.206	0.182	0.042273	0.355975	0.225225	47.84483	6.157522
1177	J4-1996	53	49	15	20.5	23.8	18.4	16.1	10.8	9.4	8.2	2.5	2.8	C	0.205	0.238	0.184	0.161	0.033006	0.268226	0.231481	52.68293	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1178	J4-1996	53	50	15	23	26.9	19.6	17.2	10.2	8.8	6.2	2.4	2.7	I	0.23	0.269	0.196	0.172	0.041548	0.29444	0.235294	44.34783	5.725553
1179	J4-1996	53	51	15	23.3	27.1	19.9	17.8	10.4	8.9	6.8	2.5	2.8	C	0.233	0.271	0.199	0.178	0.042638	0.307013	0.240385	44.63519	6.157522
1180	J4-1996	53	52	15	22.5	26.6	18.6	16.2	9.4	7.4	5.4	2.4	2.7	I	0.225	0.266	0.186	0.162	0.039761	0.228007	0.255319	41.77778	5.725553
1181	J4-1996	53	53	15	24.2	27.4	21.4	18.9	10.4	8.9	6.6	2.5	2.8	C	0.242	0.274	0.214	0.189	0.045996	0.34249	0.240385	42.97521	6.157522
1182	J4-1996	53	54	15	16.5	18.4	13.3	10.7	9.9	8.4	6.8	2.5	2.8	C	0.165	0.184	0.133	0.107	0.021382	0.127616	0.252525	60	6.157522
1183	J4-1996	53	55	15	16	18.8	13.1	10.1	9.8	7.8	6.4	2.4	2.9	I	0.16	0.188	0.131	0.101	0.020106	0.116589	0.244898	61.25	6.605199
1184	J4-1996	53	56	15	22.5	26.7	18.5	16.1	10.1	8.9	6.8	2.5	2.8	C	0.225	0.267	0.185	0.161	0.039761	0.27274	0.247525	44.88889	6.157522
1185	J4-1996	53	57	15	22.6	25.4	18.6	16.2	10.3	9.1	7.2	2.5	2.8	C	0.226	0.254	0.186	0.162	0.040115	0.272953	0.242718	45.57522	6.157522
1186	J4-1996	53	58	15	22.2	26.6	18.6	16.2	10.1	9.4	7.6	2.5	2.8	C	0.222	0.266	0.186	0.162	0.038708	0.28963	0.247525	45.4955	6.157522
1187	J4-1996	53	59	15	18.2	22.6	16.1	14.4	9.9	8.9	7	2.5	2.8	C	0.182	0.226	0.161	0.144	0.026016	0.204454	0.252525	54.3956	6.157522
1188	J4-1996	53	60	15	25.5	28.1	23.4	19.6	10.4	10.1	8.1	2.5	2.8	C	0.255	0.281	0.234	0.196	0.051071	0.444751	0.240385	40.78431	6.157522
1189	J4-1996	53	61	15	14	17.3	12.1	9.6	8.1	6.8	5.2	2.4	2.6	S	0.14	0.173	0.121	0.096	0.015394	0.086973	0.296296	57.85714	5.309292
1190	J4-1996	53	62	15	22	25.6	18.2	15.7	10.4	9.4	7.6	2.5	2.8	C	0.22	0.256	0.182	0.157	0.038013	0.273999	0.240385	47.27273	6.157522
1191	J4-1996	53	63	15	18.6	22.1	16.4	13.2	9.8	7.9	6.4	2.4	2.6	I	0.186	0.221	0.164	0.132	0.027172	0.179779	0.244898	52.68817	5.309292
1192	J4-1996	53	64	15	18.5	22.4	16.3	13.1	9.4	7.6	6.2	2.4	2.6	I	0.185	0.224	0.163	0.131	0.02688	0.172717	0.255319	50.81081	5.309292
1193	J4-1996	54	1	15	18	23.1	15.8	12.9	10.2	8.8	6.5	2.5	2.8	C	0.18	0.231	0.158	0.129	0.025447	0.195662	0.245098	56.66667	6.157522
1194	J4-1996	54	2	15	21.5	25.4	19.2	16.8	10.9	9.4	8.4	2.5	2.8	C	0.215	0.254	0.192	0.168	0.036305	0.295551	0.229358	50.69767	6.157522
1195	J4-1996	54	3	15	22.5	25.6	20.4	18.2	10.3	8.7	6.4	2.5	2.8	C	0.225	0.256	0.204	0.182	0.039761	0.30193	0.242718	45.77778	6.157522
1196	J4-1996	54	4	15	27.8	29.8	25.6	23.4	10.5	8.9	6.9	2.5	2.7	C	0.278	0.298	0.256	0.234	0.060699	0.472648	0.238095	37.76978	5.725553
1197	J4-1996	54	5	15	15.2	17.7	13.4	11.3	8.6	7.2	5.4	2.4	2.6	I	0.152	0.177	0.134	0.113	0.018146	0.109254	0.27907	56.57895	5.309292
1198	J4-1996	54	6	15	26	29.3	23.8	21.4	10.4	8.6	6.2	2.5	2.8	C	0.26	0.293	0.238	0.214	0.053093	0.403263	0.240385	40	6.157522
1199	J4-1996	54	7	15	15.2	16.4	12.9	10.2	8.4	7.1	5.3	2.4	2.6	I	0.152	0.164	0.129	0.102	0.018146	0.09653	0.285714	55.26316	5.309292
1200	J4-1996	54	8	15	18.2	21.2	16.4	13.8	9.8	8	5.9	2.5	2.7	I	0.182	0.212	0.164	0.138	0.026016	0.17967	0.255102	53.84615	5.725553
1201	J4-1996	54	9	15	21	24.4	18.9	15.5	10.4	9.4	7.2	2.5	2.8	C	0.21	0.244	0.189	0.155	0.034636	0.278631	0.240385	49.52381	6.157522
1202	J4-1996	54	10	15	19.2	22.8	17.8	14.3	9.6	8	6.4	2.5	2.7	I	0.192	0.228	0.178	0.143	0.028953	0.208569	0.260417	50	5.725553
1203	J4-1996	54	11	15	14	16.4	12.2	10.4	8.4	7.3	5.2	2.4	2.6	I	0.14	0.164	0.122	0.104	0.015394	0.092927	0.285714	60	5.309292
1204	J4-1996	54	12	15	15.5	17.9	13.6	11.5	10.2	8	6.3	2.5	2.7	I	0.155	0.179	0.136	0.115	0.018869	0.124878	0.245098	65.80645	5.725553
1205	J4-1996	54	13	15	21	24.3	19.4	17.1	10.4	8.6	6.5	2.5	2.9	C	0.21	0.243	0.194	0.171	0.034636	0.268864	0.240385	49.52381	6.605199

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1206	J4-1996	54	14	15	10.5	12.3	8.6	5.4	7.4	5.2	3.4	2.4	2.6	S	0.105	0.123	0.086	0.054	0.008659	0.03242	0.324324	70.47619	5.309292
1207	J4-1996	54	15	15	21.5	23.8	18.9	15.6	10.9	9.2	7	2.5	2.8	C	0.215	0.238	0.189	0.156	0.036305	0.269594	0.229358	50.69767	6.157522
1208	J4-1996	54	16	15	17.8	19.6	15.2	13.5	9.9	7.8	5.6	2.5	2.7	I	0.178	0.196	0.152	0.135	0.024885	0.15219	0.252525	55.61798	5.725553
1209	J4-1996	54	17	15	28.7	31.4	26.4	23.6	11.2	9.5	7.2	2.5	2.8	C	0.287	0.314	0.264	0.236	0.064692	0.53855	0.223214	39.02439	6.157522
1210	J4-1996	54	18	15	10.2	12.6	8.4	6.5	7.6	6.5	4.3	2.4	2.6	S	0.102	0.126	0.084	0.065	0.008171	0.041117	0.315789	74.5098	5.309292
1211	J4-1996	54	19	15	21	23.4	19.2	16.3	11.1	9.4	7	2.5	2.8	C	0.21	0.234	0.192	0.163	0.034636	0.281505	0.225225	52.85714	6.157522
1212	J4-1996	54	20	15	14.4	16.8	11.9	9.2	9.4	7.9	5.2	2.4	2.7	I	0.144	0.168	0.119	0.092	0.016286	0.096515	0.255319	65.27778	5.725553
1213	J4-1996	54	21	15	15.5	17.5	13.2	10.4	9.4	8.9	6.4	2.5	2.8	C	0.155	0.175	0.132	0.104	0.018869	0.129475	0.265957	60.64516	6.157522
1214	J4-1996	54	22	15	22.5	25.1	20.3	18.4	11.1	9.4	7.6	2.5	2.8	C	0.225	0.251	0.203	0.184	0.039761	0.322002	0.225225	49.33333	6.157522
1215	J4-1996	54	23	15	20	23.2	18.4	15.8	10.1	8.9	6.8	2.5	2.8	C	0.2	0.232	0.184	0.158	0.031416	0.249559	0.247525	50.5	6.157522
1216	J4-1996	54	24	15	20.5	24.4	18.1	15.2	10.3	9	6.9	2.5	2.8	C	0.205	0.244	0.181	0.152	0.033006	0.251741	0.242718	50.2439	6.157522
1217	J4-1996	54	25	15	23.2	25.6	21.2	18.9	11.4	9.4	8.1	2.5	2.8	C	0.232	0.256	0.212	0.189	0.042273	0.345799	0.219298	49.13793	6.157522
1218	J4-1996	54	26	15	13.5	15.6	11.4	9.2	8	7.2	5.6	2.4	2.6	S	0.135	0.156	0.114	0.092	0.014314	0.079907	0.3	59.25926	5.309292
1219	J4-1996	54	27	15	25.6	27.4	23.2	20.5	11.1	9.4	8.5	2.5	2.8	C	0.256	0.274	0.232	0.205	0.051472	0.409	0.225225	43.35938	6.157522
1220	J4-1996	54	28	15	15.5	17.4	13.3	10.4	10.2	8.4	6.4	2.4	2.7	I	0.155	0.174	0.133	0.104	0.018869	0.122983	0.235294	65.80645	5.725553
1221	J4-1996	54	29	15	13.5	15.6	9.8	6.7	9.3	7.2	5.6	2.4	2.6	S	0.135	0.156	0.098	0.067	0.014314	0.063373	0.258065	68.88889	5.309292
1222	J4-1996	54	30	15	19.5	22.2	16.2	13.9	10.9	9.2	7.1	2.5	2.7	I	0.195	0.222	0.162	0.139	0.029865	0.20904	0.229358	55.89744	5.725553
1223	J4-1996	54	31	15	34.6	27.4	21.4	19.2	11.8	10.4	8.6	2.6	2.8	C	0.346	0.274	0.214	0.192	0.094025	0.401769	0.220339	34.10405	6.157522
1224	J4-1996	54	32	15	28.2	31.1	26.3	24.4	12.6	10.8	8.8	2.6	3.2	D	0.282	0.311	0.263	0.244	0.062458	0.612045	0.206349	44.68085	8.042477
1225	J4-1996	54	33	15	24.5	27.2	21.6	18.6	12.4	10.6	8.5	2.6	2.8	D	0.245	0.272	0.216	0.186	0.047144	0.409606	0.209677	50.61224	6.157522
1226	J4-1996	54	34	15	23.5	25.6	19.6	17.2	10.4	9.3	7.8	2.5	2.8	C	0.235	0.256	0.196	0.172	0.043374	0.302861	0.240385	44.25532	6.157522
1227	J4-1996	54	35	15	22.5	24.4	19.2	17	10.6	9.5	7.8	2.5	2.8	C	0.225	0.244	0.192	0.17	0.039761	0.293343	0.235849	47.11111	6.157522
1228	J4-1996	54	36	15	21.5	23.4	18.6	16.4	10.4	9.2	7.2	2.5	2.9	C	0.215	0.234	0.186	0.164	0.036305	0.264984	0.240385	48.37209	6.605199
1229	J4-1996	54	37	15	15.5	17.8	13.2	9.4	9.2	7.9	5.6	2.5	2.7	I	0.155	0.178	0.132	0.094	0.018869	0.113975	0.271739	59.35484	5.725553
1230	J4-1996	54	38	15	14.5	16.6	12.4	8.6	9.4	6.1	5.4	2.4	2.6	S	0.145	0.166	0.124	0.086	0.016513	0.077019	0.255319	64.82759	5.309292
1231	J4-1996	54	39	15	18	20.4	16.4	13.3	9.8	8.6	6.8	2.4	2.7	I	0.18	0.204	0.164	0.133	0.025447	0.187873	0.244898	54.44444	5.725553

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1232	J4-1996	54	40	15	20	22.6	18.1	16.4	10.4	9.1	7	2.5	2.8	C	0.2	0.226	0.181	0.164	0.031416	0.248977	0.240385	52	6.157522
1233	J4-1996	54	41	15	19.5	21.8	17.2	14.2	10.1	8.6	6.8	2.5	2.8	C	0.195	0.218	0.172	0.142	0.029865	0.209414	0.247525	51.79487	6.157522
1234	J4-1996	54	42	15	12.5	15.1	10.4	8.6	7.9	7.1	5.4	2.4	2.6	S	0.125	0.151	0.104	0.086	0.012272	0.068274	0.303797	63.2	5.309292
1235	J4-1996	54	43	15	16.7	18.2	14.1	11.9	9.8	8.2	6.3	2.5	2.7	I	0.167	0.182	0.141	0.119	0.021904	0.136114	0.255102	58.68263	5.725553
1236	J4-1996	54	44	15	10.6	12.7	8.5	6.1	8.9	7	5.2	2.5	2.7	I	0.106	0.127	0.085	0.061	0.008825	0.04467	0.280899	83.96226	5.725553
1237	J4-1996	54	45	15	10.5	12.8	8.4	6.2	9.1	7.8	5.6	2.5	2.7	I	0.105	0.128	0.084	0.062	0.008659	0.04947	0.274725	86.66667	5.725553
1238	J4-1996	54	46	15	20	22.4	18.2	15.6	10.2	8.6	6.4	2.5	2.8	C	0.2	0.224	0.182	0.156	0.031416	0.233037	0.245098	51	6.157522
1239	J4-1996	54	47	15	19	21.5	17.4	15.2	9.6	7.4	5.8	2.5	2.8	C	0.19	0.215	0.174	0.152	0.028353	0.184464	0.260417	50.52632	6.157522
1240	J4-1996	54	48	15	11.5	14.6	9.4	7.1	10.9	9.5	7.8	2.4	2.9	I	0.115	0.146	0.094	0.071	0.010387	0.076728	0.220183	94.78261	6.605199
1241	J4-1996	54	49	15	18	21.1	16.2	13.3	10.4	8.6	6.8	2.5	2.9	C	0.18	0.211	0.162	0.133	0.025447	0.188208	0.240385	57.77778	6.605199
1242	J4-1996	54	50	15	22.5	25.3	20.1	18.4	10.1	8.2	6.2	2.5	2.8	C	0.225	0.253	0.201	0.184	0.039761	0.278508	0.247525	44.88889	6.157522
1243	J4-1996	54	51	15	20.1	23.4	18.4	15.9	9.4	7.6	5.9	2.5	2.8	C	0.201	0.234	0.184	0.159	0.031731	0.214349	0.265957	46.76617	6.157522
1244	J4-1996	54	52	15	13.2	15.6	11.5	9.4	7.8	6.9	4.8	2.4	2.6	S	0.132	0.156	0.115	0.094	0.013685	0.077741	0.307692	59.09091	5.309292
1245	J4-1996	54	53	15	22.3	25.2	20.1	18.3	10.4	8.6	6.4	2.5	2.8	C	0.223	0.252	0.201	0.183	0.039057	0.291112	0.240385	46.63677	6.157522
1246	J4-1996	54	54	15	17.5	19.6	15.3	13.4	9.8	7.4	5.3	2.5	2.7	I	0.175	0.196	0.153	0.134	0.024053	0.145306	0.255102	56	5.725553
1247	J4-1996	54	55	15	18.2	20.3	15.5	12.4	9.6	7.1	5.4	2.5	2.7	I	0.182	0.203	0.155	0.124	0.026016	0.141904	0.260417	52.74725	5.725553
1248	J4-1996	54	56	15	16.2	18.4	14.4	11.9	8.9	6.9	4.8	2.5	2.7	I	0.162	0.184	0.144	0.119	0.020612	0.118285	0.280899	54.93827	5.725553
1249	J4-1996	54	57	15	8.2	11.2	6.4	3.2	7.8	6.3	3.9	2.4	2.6	S	0.082	0.112	0.064	0.032	0.005281	0.0247	0.307692	95.12195	5.309292
1250	J4-1996	54	58	15	11.5	13.4	10.4	8.4	7.9	7	5.3	2.4	2.6	S	0.115	0.134	0.104	0.084	0.010387	0.062561	0.303797	68.69565	5.309292
1251	J4-1996	54	59	15	11.2	13.1	9.5	7.4	7.8	7.1	5.2	2.4	2.6	S	0.112	0.131	0.095	0.074	0.009852	0.054589	0.307692	69.64286	5.309292
1252	J4-1996	54	60	15	15.8	17.6	13.4	11.9	9.4	8.2	6.1	2.5	2.7	I	0.158	0.176	0.134	0.119	0.019607	0.125543	0.265957	59.49367	5.725553
1253	J4-1996	54	61	15	30	32.5	28.4	25.5	11.6	9.9	7.8	2.5	3.4	D	0.3	0.325	0.284	0.255	0.070686	0.639237	0.215517	38.66667	9.079203
1254	J4-1996	55	1	15	22.1	24.6	20.2	17.6	10.9	9.6	7.2	2.5	2.8	C	0.221	0.246	0.202	0.176	0.03836	0.320076	0.229358	49.32127	6.157522
1255	J4-1996	55	2	15	24	26.3	22.3	19.4	10.8	9.8	7.4	2.5	2.8	C	0.24	0.263	0.223	0.194	0.045239	0.392184	0.231481	45	6.157522
1256	J4-1996	55	3	15	18.5	21.9	15.9	13.5	9.4	8.4	6.2	2.5	2.8	I	0.185	0.219	0.159	0.135	0.02688	0.183967	0.265957	50.81081	6.157522
1257	J4-1996	55	4	15	22	24.4	19.3	16.8	9.8	8.6	6.9	2.5	2.8	C	0.22	0.244	0.193	0.168	0.038013	0.266525	0.255102	44.54545	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1258	J4-1996	55	5	15	15	17.6	12.8	10.2	9.2	9.6	5.8	2.5	2.7	I	0.15	0.176	0.128	0.102	0.017671	0.134355	0.271739	61.33333	5.725553
1259	J4-1996	55	6	15	17.5	19.4	15.2	13.4	10.1	8.4	6.2	2.5	2.8	C	0.175	0.194	0.152	0.134	0.024053	0.162743	0.247525	57.71429	6.157522
1260	J4-1996	55	7	15	31.8	33.6	29.4	26.8	12.4	10.7	8.4	2.6	3.4	D	0.318	0.336	0.294	0.268	0.079423	0.742982	0.209677	38.99371	9.079203
1261	J4-1996	55	8	15	15.5	17.6	13.2	10.9	9.6	7.2	5.4	2.5	2.7	I	0.155	0.176	0.132	0.109	0.018869	0.106079	0.260417	61.93548	5.725553
1262	J4-1996	55	9	15	24.4	26.8	21.8	19.4	10.4	8.6	6.2	2.5	2.8	C	0.244	0.268	0.218	0.194	0.046759	0.337221	0.240385	42.62295	6.157522
1263	J4-1996	55	10	15	25	27.4	23.4	21.2	10.3	8.4	6.1	2.5	2.8	C	0.25	0.274	0.234	0.212	0.049087	0.372798	0.242718	41.2	6.157522
1264	J4-1996	55	11	15	17.8	20.1	15.3	13.4	9.6	7.8	5.9	2.5	2.8	C	0.178	0.201	0.153	0.134	0.024885	0.155188	0.260417	53.93258	6.157522
1265	J4-1996	55	12	15	17.5	19.8	15.2	13.1	10.3	8.1	6	2.5	2.8	C	0.175	0.198	0.152	0.131	0.024053	0.157751	0.242718	58.85714	6.157522
1266	J4-1996	55	13	15	12.5	15.2	9.8	7.2	9.2	7.6	5.8	2.5	2.7	I	0.125	0.152	0.098	0.072	0.012272	0.06636	0.271739	73.6	5.725553
1267	J4-1996	55	14	15	20.5	22.4	18.1	16.4	10.6	8.5	6.8	2.5	2.8	C	0.205	0.224	0.181	0.164	0.033006	0.23156	0.235849	51.70732	6.157522
1268	J4-1996	55	15	15	15.8	17.6	13.4	11.6	10.4	8.4	6.2	2.5	2.8	C	0.158	0.176	0.134	0.116	0.019607	0.12783	0.240385	65.82278	6.157522
1269	J4-1996	55	16	15	18	20.4	16.2	14.4	10.4	8.2	6	2.5	2.8	C	0.18	0.204	0.162	0.144	0.025447	0.179606	0.240385	57.77778	6.157522
1270	J4-1996	55	17	15	21.5	23.6	18.7	16.3	10.9	9.6	7.2	2.5	2.8	C	0.215	0.236	0.187	0.163	0.036305	0.279151	0.229358	50.69767	6.157522
1271	J4-1996	55	18	15	15	17.8	13.1	10.8	10.2	8.4	6	2.5	2.8	C	0.15	0.178	0.131	0.108	0.017671	0.123142	0.245098	68	6.157522
1272	J4-1996	55	19	15	15.5	17.9	13.4	10.6	10.6	8.5	6.2	2.5	2.8	C	0.155	0.179	0.134	0.106	0.018869	0.128067	0.235849	68.3871	6.157522
1273	J4-1996	55	20	15	25.6	27.8	23.2	20.8	11.2	9.5	7.3	2.5	2.8	C	0.256	0.278	0.232	0.208	0.051472	0.417638	0.223214	43.75	6.157522
1274	J4-1996	55	21	15	15.6	17.8	13.5	11.6	9.8	7.6	5.8	2.5	2.7	I	0.156	0.178	0.135	0.116	0.019113	0.117431	0.255102	62.82051	5.725553
1275	J4-1996	55	22	15	7.5	9.4	6.2	5.4	7.7	5.8	3.4	2.4	2.6	S	0.075	0.094	0.062	0.054	0.004418	0.020596	0.311688	102.6667	5.309292
1276	J4-1996	55	23	15	11.5	13.4	9.4	6.8	8.6	6.2	4.3	2.4	2.6	S	0.115	0.134	0.094	0.068	0.010387	0.04701	0.27907	74.78261	5.309292
1277	J4-1996	55	24	15	23.5	26.6	20.8	18.2	10.9	9.8	7.4	2.5	2.8	C	0.235	0.266	0.208	0.182	0.043374	0.355258	0.229358	46.38298	6.157522
1278	J4-1996	55	25	15	19.5	21.6	16.9	13.8	10.2	8.6	6.4	2.5	2.8	C	0.195	0.216	0.169	0.138	0.029865	0.20257	0.245098	52.30769	6.157522
1279	J4-1996	55	26	15	16.5	18.6	14.1	11.9	10.4	8.6	6.4	2.5	2.8	C	0.165	0.186	0.141	0.119	0.021382	0.144411	0.240385	63.0303	6.157522
1280	J4-1996	55	27	15	20.5	22.8	13.6	15.7	11.2	9.2	7.1	2.5	2.8	C	0.205	0.228	0.136	0.157	0.033006	0.181385	0.223214	54.63415	6.157522
1281	J4-1996	55	28	15	21.5	23.6	19.2	16.6	10.9	9.8	7.4	2.5	2.8	C	0.215	0.236	0.192	0.166	0.036305	0.295956	0.229358	50.69767	6.157522
1282	J4-1996	55	29	15	31.5	33.8	28.9	24.8	12.4	10.6	8.2	2.6	3.4	D	0.315	0.338	0.289	0.248	0.077931	0.707411	0.209677	39.36508	9.079203
1283	J4-1996	55	30	15	15.2	17.4	13.4	11.2	10.4	8.6	6.4	2.5	2.8	C	0.152	0.174	0.134	0.112	0.018146	0.129059	0.240385	68.42105	6.157522
1284	J4-1996	55	31	15	15.2	17.5	13.2	11	10.2	8.5	6.3	2.5	2.7	C	0.152	0.175	0.132	0.11	0.018146	0.125085	0.245098	67.10526	5.725553

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1285	J4-1996	55	32	15	12.6	14.8	10.1	8.6	9.6	7.8	6.9	2.5	3.3	I	0.126	0.148	0.101	0.086	0.012469	0.071577	0.260417	76.19048	8.552986
1286	J4-1996	55	33	15	34.2	37.1	31.4	29.2	13.4	11.4	9.1	2.6	2.8	D	0.342	0.371	0.314	0.292	0.091863	0.921154	0.19403	39.18129	6.157522
1287	J4-1996	55	34	15	21.4	23.6	19.2	16.8	11.1	9.6	7.8	2.5	2.6	C	0.214	0.236	0.192	0.168	0.035968	0.290756	0.225225	51.86916	5.309292
1288	J4-1996	55	35	15	18.8	21.4	16.4	14.2	7.8	6.8	4.9	2.4	2.6	S	0.188	0.214	0.164	0.142	0.027759	0.154475	0.307692	41.48936	5.309292
1289	J4-1996	55	36	15	11.3	13.6	9.6	7.4	7.4	6.2	4.1	2.4	3.3	S	0.113	0.136	0.096	0.074	0.010029	0.049373	0.324324	65.48673	8.552986
1290	J4-1996	55	37	15	31.5	33.4	28.8	25.6	12.8	11.5	9.8	2.5	3.4	D	0.315	0.334	0.288	0.256	0.077931	0.766023	0.195313	40.63492	9.079203
1291	J4-1996	55	38	15	29.5	32.2	27.4	23.4	12.6	11.4	9.6	2.6	2.6	D	0.295	0.322	0.274	0.234	0.068349	0.684564	0.206349	42.71186	5.309292
1292	J4-1996	55	39	15	14.6	16.8	12.2	10.1	7.8	6.6	4.8	2.4	2.8	S	0.146	0.168	0.122	0.101	0.016742	0.084632	0.307692	53.42466	6.157522
1293	J4-1996	55	40	15	29.2	30.2	27.4	24.9	11.1	9.8	7.9	2.5	2.8	C	0.292	0.302	0.274	0.249	0.066966	0.581769	0.225225	38.0137	6.157522
1294	J4-1996	55	41	15	15.2	17.8	13.4	11.5	10.4	8.6	6.8	2.5	2.8	I	0.152	0.178	0.134	0.115	0.018146	0.131411	0.240385	68.42105	6.157522
1295	J4-1996	55	42	15	22.5	24.6	20.6	18.4	10.9	9.4	7.9	2.5	2.8	C	0.225	0.246	0.206	0.184	0.039761	0.324983	0.229358	48.44444	6.157522
1296	J4-1996	55	43	15	18.2	21.4	16.4	14.2	10.4	8.8	6.9	2.5	2.8	C	0.182	0.214	0.164	0.142	0.026016	0.199908	0.240385	57.14286	6.157522
1297	J4-1996	55	44	15	13.2	15.6	11.4	9.6	8.9	7.7	5.3	2.5	2.8	I	0.132	0.156	0.114	0.096	0.013685	0.086214	0.280899	67.42424	6.157522
1298	J4-1996	55	45	15	26.2	28.8	24.6	22.5	11.9	10.9	9.2	2.5	2.8	C	0.262	0.288	0.246	0.225	0.053913	0.535956	0.210084	45.41985	6.157522
1299	J4-1996	55	46	15	19.4	21.5	17.8	15.6	10.9	9.5	9.4	2.5	2.8	I	0.194	0.215	0.178	0.156	0.029559	0.245348	0.229358	56.18557	6.157522
1300	J4-1996	55	47	15	12.5	15.1	10.4	8.8	8.8	7.8	5.4	2.4	2.6	S	0.125	0.151	0.104	0.088	0.012272	0.07536	0.272727	70.4	5.309292
1301	J4-1996	56	1	15	27	29.2	24.3	20.8	12.1	10.1	8.1	2.5	2.8	C	0.27	0.292	0.243	0.208	0.057256	0.482197	0.206612	44.81481	6.157522
1302	J4-1996	56	2	15	16	19.8	14.1	12	9.6	7.6	5.6	2.4	2.8	I	0.16	0.198	0.141	0.12	0.020106	0.132441	0.25	60	6.157522
1303	J4-1996	56	3	15	13	15.6	11.1	9.2	9.2	7.2	5.2	2.4	2.6	S	0.13	0.156	0.111	0.092	0.013273	0.077362	0.26087	70.76923	5.309292
1304	J4-1996	56	4	15	22.5	26.4	20.5	18.5	11.8	9.8	7.8	2.5	2.8	C	0.225	0.264	0.205	0.185	0.039761	0.348953	0.211864	52.44444	6.157522
1305	J4-1996	56	5	15	19.5	23.5	17.2	15.5	10.6	8.4	6.4	2.4	2.8	I	0.195	0.235	0.172	0.155	0.029865	0.217257	0.226415	54.35897	6.157522
1306	J4-1996	56	6	15	25.2	27.7	21.7	19.6	12.2	10	8	2.5	2.8	C	0.252	0.277	0.217	0.196	0.049876	0.397282	0.204918	48.4127	6.157522
1307	J4-1996	56	7	15	11	13.1	9	7.2	11.8	9.8	7.8	2.4	2.8	I	0.11	0.131	0.09	0.072	0.009503	0.070228	0.20339	107.2727	6.157522
1308	J4-1996	56	8	15	12.5	16.5	10.4	8.5	10.1	8.1	6.1	2.4	2.8	I	0.125	0.165	0.104	0.085	0.012272	0.082399	0.237624	80.8	6.157522
1309	J4-1996	56	9	15	27	29.1	25	21.6	12.2	10.1	8.1	2.6	2.9	D	0.27	0.291	0.25	0.216	0.057256	0.504161	0.213115	45.18519	6.605199
1310	J4-1996	56	10	15	16.6	19.5	14.5	12.6	10.9	8.9	6.9	2.4	2.8	I	0.166	0.195	0.145	0.126	0.021642	0.160772	0.220183	65.66265	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1311	J4-1996	56	11	15	20.7	24.7	18.7	16.7	10.6	8.6	7.6	2.5	2.8	C	0.207	0.247	0.187	0.167	0.033654	0.257539	0.235849	51.20773	6.157522
1312	J4-1996	56	12	15	21.1	23.2	19.1	17.2	11.4	9.4	7.4	2.5	2.8	C	0.211	0.232	0.191	0.172	0.034967	0.282183	0.219298	54.02844	6.157522
1313	J4-1996	56	13	15	25.2	28.4	23.1	20.2	11.8	9.8	7.8	2.5	2.8	C	0.252	0.284	0.231	0.202	0.049876	0.429621	0.211864	46.8254	6.157522
1314	J4-1996	56	14	15	15.5	19.5	13.6	11.6	9.8	7.8	5.8	2.4	2.8	I	0.155	0.195	0.136	0.116	0.018869	0.128102	0.244898	63.22581	6.157522
1315	J4-1996	56	15	15	22	24	20.1	18.1	11.2	9.2	7.2	2.5	2.8	C	0.22	0.24	0.201	0.181	0.038013	0.303436	0.223214	50.90909	6.157522
1316	J4-1996	56	16	15	21	25.3	19.1	17.2	12.1	10	8	2.5	2.8	C	0.21	0.253	0.191	0.172	0.034636	0.313527	0.206612	57.61905	6.157522
1317	J4-1996	56	17	15	20.5	23.6	18.3	16.4	11.6	9.6	7.6	2.5	2.8	C	0.205	0.236	0.183	0.164	0.033006	0.272122	0.215517	56.58537	6.157522
1318	J4-1996	56	18	15	16.5	19.5	14.4	12.5	8.5	6.5	4.5	2.4	2.8	I	0.165	0.195	0.144	0.125	0.021382	0.116221	0.282353	51.51515	6.157522
1319	J4-1996	56	19	15	13.5	17.6	11.5	9.4	8.4	6.4	4.4	2.4	2.8	S	0.135	0.176	0.115	0.094	0.014314	0.07767	0.285714	62.22222	6.157522
1320	J4-1996	56	20	15	24	27.2	21.1	19.2	11.9	9.9	7.9	2.5	2.8	C	0.24	0.272	0.211	0.192	0.045239	0.374429	0.210084	49.58333	6.157522
1321	J4-1996	56	21	15	14.2	17.1	12.1	10.3	9.2	4.4	5.1	2.4	2.8	I	0.142	0.171	0.121	0.103	0.015837	0.056682	0.26087	64.78873	6.157522
1322	J4-1996	56	22	15	14.3	16.8	12.3	10.1	8.4	4.5	4.4	2.4	2.8	I	0.143	0.168	0.123	0.101	0.016061	0.058281	0.285714	58.74126	6.157522
1323	J4-1996	56	23	15	19.5	23.1	17.4	15.5	8.5	6.8	4.5	2.5	2.8	C	0.195	0.231	0.174	0.155	0.029865	0.17668	0.294118	43.58974	6.157522
1324	J4-1996	56	24	15	24.5	26.5	21.4	19.5	10.8	4.6	6.8	2.5	2.8	C	0.245	0.265	0.214	0.195	0.047144	0.175484	0.231481	44.08163	6.157522
1325	J4-1996	56	25	15	14.2	17.4	12.1	10.2	8.6	6.6	4.6	2.4	2.8	I	0.142	0.174	0.121	0.102	0.015837	0.085741	0.27907	60.56338	6.157522
1326	J4-1996	56	26	15	21	23.2	19.1	17.2	11.2	9.2	2.4	2.5	2.8	C	0.21	0.232	0.191	0.172	0.034636	0.276179	0.223214	53.33333	6.157522
1327	J4-1996	56	27	15	16.5	19.5	14.5	12.4	10.5	8.5	6.5	2.4	2.8	I	0.165	0.195	0.145	0.124	0.021382	0.15299	0.228571	63.63636	6.157522
1328	J4-1996	56	28	15	20.2	22.1	18.1	16.2	12.2	10.2	8.2	2.5	2.8	C	0.202	0.221	0.181	0.162	0.032047	0.275219	0.204918	60.39604	6.157522
1329	J4-1996	56	29	15	27.5	29.6	25.4	23.5	12.1	10.1	8.1	2.5	2.8	C	0.275	0.296	0.254	0.235	0.059396	0.530031	0.206612	44	6.157522
1330	J4-1996	56	30	15	26.6	29.6	24.6	22.4	11.8	9.8	7.8	2.5	2.8	C	0.266	0.296	0.246	0.224	0.055572	0.487286	0.211864	44.3609	6.157522
1331	J4-1996	56	31	15	24.5	26.6	22.1	20.5	11.4	9.4	7.4	2.5	2.8	C	0.245	0.266	0.221	0.205	0.047144	0.379159	0.219298	46.53061	6.157522
1332	J4-1996	56	32	15	11	13.4	9.1	7	8.2	5.2	3.2	2.4	2.6	S	0.11	0.134	0.091	0.07	0.009503	0.038104	0.292683	74.54545	5.309292
1333	J4-1996	56	33	15	15.2	17.4	13.2	11.1	9.4	7.4	5.4	2.4	2.8	I	0.152	0.174	0.132	0.111	0.018146	0.108773	0.255319	61.84211	6.157522
1334	J4-1996	56	34	15	20	24.2	18.1	16.1	10.6	8.6	6.8	2.5	2.8	C	0.2	0.242	0.181	0.161	0.031416	0.242629	0.235849	53	6.157522
1335	J4-1996	56	35	15	17	19.1	15.2	13.1	9.6	7.6	5.6	2.4	2.6	I	0.17	0.191	0.152	0.131	0.022698	0.145304	0.25	56.47059	5.309292
1336	J4-1996	56	36	15	19.5	21.5	17.4	15.4	10.8	8.8	6.8	2.4	2.6	I	0.195	0.215	0.174	0.154	0.029865	0.220068	0.222222	55.38462	5.309292
1337	J4-1996	56	37	15	20.6	22.6	18.6	16.1	11.4	9.4	7.4	2.5	2.8	C	0.206	0.226	0.186	0.161	0.033329	0.265017	0.219298	55.33981	6.157522
1338	J4-1996	56	38	15	21.5	23.5	19.5	17.4	11.8	9.8	7.8	2.5	2.8	C	0.215	0.235	0.195	0.174	0.036305	0.304799	0.211864	54.88372	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1339	J4-1996	56	39	15	18.5	21.5	16.5	14.6	10.4	8.4	6.4	2.4	2.6	I	0.185	0.215	0.165	0.146	0.02688	0.194007	0.230769	56.21622	5.309292
1340	J4-1996	56	40	15	17.5	19.5	15.4	13.5	10.1	8.1	6.1	2.4	2.6	I	0.175	0.195	0.154	0.135	0.024053	0.160224	0.237624	57.71429	5.309292
1341	J4-1996	56	41	15	11	13.1	9.1	7.2	8.2	6.2	4.2	2.4	2.6	S	0.11	0.131	0.091	0.072	0.009503	0.045017	0.292683	74.54545	5.309292
1342	J4-1996	56	42	15	24	26.1	22.1	20.1	12.2	10.2	8.2	2.5	2.8	C	0.24	0.261	0.221	0.201	0.045239	0.405742	0.204918	50.83333	6.157522
1343	J4-1996	56	43	15	18.2	24.2	16.1	14.1	10.4	8.4	6.4	2.4	2.6	I	0.182	0.242	0.161	0.141	0.026016	0.200261	0.230769	57.14286	5.309292
1344	J4-1996	56	44	15	24.7	26.7	22.5	20.7	12.6	10.6	8.6	2.5	2.8	C	0.247	0.267	0.225	0.207	0.047916	0.439347	0.198413	51.01215	6.157522
1345	J4-1996	56	45	15	16	18.1	14.1	12	9.6	7.6	5.6	2.4	2.6	I	0.16	0.181	0.141	0.12	0.020106	0.126031	0.25	60	5.309292
1346	J4-1996	56	46	15	18	20.2	16.1	14.1	9.9	7.9	5.9	2.4	2.6	I	0.18	0.202	0.161	0.141	0.025447	0.169975	0.242424	55	5.309292
1347	J4-1996	56	47	15	14.5	18.6	12.5	10.5	9.6	7.6	5.6	2.4	2.6	S	0.145	0.186	0.125	0.105	0.016513	0.107563	0.25	66.2069	5.309292
1348	J4-1996	56	48	15	24.3	26.5	20.1	18.3	12.8	10.8	8.4	2.5	2.8	C	0.243	0.265	0.201	0.183	0.046377	0.375084	0.195313	52.6749	6.157522
1349	J4-1996	56	49	15	23.2	25.2	21.2	19.2	11.8	9.8	7.8	2.5	2.8	C	0.232	0.252	0.212	0.192	0.042273	0.359373	0.211864	50.86207	6.157522
1350	J4-1996	56	50	15	15	17.2	13	11.1	9.2	7.2	5.2	2.4	2.8	S	0.15	0.172	0.13	0.111	0.017671	0.103206	0.26087	61.33333	6.157522
1351	J4-1996	56	51	15	26	28.1	24.2	22.1	11.6	9.6	7.6	2.5	2.8	C	0.26	0.281	0.242	0.221	0.053093	0.454976	0.215517	44.61538	6.157522
1352	J4-1996	56	52	15	20.5	22.6	18.5	16.5	11.9	9.9	7.9	2.5	2.8	C	0.205	0.226	0.185	0.165	0.033006	0.27888	0.210084	58.04878	6.157522
1353	J4-1996	56	53	15	15	19.2	13.2	11.1	11.6	9.6	7.6	2.5	2.8	C	0.15	0.192	0.132	0.111	0.017671	0.14939	0.215517	77.33333	6.157522
1354	J4-1996	56	54	15	17.6	19.8	15.6	13.5	11.6	9.6	7.6	2.5	2.8	C	0.176	0.198	0.156	0.135	0.024328	0.194493	0.215517	65.90909	6.157522
1355	J4-1996	56	55	15	23	25.4	21.1	19.2	12.1	10.1	8.1	2.4	2.8	C	0.23	0.254	0.211	0.192	0.041548	0.369476	0.198347	52.6087	6.157522
1356	J4-1996	56	56	15	17.2	19.4	15.2	13.1	10.8	8.8	6.8	2.4	2.6	I	0.172	0.194	0.152	0.131	0.023235	0.169577	0.222222	62.7907	5.309292
1357	J4-1996	56	57	15	13.5	15.8	11.5	9.2	9.6	7.6	5.6	2.4	2.6	I	0.135	0.158	0.115	0.092	0.014314	0.085882	0.25	71.11111	5.309292
1358	J4-1996	56	58	15	16.5	19.5	14.5	12.6	9.8	7.8	5.8	2.5	2.6	I	0.165	0.195	0.145	0.126	0.021382	0.140901	0.255102	59.39394	5.309292
1359	J4-1996	56	59	15	22.7	26.8	20.7	18.6	11.4	9.4	7.4	2.5	2.8	C	0.227	0.268	0.207	0.186	0.040471	0.341841	0.219298	50.22026	6.157522
1360	J4-1996	56	60	15	17.8	19.6	15.8	13.8	11.5	9.5	7.5	2.5	2.8	C	0.178	0.196	0.158	0.138	0.024885	0.19563	0.217391	64.60674	6.157522
1361	J4-1996	56	61	15	17.3	19.3	15.6	13.3	11.5	9.3	7.3	2.5	2.8	C	0.173	0.193	0.156	0.133	0.023506	0.185383	0.217391	66.47399	6.157522
1362	J4-1996	56	62	15	20.1	22.2	18.1	16.1	11.4	9.4	7.4	2.5	2.8	C	0.201	0.222	0.181	0.161	0.031731	0.253781	0.219298	56.71642	6.157522
1363	J4-1996	57	1	15	22	24.2	19.6	14.6	10.2	9.4	7.8	2.6	2.8	C	0.22	0.242	0.196	0.146	0.038013	0.287366	0.254902	46.36364	6.157522
1364	J4-1996	57	2	15	17.1	19.8	14.7	11.8	9.5	8.6	6.2	2.4	2.6	I	0.171	0.198	0.147	0.118	0.022966	0.157112	0.252632	55.55556	5.309292
1365	J4-1996	57	3	15	17	19.6	14.5	11.5	9.6	8.7	6.3	2.4	2.6	I	0.17	0.196	0.145	0.115	0.022698	0.154586	0.25	56.47059	5.309292
1366	J4-1996	57	4	15	18	21.2	15.2	12.1	9.8	8.9	6.8	2.4	2.6	I	0.18	0.212	0.152	0.121	0.025447	0.177082	0.244898	54.44444	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1367	J4-1996	57	5	15	17.4	20.1	14.4	11.4	9.6	8.8	6.5	2.4	2.6	I	0.174	0.201	0.144	0.114	0.023779	0.157054	0.25	55.17241	5.309292
1368	J4-1996	57	6	15	15	19.1	13.6	10.1	9.6	8.7	6.4	2.4	2.6	I	0.15	0.191	0.136	0.101	0.017671	0.137418	0.25	64	5.309292
1369	J4-1996	57	7	15	24	29.6	21.8	18.4	10.4	9.4	7.9	2.6	2.9	C	0.24	0.296	0.218	0.184	0.045239	0.383371	0.25	43.33333	6.605199
1370	J4-1996	57	8	15	24.5	27.9	21.2	17.6	10.6	9.8	7.4	2.6	2.8	C	0.245	0.279	0.212	0.176	0.047144	0.370212	0.245283	43.26531	6.157522
1371	J4-1996	57	9	15	13.7	16.8	11.4	9.4	8.5	7.4	5.2	2.4	2.6	I	0.137	0.168	0.114	0.094	0.014741	0.086253	0.282353	62.0438	5.309292
1372	J4-1996	57	10	15	16.2	19.1	14.1	11.2	9.2	7	6.4	2.4	2.6	I	0.162	0.191	0.141	0.112	0.020612	0.117789	0.26087	56.79012	5.309292
1373	J4-1996	57	11	15	21.5	23.6	18.6	14.2	10.1	8.9	6.9	2.6	2.8	C	0.215	0.236	0.186	0.142	0.036305	0.249596	0.257426	46.97674	6.157522
1374	J4-1996	57	12	15	26.1	29.1	23.4	18.9	10.4	9.4	7.9	2.6	2.8	C	0.261	0.291	0.234	0.189	0.053502	0.417649	0.25	39.84674	6.157522
1375	J4-1996	57	13	15	9.4	11.2	8.2	6.4	7.4	6.8	4.8	2.3	2.6	S	0.094	0.112	0.082	0.064	0.00694	0.038752	0.310811	78.7234	5.309292
1376	J4-1996	57	14	15	21.5	24.3	19.4	11.6	10.5	9.6	7.8	2.6	2.8	C	0.215	0.243	0.194	0.116	0.036305	0.280292	0.247619	48.83721	6.157522
1377	J4-1996	57	15	15	18.5	20.6	16.2	11.4	10.2	8.9	6.2	2.5	2.8	C	0.185	0.206	0.162	0.114	0.02688	0.186876	0.245098	55.13514	6.157522
1378	J4-1996	57	16	15	13.2	17.2	11.1	9.1	8.6	7.9	5.2	2.4	2.6	I	0.132	0.172	0.111	0.091	0.013685	0.090121	0.27907	65.15152	5.309292
1379	J4-1996	57	17	15	20	23.4	18.6	14.2	10.4	9.7	7.4	2.6	2.8	C	0.2	0.234	0.186	0.142	0.031416	0.270838	0.25	52	6.157522
1380	J4-1996	57	18	15	12.5	14.9	10.2	8.4	8.7	7.8	5.3	2.4	2.6	I	0.125	0.149	0.102	0.084	0.012272	0.072363	0.275862	69.6	5.309292
1381	J4-1996	57	19	15	17	19.6	14.4	11.1	8.9	7.7	5.4	2.4	2.6	I	0.17	0.196	0.144	0.111	0.022698	0.134741	0.269663	52.35294	5.309292
1382	J4-1996	57	20	15	13	17.8	11.2	9.1	8.8	7.8	5.6	2.4	2.6	I	0.13	0.178	0.112	0.091	0.013273	0.092036	0.272727	67.69231	5.309292
1383	J4-1996	57	21	15	24.2	27.9	21.8	16.2	10.4	9.3	7.9	2.6	2.8	C	0.242	0.279	0.218	0.162	0.045996	0.358126	0.25	42.97521	6.157522
1384	J4-1996	57	22	15	18	20.2	16.4	11.4	7.8	6.9	5.8	2.3	2.5	S	0.18	0.202	0.164	0.114	0.025447	0.145763	0.294872	43.33333	4.908739
1385	J4-1996	57	23	15	17	19.5	14.3	10.4	7.7	6.7	5.6	2.3	2.5	S	0.17	0.195	0.143	0.104	0.022698	0.114572	0.298701	45.29412	4.908739
1386	J4-1996	57	24	15	19.5	21.6	17	12.1	8.9	7.9	6.2	2.4	2.6	I	0.195	0.216	0.17	0.121	0.029865	0.182931	0.269663	45.64103	5.309292
1387	J4-1996	57	25	15	15.6	19.1	13.4	9.6	7.4	6.8	5.8	2.3	2.5	S	0.156	0.191	0.134	0.096	0.019113	0.104608	0.310811	47.4359	4.908739
1388	J4-1996	57	26	15	20	23.3	17.9	12.4	8.8	7.8	7.4	2.4	2.6	I	0.2	0.233	0.179	0.124	0.031416	0.201987	0.272727	44	5.309292
1389	J4-1996	57	27	15	25.2	28.1	23.1	16.4	10.4	9.6	8.2	2.6	2.8	C	0.252	0.281	0.231	0.164	0.049876	0.401245	0.25	41.26984	6.157522
1390	J4-1996	57	28	15	19.2	22.4	16.4	11.5	9.4	8.6	6.4	2.4	2.6	I	0.192	0.224	0.164	0.115	0.028953	0.192484	0.255319	48.95833	5.309292
1391	J4-1996	57	29	15	13.5	16.8	11.2	9.2	8.5	7.4	5.2	2.3	2.5	S	0.135	0.168	0.112	0.092	0.014314	0.084141	0.270588	62.96296	4.908739
1392	J4-1996	57	30	15	23.5	26.4	20.4	15.2	10.4	9.4	8.1	2.4	2.8	C	0.235	0.264	0.204	0.152	0.043374	0.319013	0.230769	44.25532	6.157522
1393	J4-1996	57	31	15	28.5	30.4	25.4	17.1	10.9	9.8	8.4	2	2.8	C	0.285	0.304	0.254	0.171	0.063794	0.487113	0.183486	38.24561	6.157522
1394	J4-1996	57	32	15	22	26.6	20.1	15.1	11.1	9.9	8	2.5	2.8	C	0.22	0.266	0.201	0.151	0.038013	0.330665	0.225225	50.45455	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1395	J4-1996	57	33	15	14.3	16.6	11.8	9.6	9.4	8.4	6.4	2.4	2.6	I	0.143	0.166	0.118	0.096	0.016061	0.101674	0.255319	65.73427	5.309292
1396	J4-1996	57	34	15	21.5	23.6	18.4	12.6	10.2	9.1	6.8	2.6	2.8	C	0.215	0.236	0.184	0.126	0.036305	0.246571	0.254902	47.44186	6.157522
1397	J4-1996	57	35	15	9.5	10.9	7.6	6.4	8.4	6.5	4.8	2.4	2.6	S	0.095	0.109	0.076	0.064	0.007088	0.033252	0.285714	88.42105	5.309292
1398	J4-1996	57	36	15	17	19.4	14.6	11.2	9.6	7.9	5.6	2.4	2.6	I	0.17	0.194	0.146	0.112	0.022698	0.140064	0.25	56.47059	5.309292
1399	J4-1996	57	37	15	27.8	29.6	24.8	16.6	10.4	9.4	7.8	2.6	2.8	C	0.278	0.296	0.248	0.166	0.060699	0.444426	0.25	37.41007	6.157522
1400	J4-1996	57	38	15	13	15.9	11.4	8.4	8.1	6.8	5.2	2.4	2.6	S	0.13	0.159	0.114	0.084	0.013273	0.075056	0.296296	62.30769	5.309292
1401	J4-1996	57	39	15	11.5	13.2	9.6	7.4	8.4	6.8	4.9	2.4	2.5	S	0.115	0.132	0.096	0.074	0.010387	0.053197	0.285714	73.04348	4.908739
1402	J4-1996	57	40	15	16.5	18.4	12.9	9.4	9.4	7.9	6.2	2.5	2.6	I	0.165	0.184	0.129	0.094	0.021382	0.112982	0.265957	56.9697	5.309292
1403	J4-1996	57	41	15	26	28.9	23.6	15.5	10	9.4	7.8	2.6	2.8	C	0.26	0.289	0.236	0.155	0.053093	0.406457	0.26	38.46154	6.157522
1404	J4-1996	57	42	15	25.8	27.6	22.8	16.1	10.1	9.2	7.6	2.6	2.9	C	0.258	0.276	0.228	0.161	0.052279	0.373366	0.257426	39.14729	6.605199
1405	J4-1996	57	43	15	27.8	29.7	24.2	16.6	10.2	9.8	8.8	2.6	2.8	C	0.278	0.297	0.242	0.166	0.060699	0.449013	0.254902	36.69065	6.157522
1406	J4-1996	57	44	15	12.5	14.4	9.9	7.5	8.5	6.9	5.2	2.4	2.6	S	0.125	0.144	0.099	0.075	0.012272	0.059219	0.282353	68	5.309292
1407	J4-1996	57	45	15	12	15.1	9.8	7.4	8.4	6.8	4.8	2.4	2.5	S	0.12	0.151	0.098	0.074	0.01131	0.059365	0.285714	70	4.908739
1408	J4-1996	57	46	15	21.5	24.2	18.8	12.5	10.3	9.4	7.3	2.6	2.8	C	0.215	0.242	0.188	0.125	0.036305	0.265243	0.252427	47.90698	6.157522
1409	J4-1996	57	47	15	26.5	28.9	23.8	15.6	10.4	9.6	7.6	2.6	2.8	C	0.265	0.289	0.238	0.156	0.055155	0.420261	0.25	39.24528	6.157522
1410	J4-1996	57	48	15	13	15.6	10.6	9.1	9.2	7.9	5.8	2.4	2.6	I	0.13	0.156	0.106	0.091	0.013273	0.080206	0.26087	70.76923	5.309292
1411	J4-1996	57	49	15	15	17.8	12.4	9.4	9.4	8.4	6.9	2.4	2.6	I	0.15	0.178	0.124	0.094	0.017671	0.112181	0.255319	62.66667	5.309292
1412	J4-1996	57	50	15	12.5	15.6	10.2	8.9	8.6	7.6	4.8	2.4	2.5	S	0.125	0.156	0.102	0.089	0.012272	0.073492	0.27907	68.8	4.908739
1413	J4-1996	57	51	15	17.8	20.1	14.7	11.3	9.4	8.3	5.8	2.4	2.8	I	0.178	0.201	0.147	0.113	0.024885	0.151677	0.255319	52.80899	6.157522
1414	J4-1996	57	52	15	12.8	15.6	10.1	8.9	8.4	6.7	4.9	2.4	2.6	S	0.128	0.156	0.101	0.089	0.012868	0.064077	0.285714	65.625	5.309292
1415	J4-1996	57	53	15	22.2	24.8	18.4	12.4	10.2	8.9	7.8	2.6	2.9	C	0.222	0.248	0.184	0.124	0.038708	0.247336	0.254902	45.94595	6.605199
1416	J4-1996	57	54	15	19	21.8	16.8	11.2	10.1	8.6	6.9	2.6	2.9	C	0.19	0.218	0.168	0.112	0.028353	0.194712	0.257426	53.15789	6.605199
1417	J4-1996	57	55	15	13.2	15.6	10.8	8.4	9.5	7.9	5.6	2.4	2.6	I	0.132	0.156	0.108	0.084	0.013685	0.08071	0.252632	71.9697	5.309292
1418	J4-1996	57	56	15	21.2	24.2	18.6	12.4	10.5	9.4	7.4	2.6	2.9	C	0.212	0.242	0.186	0.124	0.035299	0.261256	0.247619	49.5283	6.605199
1419	J4-1996	57	57	15	19	22.3	15.8	10.9	9.6	8.9	6.8	2.6	2.9	C	0.19	0.223	0.158	0.109	0.028353	0.188109	0.270833	50.52632	6.605199
1420	J4-1996	57	58	15	9.2	11.2	7.6	6.4	7.4	6.2	5.8	2.4	2.8	S	0.092	0.112	0.076	0.064	0.006648	0.032255	0.324324	80.43478	6.157522
1421	J4-1996	57	59	15	24.2	26.8	21.9	15.2	9.6	8.8	6.2	2.6	2.9	C	0.242	0.268	0.219	0.152	0.045996	0.330338	0.270833	39.66942	6.605199
1422	J4-1996	57	60	15	23.7	25.9	20.4	14.4	10	9.1	6.8	2.6	2.9	C	0.237	0.259	0.204	0.144	0.044115	0.302896	0.26	42.19409	6.605199
1423	J4-1996	57	61	15	18	21.2	15.7	10.2	10.1	8.9	5.9	2.5	2.9	C	0.18	0.212	0.157	0.102	0.025447	0.179346	0.247525	56.11111	6.605199
1424	J4-1996	57	62	15	28	32.4	25.6	16	10.4	9.4	7.9	2.6	2.8	C	0.28	0.324	0.256	0.16	0.061575	0.483225	0.25	37.14286	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1425	J4-1996	57	63	15	20	22.8	18.2	12.1	10.2	9.2	6.9	2.6	2.9	C	0.2	0.228	0.182	0.121	0.031416	0.239797	0.254902	51	6.605199
1426	J4-1996	57	64	15	15.8	17.2	13.1	9.1	9.3	7.4	5.8	2.4	2.6	I	0.158	0.172	0.131	0.091	0.019607	0.103171	0.258065	58.86076	5.309292
1427	J4-1996	57	65	15	17.5	19.6	14.6	11	9.4	7.6	5.9	2.4	2.6	I	0.175	0.196	0.146	0.11	0.024053	0.135079	0.255319	53.71429	5.309292
1428	J4-1996	58	1	15	14.2	16.9	12.6	10.1	8.1	6.8	5.4	2.4	2.6	S	0.142	0.169	0.126	0.101	0.015837	0.091029	0.296296	57.04225	5.309292
1429	J4-1996	58	2	15	31	33.4	28.8	14.6	11.9	10.2	8.8	2.8	3.4	D	0.31	0.334	0.288	0.146	0.075477	0.620387	0.235294	38.3871	9.079203
1430	J4-1996	58	3	15	15	17.2	13.2	10.6	9.2	8.4	6.2	2.4	2.6	I	0.15	0.172	0.132	0.106	0.017671	0.121519	0.26087	61.33333	5.309292
1431	J4-1996	58	4	15	20	22.6	18.5	11.7	10.1	9.6	7.2	2.6	2.8	C	0.2	0.226	0.185	0.117	0.031416	0.25342	0.257426	50.5	6.157522
1432	J4-1996	58	5	15	20.5	22.4	17.8	10.9	9.9	9.4	7.4	2.7	2.8	C	0.205	0.224	0.178	0.109	0.033006	0.232302	0.272727	48.29268	6.157522
1433	J4-1996	58	6	15	22.5	24.6	20.1	12.1	10.2	9.8	8.2	2.6	2.8	C	0.225	0.246	0.201	0.121	0.039761	0.303721	0.254902	45.33333	6.157522
1434	J4-1996	58	7	15	23.5	26.4	20.9	12.4	9.8	9.4	8.1	2.6	2.8	C	0.235	0.264	0.209	0.124	0.043374	0.319668	0.265306	41.70213	6.157522
1435	J4-1996	58	8	15	22	24.7	20.3	11.8	10.2	9.5	7.9	2.7	2.9	C	0.22	0.247	0.203	0.118	0.038013	0.298164	0.264706	46.36364	6.605199
1436	J4-1996	58	9	15	15	17.6	13.1	9.8	9	8.2	5.9	2.4	2.6	I	0.15	0.176	0.131	0.098	0.017671	0.117239	0.266667	60	5.309292
1437	J4-1996	58	10	15	21.8	24.2	19.4	11.8	10.2	9.6	7.8	2.6	2.8	C	0.218	0.242	0.194	0.118	0.037325	0.28027	0.254902	46.78899	6.157522
1438	J4-1996	58	11	15	24	26.5	21.6	12.6	10.6	9.8	8.4	2.5	2.8	C	0.24	0.265	0.216	0.126	0.045239	0.349856	0.235849	44.16667	6.157522
1439	J4-1996	58	12	15	14.4	16.8	12.3	9.8	9.2	8.2	5.6	2.4	2.6	I	0.144	0.168	0.123	0.098	0.016286	0.10556	0.26087	63.88889	5.309292
1440	J4-1996	58	13	15	22.5	25.1	19.8	11.8	10.4	9.9	8.1	2.6	2.8	C	0.225	0.251	0.198	0.118	0.039761	0.302907	0.25	46.22222	6.157522
1441	J4-1996	58	14	15	23.5	26.7	20.9	11.9	10.3	9.9	8.4	2.6	2.9	C	0.235	0.267	0.209	0.119	0.043374	0.337161	0.252427	43.82979	6.605199
1442	J4-1996	58	15	15	14.6	16.3	12.2	9.6	9.4	8.3	5.6	2.5	2.9	I	0.146	0.163	0.122	0.096	0.016742	0.103563	0.265957	64.38356	6.605199
1443	J4-1996	58	16	15	22.2	24.6	19.8	11.8	10.4	9.6	7.9	2.6	3	C	0.222	0.246	0.198	0.118	0.038708	0.290605	0.25	46.84685	7.068583
1444	J4-1996	58	17	15	32.5	34.7	29.6	14.6	12.4	10.8	9.8	2.8	3.4	D	0.325	0.347	0.296	0.146	0.082958	0.695816	0.225806	38.15385	9.079203
1445	J4-1996	58	18	15	19.2	21.8	16.4	10.4	10.6	9.2	6.4	2.6	2.8	C	0.192	0.218	0.164	0.104	0.028953	0.199818	0.245283	55.20833	6.157522
1446	J4-1996	58	19	15	18.3	20.8	16.4	10.4	10.2	9.1	6.1	2.6	2.9	C	0.183	0.208	0.164	0.104	0.026302	0.192572	0.254902	55.7377	6.605199
1447	J4-1996	58	20	15	23.6	25.8	20.1	11.5	10.4	9.4	7.1	2.6	2.8	C	0.236	0.258	0.201	0.115	0.043744	0.297024	0.25	44.0678	6.157522
1448	J4-1996	58	21	15	21.5	24.7	19.2	11.4	10.6	9.4	7.4	2.6	2.8	C	0.215	0.247	0.192	0.114	0.036305	0.272498	0.245283	49.30233	6.157522
1449	J4-1996	58	22	15	28.5	30.2	25.7	14.1	11.8	10.6	9.9	2.8	3.5	D	0.285	0.302	0.257	0.141	0.063794	0.520716	0.237288	41.40351	9.621128
1450	J4-1996	58	23	15	24.2	26.8	21.3	13.6	10.4	9.6	8.4	2.6	2.9	C	0.242	0.268	0.213	0.136	0.045996	0.341549	0.25	42.97521	6.605199
1451	J4-1996	58	24	15	29	31.6	26.8	14.6	12.2	10.7	9.8	2.8	3.4	D	0.29	0.316	0.268	0.146	0.066052	0.572111	0.229508	42.06897	9.079203
1452	J4-1996	58	25	15	17.5	19.8	13.9	9.4	9.4	8.7	6.2	2.6	2.8	I	0.175	0.198	0.139	0.094	0.024053	0.142722	0.276596	53.71429	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1453	J4-1996	58	26	15	25	27.8	22.8	14.8	10.4	9.4	8.2	2.6	2.9	C	0.25	0.278	0.228	0.148	0.049087	0.377903	0.25	41.6	6.605199
1454	J4-1996	58	27	15	19.5	21.8	16.9	11.4	10.6	9.4	6.8	2.6	2.9	C	0.195	0.218	0.169	0.114	0.029865	0.21504	0.245283	54.35897	6.605199
1455	J4-1996	58	28	15	18.5	20.5	16.2	11.3	10.2	9.2	6.1	2.6	2.9	C	0.185	0.205	0.162	0.113	0.02688	0.192407	0.254902	55.13514	6.605199
1456	J4-1996	58	29	15	20.5	23.4	17.6	12.1	10.4	9.4	6.8	2.6	2.8	C	0.205	0.234	0.176	0.121	0.033006	0.237849	0.25	50.73171	6.157522
1457	J4-1996	58	30	15	15.8	18.1	18.4	9.6	9.3	8.4	5.6	2.4	2.6	I	0.158	0.181	0.184	0.096	0.019607	0.195063	0.258065	58.86076	5.309292
1458	J4-1996	58	31	15	25	27.6	22.6	11.6	10.4	9.4	8.2	2.6	2.8	C	0.25	0.276	0.226	0.116	0.049087	0.361676	0.25	41.6	6.157522
1459	J4-1996	58	32	15	31	34.1	29.1	14.8	11.9	10.8	10.1	2.8	3.4	D	0.31	0.341	0.291	0.148	0.075477	0.674214	0.235294	38.3871	9.079203
1460	J4-1996	58	33	15	17.2	19.8	14.4	10.8	8.9	7.9	5.2	2.6	2.8	I	0.172	0.198	0.144	0.108	0.023235	0.138376	0.292135	51.74419	6.157522
1461	J4-1996	58	34	15	11.5	13.6	9.6	8.4	7.4	5.9	4.8	2.4	2.6	S	0.115	0.136	0.096	0.084	0.010387	0.048204	0.324324	64.34783	5.309292
1462	J4-1996	58	35	15	17	19.8	14.8	11.2	9.4	8.1	6.2	2.5	2.8	I	0.17	0.198	0.148	0.112	0.022698	0.147766	0.265957	55.29412	6.157522
1463	J4-1996	58	36	15	14.5	16.2	11.9	9.6	10.6	8.9	6.8	2.6	2.9	C	0.145	0.162	0.119	0.096	0.016513	0.107302	0.245283	73.10345	6.605199
1464	J4-1996	58	37	15	15.8	17.9	13.3	11	9.2	8.2	6.9	2.4	2.8	I	0.158	0.179	0.133	0.11	0.019607	0.123328	0.26087	58.22785	6.157522
1465	J4-1996	58	38	15	21.2	24.1	19.1	10.1	10.4	8.8	7.4	2.5	2.9	C	0.212	0.241	0.191	0.101	0.035299	0.246748	0.240385	49.0566	6.605199
1466	J4-1996	58	39	15	22.5	25.4	19.8	16.2	10.5	8.7	7.6	2.5	3	C	0.225	0.254	0.198	0.162	0.039761	0.281946	0.238095	46.66667	7.068583
1467	J4-1996	59	1	15	22.5	24.2	19.5	14.1	10.2	9.6	7.2	2.4	2.8	C	0.225	0.242	0.195	0.141	0.039761	0.289711	0.235294	45.33333	6.157522
1468	J4-1996	59	2	15	17	19.6	15.2	11.6	9.4	8.4	6.8	2.4	2.5	I	0.17	0.196	0.152	0.116	0.022698	0.158653	0.255319	55.29412	4.908739
1469	J4-1996	59	3	15	22.5	24.3	20.1	14.6	10.4	9.7	9.2	2.4	2.8	C	0.225	0.243	0.201	0.146	0.039761	0.307235	0.230769	46.22222	6.157522
1470	J4-1996	59	4	15	12	14.2	10.6	9.8	8.3	7.4	5.4	2.4	2.5	S	0.12	0.142	0.106	0.098	0.01131	0.07237	0.289157	69.16667	4.908739
1471	J4-1996	59	5	15	16.2	18.4	14.3	10.1	9.2	8.3	6.6	2.4	2.6	I	0.162	0.184	0.143	0.101	0.020612	0.136735	0.26087	56.79012	5.309292
1472	J4-1996	59	6	15	25	27.6	23.8	15.4	10.2	9.6	7.8	2.5	2.8	C	0.25	0.276	0.238	0.154	0.049087	0.410252	0.245098	40.8	6.157522
1473	J4-1996	59	7	15	23.2	26.1	21.6	16.4	10.1	9.5	7.2	2.6	2.8	C	0.232	0.261	0.216	0.164	0.042273	0.350234	0.257426	43.53448	6.157522
1474	J4-1996	59	8	15	14.2	18.8	12.1	9.4	9.1	7.3	5.4	2.4	2.6	I	0.142	0.188	0.121	0.094	0.015837	0.098179	0.263736	64.08451	5.309292
1475	J4-1996	59	9	15	21	23.7	19.6	14.1	10.1	9.1	7.2	2.6	2.9	C	0.21	0.237	0.196	0.141	0.034636	0.273632	0.257426	48.09524	6.605199
1476	J4-1996	59	10	15	13.5	16.1	11.6	9.8	9.8	7.2	5.8	2.4	2.6	I	0.135	0.161	0.116	0.098	0.014314	0.084209	0.244898	72.59259	5.309292
1477	J4-1996	59	11	15	17.5	19.8	15.8	10.9	9.1	7.8	6.2	2.4	2.6	I	0.175	0.198	0.158	0.109	0.024053	0.154113	0.263736	52	5.309292
1478	J4-1996	59	12	15	16.4	19.1	14.2	10.1	9.2	7.5	6.1	2.4	2.6	I	0.164	0.191	0.142	0.101	0.021124	0.125014	0.26087	56.09756	5.309292
1479	J4-1996	59	13	15	16.2	18.8	14	10	8.9	7	5.9	2.5	2.7	I	0.162	0.188	0.14	0.1	0.020612	0.113386	0.280899	54.93827	5.725553
1480	J4-1996	59	14	15	20.8	22.4	18.4	16.4	10.1	9.4	7.9	2.6	2.8	C	0.208	0.224	0.184	0.164	0.033979	0.261467	0.257426	48.55769	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1481	J4-1996	59	15	15	15.8	17.6	13.4	10.4	10	9.2	7.2	2.4	2.8	C	0.158	0.176	0.134	0.104	0.019607	0.136825	0.24	63.29114	6.157522
1482	J4-1996	59	16	15	24.5	28.6	21.8	16.5	10.4	9.9	8.4	2.4	2.8	C	0.245	0.286	0.218	0.165	0.047144	0.387628	0.230769	42.44898	6.157522
1483	J4-1996	59	17	15	13.8	17.1	11.4	9.7	8.2	7.6	5.6	2.4	2.6	S	0.138	0.171	0.114	0.097	0.014957	0.090166	0.292683	59.42029	5.309292
1484	J4-1996	59	18	15	13.4	17	11.3	9.8	8	7.1	5.1	2.4	2.6	S	0.134	0.17	0.113	0.098	0.014103	0.083255	0.3	59.70149	5.309292
1485	J4-1996	59	19	15	25	28.1	23.6	15.4	10.2	9.9	8.6	2.6	2.8	C	0.25	0.281	0.236	0.154	0.049087	0.421767	0.254902	40.8	6.157522
1486	J4-1996	59	20	15	15.5	18.1	12.2	9.4	8.9	6.9	5.2	2.4	2.6	I	0.155	0.181	0.122	0.094	0.018869	0.091344	0.269663	57.41935	5.309292
1487	J4-1996	59	21	15	21.5	23.8	19.4	15.1	10.3	9.8	7.6	2.4	2.7	C	0.215	0.238	0.194	0.151	0.036305	0.295034	0.23301	47.90698	5.725553
1488	J4-1996	59	22	15	24	27.2	21.8	17.4	10.4	9.9	7.9	2.4	2.6	C	0.24	0.272	0.218	0.174	0.045239	0.381458	0.230769	43.33333	5.309292
1489	J4-1996	59	23	15	13.8	17.1	11.4	9.8	8.9	7.4	5.2	2.4	2.6	I	0.138	0.171	0.114	0.098	0.014957	0.087982	0.269663	64.49275	5.309292
1490	J4-1996	59	24	15	13.5	16.8	11.1	8.9	8.8	7.1	5	2.4	2.6	I	0.135	0.168	0.111	0.089	0.014314	0.079397	0.272727	65.18519	5.309292
1491	J4-1996	59	25	15	15.2	17.6	13.2	9.4	8.8	7.2	5.4	2.4	2.6	I	0.152	0.176	0.132	0.094	0.018146	0.103209	0.272727	57.89474	5.309292
1492	J4-1996	59	26	15	22.5	24.6	20.1	16.4	10.1	9.8	8.1	2.6	2.8	C	0.225	0.246	0.201	0.164	0.039761	0.319442	0.257426	44.88889	6.157522
1493	J4-1996	59	27	15	31	33.5	28.8	18.4	13.2	11.8	10.4	2.8	3.4	D	0.31	0.335	0.288	0.184	0.075477	0.738106	0.212121	42.58065	9.079203
1494	J4-1996	59	28	15	14	17.1	13.7	10.4	9.4	7.6	5.4	2.5	2.6	I	0.14	0.171	0.137	0.104	0.015394	0.114539	0.265957	67.14286	5.309292
1495	J4-1996	59	29	15	14.5	17.2	12.8	9.6	9.2	7.4	5.1	2.5	2.6	I	0.145	0.172	0.128	0.096	0.016513	0.101066	0.271739	63.44828	5.309292
1496	J4-1996	59	30	15	12.2	14.6	10.1	8.6	9.3	7.4	5.1	2.5	2.6	S	0.122	0.146	0.101	0.086	0.01169	0.067337	0.268817	76.22951	5.309292
1497	J4-1996	59	31	15	17.8	19.8	15.1	11.4	10.1	7.9	6.2	2.6	2.9	C	0.178	0.198	0.151	0.114	0.024885	0.148295	0.257426	56.74157	6.605199
1498	J4-1996	59	32	15	14.5	16.8	12.7	9.3	9.2	7.6	5.4	2.5	2.6	I	0.145	0.168	0.127	0.093	0.016513	0.100866	0.271739	63.44828	5.309292
1499	J4-1996	59	33	15	15	17.6	13.1	9.6	9.1	7.4	5.1	2.4	2.7	I	0.15	0.176	0.131	0.096	0.017671	0.105425	0.263736	60.66667	5.725553
1500	J4-1996	59	34	15	12.6	15.1	10.2	8.5	8.4	6.8	4.6	2.4	2.6	S	0.126	0.151	0.102	0.085	0.012469	0.06377	0.285714	66.66667	5.309292
1501	J4-1996	59	35	15	13	15.2	11.6	9.8	7.4	6.4	5.1	2.4	2.9	S	0.13	0.152	0.116	0.098	0.013273	0.072493	0.324324	56.92308	6.605199
1502	J4-1996	59	36	15	26.5	28.6	24.2	11.4	10.9	10.4	9.2	2.6	2.8	C	0.265	0.286	0.242	0.114	0.055155	0.447952	0.238532	41.13208	6.157522
1503	J4-1996	59	37	15	10.5	12.8	8.9	6.2	7.4	6.6	5.4	2.4	2.6	S	0.105	0.128	0.089	0.062	0.008659	0.044849	0.324324	70.47619	5.309292
1504	J4-1996	59	38	15	13.2	16.4	10.4	8.4	8.9	8.2	6.4	2.6	2.8	I	0.132	0.164	0.104	0.084	0.013685	0.082882	0.292135	67.42424	6.157522
1505	J4-1996	59	39	15	16.2	18.4	14.2	11.2	10.4	9.9	8.9	2.7	2.9	C	0.162	0.184	0.142	0.112	0.020612	0.164653	0.259615	64.19753	6.605199
1506	J4-1996	59	40	15	19.2	21.9	15.8	10.8	10.9	10.1	9	2.7	2.9	C	0.192	0.219	0.158	0.108	0.028953	0.210848	0.247706	56.77083	6.605199
1507	J4-1996	59	41	15	11	13.6	9.4	8.1	8.1	7.2	6.1	2.4	2.6	S	0.11	0.136	0.094	0.081	0.009503	0.056927	0.296296	73.63636	5.309292
1508	J4-1996	59	42	15	13.1	16.4	10.2	9.4	9	8.9	8.1	2.4	2.6	I	0.131	0.164	0.102	0.094	0.013478	0.090111	0.266667	68.70229	5.309292

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1509	J4-1996	59	43	15	12.8	15.1	10.9	8.9	7.8	6.6	5.4	2.4	2.6	S	0.128	0.151	0.109	0.089	0.012868	0.0676	0.307692	60.9375	5.309292
1510	J4-1996	59	44	15	12.6	14.6	10.7	9.1	7.9	6.8	5.2	2.4	2.6	S	0.126	0.146	0.107	0.091	0.012469	0.067109	0.303797	62.69841	5.309292
1511	J4-1996	59	45	15	15.5	17.4	13.6	11.2	9.1	8.6	7.9	2.6	2.9	I	0.155	0.174	0.136	0.112	0.018869	0.131491	0.285714	58.70968	6.605199
1512	J4-1996	59	46	15	18.8	21.2	16.1	12.1	10.2	9.6	8.4	2.6	2.9	C	0.188	0.212	0.161	0.121	0.027759	0.20517	0.254902	54.25532	6.605199
1513	J4-1996	59	47	15	14.2	16.5	12.1	10.1	9.2	8.3	7.6	2.5	2.8	I	0.142	0.165	0.121	0.101	0.015837	0.10429	0.271739	64.78873	6.157522
1514	J4-1996	59	48	15	15.2	17.6	13.2	11.1	10.1	9.6	6.1	2.6	2.9	C	0.152	0.176	0.132	0.111	0.018146	0.141991	0.257426	66.44737	6.605199
1515	J4-1996	59	49	15	20	24.8	18.1	13.4	10.4	9.9	7.4	2.6	2.9	C	0.2	0.248	0.181	0.134	0.031416	0.272794	0.25	52	6.605199
1516	J4-1996	59	50	15	10.2	12.9	8.9	7.4	8.5	7.4	6.1	2.5	2.8	I	0.102	0.129	0.089	0.074	0.008171	0.052115	0.294118	83.33333	6.157522
1517	J4-1996	59	51	15	9.8	11.4	8.4	7.1	8.6	7.5	6.1	2.5	2.8	I	0.098	0.114	0.084	0.071	0.007543	0.045417	0.290698	87.7551	6.157522
1518	J4-1996	59	52	15	20.2	22.6	18.4	13	10.2	9.6	8.1	2.6	2.9	C	0.202	0.226	0.184	0.13	0.032047	0.2556	0.254902	50.49505	6.605199
1519	J4-1996	59	53	15	12.3	14.9	9.8	8.2	9.1	8.4	5.9	2.5	2.8	I	0.123	0.149	0.098	0.082	0.011882	0.074045	0.274725	73.98374	6.157522
1520	J4-1996	59	54	15	12	15.1	9.9	8.1	9	8.1	5.8	2.5	2.8	I	0.12	0.151	0.099	0.081	0.01131	0.0727	0.277778	75	6.157522
1521	J4-1996	59	55	15	13.6	16.1	10.1	8.6	9.4	8.1	6	2.5	2.9	I	0.136	0.161	0.101	0.086	0.014527	0.07859	0.265957	69.11765	6.605199
1522	J4-1996	59	56	15	22.5	24.2	19.1	14.2	10.3	9.5	8.1	2.6	3	C	0.225	0.242	0.191	0.142	0.039761	0.279365	0.252427	45.77778	7.068583
1523	J4-1996	60	1	15	21.5	23.4	19.2	12.1	10.1	9.8	8.4	2.6	3.1	C	0.215	0.234	0.192	0.121	0.036305	0.278183	0.257426	46.97674	7.547676
1524	J4-1996	60	2	15	21.5	23.6	18.9	11.8	10.4	9.9	8.3	2.6	3	C	0.215	0.236	0.189	0.118	0.036305	0.275385	0.25	48.37209	7.068583
1525	J4-1996	60	3	15	19.6	21.6	17.4	10.4	10.6	8.9	6.8	2.5	2.9	C	0.196	0.216	0.174	0.104	0.030172	0.208042	0.235849	54.08163	6.605199
1526	J4-1996	60	4	15	12.2	15.7	10.3	9.1	8.9	7.4	5.9	2.4	2.7	I	0.122	0.157	0.103	0.091	0.01169	0.073004	0.269663	72.95082	5.725553
1527	J4-1996	60	5	15	12.5	13.9	10.1	8.8	8.8	7.1	5.6	2.4	2.8	I	0.125	0.139	0.101	0.088	0.012272	0.063077	0.272727	70.4	6.157522
1528	J4-1996	60	6	15	21	23.8	19.2	11.4	10.5	9.4	8.6	2.5	2.8	C	0.21	0.238	0.192	0.114	0.034636	0.267127	0.238095	50	6.157522
1529	J4-1996	60	7	15	27	29.5	25.4	18.4	10.3	10.2	9.8	2.6	2.9	C	0.27	0.295	0.254	0.184	0.057256	0.505959	0.252427	38.14815	6.605199
1530	J4-1996	60	8	15	13.6	17.1	11.4	9.1	7.6	5.8	4.9	2.4	2.5	S	0.136	0.171	0.114	0.091	0.014527	0.067955	0.315789	55.88235	4.908739
1531	J4-1996	60	9	15	24.6	26.8	21.9	16.4	10.9	10.6	9.7	2.5	2.9	C	0.246	0.268	0.219	0.164	0.047529	0.403168	0.229358	44.30894	6.605199
1532	J4-1996	60	10	15	18.5	21.1	16.1	11	10.4	9.4	8.1	2.6	2.8	C	0.185	0.211	0.161	0.11	0.02688	0.197248	0.25	56.21622	6.157522
1533	J4-1996	60	11	15	26.5	29	24.3	17.4	13.1	11.8	10.3	2.9	3.5	D	0.265	0.29	0.243	0.174	0.055155	0.541499	0.221374	49.43396	9.621128
1534	J4-1996	60	12	15	21.7	23.6	18.8	12.1	10.4	9.5	8.4	2.6	2.9	C	0.217	0.236	0.188	0.121	0.036984	0.263275	0.25	47.92627	6.605199
1535	J4-1996	60	13	15	18.5	21.3	16.4	11.2	9.9	8.9	6.2	2.5	2.8	C	0.185	0.213	0.164	0.112	0.02688	0.192805	0.252525	53.51351	6.157522
1536	J4-1996	60	14	15	12.2	15.2	10.1	8.9	7.6	5.9	4.3	2.4	2.5	S	0.122	0.152	0.101	0.089	0.01169	0.055474	0.315789	62.29508	4.908739

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1537	J4-1996	60	15	15	6.2	8.9	4.1	3.2	7.2	5.1	3.1	2.4	2.6	S	0.062	0.089	0.041	0.032	0.003019	0.01046	0.333333	116.129	5.309292
1538	J4-1996	60	16	15	25.2	27.9	23.1	17.2	10.9	10.2	9.9	2.8	2.9	C	0.252	0.279	0.231	0.172	0.049876	0.428417	0.256881	43.25397	6.605199
1539	J4-1996	60	17	15	18.5	21.1	16.4	11.3	10.9	9.8	8	2.6	2.8	C	0.185	0.211	0.164	0.113	0.02688	0.211503	0.238532	58.91892	6.157522
1540	J4-1996	60	18	15	20.5	23.4	18.1	12.4	10.9	9.7	8.2	2.5	2.9	C	0.205	0.234	0.181	0.124	0.033006	0.255439	0.229358	53.17073	6.605199
1541	J4-1996	60	19	15	25.2	27.6	23.2	15.1	10.7	9.8	8.9	2.6	3	C	0.252	0.276	0.232	0.151	0.049876	0.403155	0.242991	42.46032	7.068583
1542	J4-1996	60	20	15	20.5	23.1	17.8	12.3	10.5	9.6	8.4	2.6	2.9	C	0.205	0.231	0.178	0.123	0.033006	0.245328	0.247619	51.21951	6.605199
1543	J4-1996	60	21	15	19	21.8	16.9	11.3	9.6	8.4	7.6	2.4	2.6	I	0.19	0.218	0.169	0.113	0.028353	0.191913	0.25	50.52632	5.309292
1544	J4-1996	60	22	15	21.1	23.4	18.6	12.6	10.2	9.5	8	2.4	2.7	C	0.211	0.234	0.186	0.126	0.034967	0.259921	0.235294	48.34123	5.725553
1545	J4-1996	60	23	15	18.2	21.4	16.4	11	10.4	9.7	8.1	2.4	2.8	C	0.182	0.214	0.164	0.11	0.026016	0.210114	0.230769	57.14286	6.157522
1546	J4-1996	60	24	15	17.6	20.8	15.7	9.8	10.1	9.2	7.8	2.5	2.8	C	0.176	0.208	0.157	0.098	0.024328	0.182405	0.247525	57.38636	6.157522
1547	J4-1996	60	25	15	12.3	15.4	10.9	8.9	7.6	6.8	5	2.4	2.8	S	0.123	0.154	0.109	0.089	0.011882	0.070463	0.315789	61.78862	6.157522
1548	J4-1996	60	26	15	25	27.7	23.4	15.1	10.9	10.4	9.2	2.5	2.9	C	0.25	0.277	0.234	0.151	0.049087	0.433666	0.229358	43.6	6.605199
1549	J4-1996	60	27	15	22.7	24.8	20.2	14.3	10.1	9.9	8.9	2.4	2.9	C	0.227	0.248	0.202	0.143	0.040471	0.317716	0.237624	44.49339	6.605199
1550	J4-1996	60	28	15	18	21.5	16.4	11.1	9.9	9.4	7.6	2.5	2.9	C	0.18	0.215	0.164	0.111	0.025447	0.204416	0.252525	55	6.605199
1551	J4-1996	60	29	15	12	15.3	10.4	8.4	8.1	7.4	5.2	2.4	2.5	S	0.12	0.153	0.104	0.084	0.01131	0.071418	0.296296	67.5	4.908739
1552	J4-1996	60	30	15	15.2	17.8	13.6	9.4	9.4	8.4	7.4	2.5	2.7	I	0.152	0.178	0.136	0.094	0.018146	0.125904	0.265957	61.84211	5.725553
1553	J4-1996	60	31	15	14.5	16.9	12.4	9.7	9.6	8.5	6.9	2.5	2.7	I	0.145	0.169	0.124	0.097	0.016513	0.110679	0.260417	66.2069	5.725553
1554	J4-1996	60	32	15	12.7	16.1	9.6	7.6	8.3	7.1	5.1	2.4	2.5	S	0.127	0.161	0.096	0.076	0.012668	0.06372	0.289157	65.35433	4.908739
1555	J4-1996	60	33	15	15.2	17.7	13.1	10.4	9.7	8.8	7.6	2.6	2.8	I	0.152	0.177	0.131	0.104	0.018146	0.12762	0.268041	63.81579	6.157522
1556	J4-1996	60	34	15	18.5	21.1	15.6	11.2	10.5	9.6	8.2	2.6	3	C	0.185	0.211	0.156	0.112	0.02688	0.194036	0.247619	56.75676	7.068583
1557	J4-1996	60	35	15	17	19.6	15.1	13.2	9.1	8.4	6.1	2.5	2.8	I	0.17	0.196	0.151	0.132	0.022698	0.161683	0.274725	53.52941	6.157522
1558	J4-1996	60	36	15	23.6	26.2	20.6	17.8	10.4	9.6	8.2	2.7	2.9	C	0.236	0.262	0.206	0.178	0.043744	0.339382	0.259615	44.0678	6.605199
1559	J4-1996	60	37	15	16.5	18.6	14.2	11.2	10.3	9.2	7.8	2.6	2.9	C	0.165	0.186	0.142	0.112	0.021382	0.153902	0.252427	62.42424	6.605199
1560	J4-1996	60	38	15	16	18.2	14.6	11.4	9.8	8.9	6.8	2.6	2.8	C	0.16	0.182	0.146	0.114	0.020106	0.153063	0.265306	61.25	6.157522
1561	J4-1996	60	39	15	12.2	14.5	10.4	9.6	8.9	8.1	5.8	2.4	2.6	I	0.122	0.145	0.104	0.096	0.01169	0.077936	0.269663	72.95082	5.309292
1562	J4-1996	60	40	15	20	22.6	18.6	15.6	9.4	8.8	6.8	2.5	2.8	C	0.2	0.226	0.186	0.156	0.031416	0.246275	0.265957	47	6.157522
1563	J4-1996	60	41	15	18.2	20.4	16.2	14.3	8.9	7.8	5.9	2.4	2.8	I	0.182	0.204	0.162	0.143	0.026016	0.170552	0.269663	48.9011	6.157522
1564	J4-1996	60	42	15	21.2	23.1	19.4	15.9	9.5	8.9	6.8	2.4	2.8	C	0.212	0.231	0.194	0.159	0.035299	0.267003	0.252632	44.81132	6.157522

S/N	STAND ID	PLOT	TREE	AGE	DBH(cm)	DB(cm)	DM(cm)	DT(cm)	THT	MHT	SQ	CL	CD	CROWN LAYER	DBH(m)	DB(m)	DM(m)	DT(m)	BA	SV	CR	SC	CPA
1565	J4-1996	60	43	15	19.2	21.4	17.6	15.8	9.3	8.8	7.2	2.5	2.8	C	0.192	0.214	0.176	0.158	0.028953	0.224237	0.268817	48.4375	6.157522
1566	J4-1996	60	44	15	26.2	28.8	24.1	18.4	12.4	10.6	9.2	2.8	3.4	D	0.262	0.288	0.241	0.184	0.053913	0.484422	0.225806	47.32824	9.079203
1567	J4-1996	60	45	15	15	17.4	13.8	9.8	7.6	6.4	4.8	2.4	2.6	S	0.15	0.174	0.138	0.098	0.017671	0.097227	0.315789	50.66667	5.309292
1568	J4-1996	60	46	15	15	17.8	12.9	9.6	7.8	6.5	4.9	2.4	2.5	S	0.15	0.178	0.129	0.096	0.017671	0.091436	0.307692	52	4.908739
1569	J4-1996	60	47	15	19.6	21.4	17.2	14.8	8.8	7.6	5.9	2.4	2.6	I	0.196	0.214	0.172	0.148	0.030172	0.185076	0.272727	44.89796	5.309292
1570	J4-1996	60	48	15	14.2	16.4	12.8	9.6	7.7	6.4	5	2.4	2.6	S	0.142	0.164	0.128	0.096	0.015837	0.085156	0.311688	54.22535	5.309292
1571	J4-1996	60	49	15	15	17.4	13.1	10.1	8.9	7.8	6.4	2.5	2.7	I	0.15	0.174	0.131	0.101	0.017671	0.111414	0.280899	59.33333	5.725553
1572	J4-1996	60	50	15	6.8	8.4	4.3	3.4	7.6	5.4	3.2	2.4	2.6	S	0.068	0.084	0.043	0.034	0.003632	0.011033	0.315789	111.7647	5.309292
1573	J4-1996	60	51	15	31	34.3	28.8	19.8	13.4	11.8	10.4	2.9	3.4	D	0.31	0.343	0.288	0.198	0.075477	0.754744	0.216418	43.22581	9.079203
1574	J4-1996	60	52	15	15.2	17.6	13.1	10.2	8.9	7.8	5.6	2.6	2.9	I	0.152	0.176	0.131	0.102	0.018146	0.112336	0.292135	58.55263	6.605199
1575	J4-1996	60	53	15	15	17.8	13.2	10.1	8.9	7.9	5.5	2.5	2.8	I	0.15	0.178	0.132	0.101	0.017671	0.115387	0.280899	59.33333	6.157522
1576	J4-1996	60	54	15	28	31.2	26.1	19.7	10.1	9.1	7.8	2.5	2.9	C	0.28	0.312	0.261	0.197	0.061575	0.486763	0.247525	36.07143	6.605199
1577	J4-1996	60	55	15	14	16.8	12.4	9.4	8.8	7.8	6	2.4	2.8	I	0.14	0.168	0.124	0.094	0.015394	0.100636	0.272727	62.85714	6.157522
1578	J4-1996	60	56	15	15.2	17.4	13.2	10.1	8.9	7.8	6	2.5	2.8	I	0.152	0.174	0.132	0.101	0.018146	0.112489	0.280899	58.55263	6.157522
1579	J4-1996	60	57	15	19.2	21.8	17.4	14.7	9.7	8.6	6.8	2.6	2.9	C	0.192	0.218	0.174	0.147	0.028953	0.214157	0.268041	50.52083	6.605199
1580	J4-1996	60	58	15	11	13.5	9.4	7.4	7.8	6.8	5.1	2.4	2.6	S	0.11	0.135	0.094	0.074	0.009503	0.052557	0.307692	70.90909	5.309292
1581	J4-1996	60	59	15	13	17.1	11.5	8.9	7.5	6.1	4.9	2.4	2.6	S	0.13	0.171	0.115	0.089	0.013273	0.071913	0.32	57.69231	5.309292
1582	J4-1996	60	60	15	21.6	23.6	19.4	15.1	10.4	9.8	8.2	2.4	2.9	C	0.216	0.236	0.194	0.151	0.036644	0.293818	0.230769	48.14815	6.605199
1583	J4-1996	60	61	15	13.6	17.8	11.2	8.9	7.6	6.4	5	2.4	2.6	S	0.136	0.178	0.112	0.089	0.014527	0.075215	0.315789	55.88235	5.309292
1584	J4-1996	60	62	15	19	22.2	17.2	14.2	8.4	7.8	6.4	2.4	2.8	I	0.19	0.222	0.172	0.142	0.028353	0.191731	0.285714	44.21053	6.157522
1585	J4-1996	60	63	15	11.7	14.2	9.5	7.5	7.8	6.1	4.8	2.4	2.6	S	0.117	0.142	0.095	0.075	0.010751	0.049418	0.307692	66.66667	5.309292
1586	J4-1996	60	64	15	11.7	14.4	9.6	7.4	7.6	6	4.9	2.4	2.6	S	0.117	0.144	0.096	0.074	0.010751	0.04954	0.315789	64.95726	5.309292
1587	J4-1996	60	65	15	21.5	24.3	18.4	15.9	10.2	9.6	8.4	2.5	2.9	C	0.215	0.243	0.184	0.159	0.036305	0.276151	0.245098	47.44186	6.605199
1588	J4-1996	60	66	15	14.5	16.8	11.9	8.9	9.8	8.4	6.5	2.4	2.6	I	0.145	0.168	0.119	0.089	0.016513	0.102027	0.244898	67.58621	5.309292
1589	J4-1996	60	67	15	18	20.4	15.9	13.8	9.9	8.4	6.6	2.4	2.6	I	0.18	0.204	0.159	0.138	0.025447	0.177891	0.242424	55	5.309292
1590	J4-1996	60	68	15	18.5	21.1	16.2	13.9	9.7	8.3	6.4	2.4	2.6	I	0.185	0.211	0.162	0.139	0.02688	0.183415	0.247423	52.43243	5.309292
1591	J4-1996	60	69	15	28.8	31.1	25.8	19.4	11.9	10.4	9.8	2.9	3.4	D	0.288	0.311	0.258	0.194	0.065144	0.545377	0.243697	41.31944	9.079203
1592	J4-1996	60	70	15	8.5	11.4	6.9	5.5	7.6	6.5	4.6	2.4	2.6	S	0.085	0.114	0.069	0.055	0.005675	0.029835	0.315789	89.41176	5.309292

Appendix 2: Whole stand level data used in the computation and data analysis

S/N	PLOT	AGE	AV.DBH	AV.THT	AV.MHT	AVSQ	AV.CL	AV.CD	BA.HA	SV.HA	AV.CR	AV.SC	CPA.HA	SI
1	1	37	30	16.37	14.45	12.43	2.51	2.85	46.075	595.75	0.16	57.85	3516.75	25.00276
2	2	37	32.92	16.58	14.75	12.66	2.54	2.91	28.25	372.75	0.16	53.74	2004	25.26525
3	3	37	34.85	16.87	14.94	12.85	2.55	2.84	29.75	394.5	0.15	53.6	1742.75	25.29806
4	4	37	34.51	17.41	15.45	13.54	2.57	2.91	35.25	487.75	0.15	52.8	166.25	25.134
5	5	37	44.48	18.6	16.8	14.8	2.6	2.98	23.75	336.75	0.14	42.23	1050.25	24.80588
6	6	37	36.06	17.65	15.79	14.03	2.57	2.84	40.25	556.25	0.15	50.74	2392.75	25.00276
7	7	37	34.99	17.14	14.92	14.26	2.54	2.9	24	320.75	0.15	52.86	1489.75	24.93713
8	8	37	39.58	17.56	15.69	13.65	2.57	2.91	36	482.75	0.15	46.79	1829.75	25.46388
9	9	36	44.67	18.65	16.66	14.63	2.6	3.1	28.25	381.75	0.14	42.68	1323.25	25.46388
10	10	36	32.51	17.56	15.58	13.56	2.55	2.89	23.75	317.75	0.15	56.01	1807.5	24.14108
11	11	36	46.52	17.56	15.52	13.46	2.6	3.16	22.25	298.25	0.15	39.6	982.75	23.54582
12	12	36	27.34	16.44	14.35	12.34	2.54	2.8	22.25	282.25	0.16	63.19	2157.5	25.36467
13	13	36	32.81	17.06	15.15	13.52	2.54	2.92	33.25	442.25	0.15	56.75	2354.75	25.19932
14	14	36	30.75	16.53	14.52	12.47	2.52	2.88	25.5	341.25	0.15	58.89	1967.5	25.39774
15	15	36	40.7	18.18	16.16	14.18	2.58	3.05	33.75	454.25	0.14	46.1	1830.75	24.73634
16	16	36	34.24	16.91	14.89	12.83	2.54	2.88	22.5	302.5	0.15	52.43	1467.25	27.44284
17	17	35	26.67	17.46	15.23	13.22	2.55	2.87	32.75	423	0.15	72.62	3393	24.1417
18	18	35	27.89	15.81	13.79	11.34	2.54	2.88	24	287.25	0.16	61.64	2283.25	24.54184
19	19	35	28.06	16.57	14.55	12.55	2.55	2.85	23.75	308.75	0.16	64.08	2247	25.17539
20	20	35	22.6	14.58	12.54	10.46	2.47	2.75	43.25	506.5	0.17	71.41	5506.75	22.47445
21	21	35	22.65	14.03	12.01	9.59	2.48	2.74	35.25	405	0.18	67.49	4573.5	23.20804
22	22	35	24.46	14.85	12.81	10.72	2.5	2.8	34.25	386.5	0.17	64.23	4175.75	23.30807
23	23	35	27.93	15.29	13.29	11.19	2.52	2.83	23.5	273.75	0.17	59.33	2204.5	23.94163
24	24	35	28.36	15.94	13.88	11.69	2.54	2.84	28.5	332	0.16	58.52	2696.5	24.65859
25	25	27	26.94	13.65	12.11	10.46	2.49	2.69	28.25	325.75	0.19	53.99	2573	25.42348
26	26	27	26.45	14.13	12.05	10.02	2.5	2.8	70.25	712.5	0.18	56.85	7257	25.78771
27	27	27	25.33	14.72	12.69	10.6	2.49	2.78	41.25	439.25	0.17	61.87	4547	26.0791
28	28	27	24.64	15.25	13.29	11.15	2.5	2.82	30.25	378.5	0.17	67.34	3608.25	25.64202
29	29	27	21.61	13.81	11.63	9.65	2.48	2.76	35	360.5	0.18	68.74	5080.25	24.69501
30	30	27	23.5	13.99	11.99	9.81	2.49	2.77	25	275	0.18	63.36	3171.5	26.47975
31	31	27	24.43	14.41	12.26	10.19	2.48	2.75	47.25	502.75	0.18	63.24	5349.25	25.09567
32	32	27	22.18	13.23	11.56	8.61	2.47	2.74	29.75	314	0.19	63.59	4006.25	21.67926
33	33	21	25.68	10.8	9.88	8.9	2.54	2.83	27.75	213.75	0.24	42.79	3339	18.99478
34	34	21	21.67	10.12	9.1	7.79	2.56	2.87	21	159.75	0.25	48	3580.5	19.72691
35	35	21	24.92	9.87	8.65	6.78	2.57	2.87	29.75	216.25	0.26	41.42	3769.25	21.43522
36	36	21	25.19	10.58	9.65	8.2	2.58	2.98	35.75	293.5	0.25	43.69	4778	20.215
37	37	21	21.14	9.46	8.22	6.61	2.61	2.94	42	307.75	0.28	47.69	7364	21.39455
38	38	21	22.62	10.19	8.78	7.13	2.68	3.04	33.75	251.5	0.27	47.18	5661	21.67926
39	39	21	19.98	9.9	8.71	7.18	2.67	2.96	29.75	232.25	0.28	54.22	5715.25	20.66241
40	40	21	21.65	10.19	8.74	7.44	2.82	3.05	41.5	263	0.28	50.92	7541.75	26.5192
41	41	20	16.97	13.83	11.66	9.48	2.49	2.77	17.25	161.5	0.18	86.84	4217.75	30.6055
42	42	20	20.04	15.02	12.96	10.8	2.51	2.8	30.75	362	0.17	82.34	5239.75	29.56307

S/N	PLOT	AGE	AV.DBH	AV.THT	AV.MHT	AVSQ	AV.CL	AV.CD	BA.HA	SV.HA	AV.CR	AV.SC	CPA.HA	SI
43	43	20	19.54	15.52	15.71	11.57	2.51	2.8	21.25	289.75	0.16	82.19	41898.75	28.52065
44	44	20	17.84	15.14	13.23	11.17	2.47	2.73	19.75	235.5	0.16	89.64	4265.75	29.02101
45	45	20	19.97	15.09	13.14	10.85	2.47	2.73	20.5	237.25	0.17	80.08	3504.75	29.85495
46	46	20	19.22	14.33	12.43	10.32	2.46	2.72	25.25	289.25	0.18	77.59	4651.5	28.35386
47	47	20	20.31	14.7	12.82	10.76	2.47	2.73	26.75	300	0.17	75.73	4528.75	26.5192
48	48	20	15.73	13.55	11.5	12.48	2.43	2.65	16.5	169.75	0.18	88.75	4417	30.6641
49	49	18	23.93	15.66	13.65	11.63	2.52	2.81	18.75	236.5	0.17	67.73	2486.5	28.14558
50	50	18	19.69	14.51	12.9	10.91	2.48	2.75	12	135.25	0.17	76.4	2235.5	29.91296
51	51	18	21.76	14.99	12.99	11.04	2.48	2.76	12.75	153.75	0.17	71.81	1948.75	27.26188
52	52	18	18.39	13.98	11.98	9.98	2.47	2.74	9	96.25	0.18	78.51	1916.25	22.8225
53	53	18	19.33	9.95	8.59	6.77	2.49	2.77	50	356.25	0.25	54.27	9679.5	24.01324
54	54	15	18.63	9.87	8.29	6.36	2.48	2.75	45	322.25	0.25	56.13	9096	25.40244
55	55	15	19.66	10.31	8.74	6.68	2.49	2.82	39	310.25	0.25	55.97	7392.75	24.65823
56	56	15	19.19	10.74	8.57	6.65	2.46	2.76	47.25	362.75	0.23	57.94	9258.5	21.38369
57	57	15	18.6	9.47	8.38	6.51	2.47	2.7	47.5	332	0.26	53.95	9326.75	23.96363
58	58	15	20.92	10.17	9.14	7.3	2.58	2.88	35.5	267.75	0.26	50.43	6412.5	22.22713
59	59	15	16.79	9.43	8.38	6.67	2.49	2.74	33.5	244.25	0.27	58.96	8278	25.20398
60	60	15	17.91	9.52	8.46	6.93	2.5	2.79	47.75	359.25	0.27	56.43	10825.25	12.7

Appendix 3:Model summary for location parameter in diameter distribution model

Regression Summary for Dependent Variable: LNA
R= .80181975 R²= .64291491 Adjusted R²= .61910924
F(2,30)=27.007 p<.00000 Std.Error of estimate: 0.03055

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			1.293075	0.02656	48.68562	4.12E-30
AV_DBH	-0.52213	0.12557	-0.00495	0.001191	-4.15809	0.000247
LNQMD2	0.919651	0.12557	0.573474	0.078302	7.32383	3.71E-08

Appendix 4:Model summary for scale parameter in diameter distribution model

Regression Summary for Dependent Variable: LNB
R= .99434614 R²= .98872425 Adjusted R²= .98797254
F(2,30)=1315.3 p<.00000 Std. Error of estimate: 0.01415

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			-1.05769	0.08324	-12.7066	1.32E-13
LNA	0.0101	0.025841	0.026337	0.067382	0.39087	0.698656
LNQMD2	0.987639	0.025841	1.605931	0.042018	38.22037	5.24E-27

Appendix 5:Model summary for shape parameter in diameter distribution model

Regression Summary for Dependent Variable: LN_A_C_
R= .80186885 R²= .64299365 Adjusted R²= .61919322
F(2,30)=27.016 p<.00000 Std.Error of estimate: 0.02936

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			1.320864	0.025529	51.74065	6.78E-31
AV_DBH	-0.52263	0.125556	-0.00477	0.001145	-4.16253	0.000244
LNQMD2	0.91966	0.125556	0.551276	0.075262	7.324708	3.7E-08

Appendix 6a:Model summary for location parameter in stem quality distribution model

Regression Summary for Dependent Variable: LNA
R= 0.71633006; R²=0.51312875; Adjusted R²=0.46276276
F(3,29)=10.188 p<.00010 ;Std.Error of estimate:0.03628

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			0.799109	0.180278	4.432644	0.000122
AV_MHT	-0.07372	0.341109	-0.00154	0.007103	-0.21613	0.8304
CPA_HA	0.2828	0.139631	2.05E-06	1.01E-06	2.025344	0.052123
LNINVSAG	0.760862	0.342787	1.274663	0.574266	2.219637	0.034422

Appendix 6b: Model summary for location parameter in stem quality distribution model

STEM QUALITY

Regression Summary for Dependent Variable: LNA
R= .72408007 R²= .52429194 Adjusted R²= .47508077
F(3,29)=10.654 p<.00007 Std.Error of estimate: 0.03586

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercpt			0.909002	0.164947	5.510871	6.14E-06
AV_MHT	1.485519	0.672029	0.030933	0.013994	2.210498	0.035115
AV_SQ	-1.3574	0.614543	-0.03107	0.014064	-2.2088	0.035245
LNINVSAG	0.521397	0.314853	0.873489	0.527468	1.656003	0.108504

Appendix 6c:Model summary for location parameter in stem quality distribution model

Regression Summary for Dependent Variable: LNA
R= .73264719 R²= .53677191 Adjusted R²= .47059646
F(4,28)=8.1113 p<.00018 Std.Error of estimate:0.03601

	BETA	St. Err. of BETA	B	St. Err. of B	t(28)	p-level
Intercept			0.758615	0.239626	3.165821	0.003712
LNTHT	0.830075	0.955716	0.458239	0.527598	0.868537	0.392484
AV_MHT	1.124189	0.792815	0.023409	0.016509	1.417971	0.167233
AV_SQ	-1.5147	0.643187	-0.03467	0.01472	-2.355	0.025764
LNINVSAG	0.197444	0.488977	0.330775	0.819177	0.403789	0.689435

Appendix 6d:Model summary for location parameter in stem quality distribution model

Regression Summary for Dependent Variable: LNA
R=0.84176076; R^2=0.70856117; Adjusted R^2=0.67841233
F(3,29)=23.502 p<.00000 Std.Error of estimate:0.02807

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			0.955965	0.08078	11.83414	1.27E-12
LNTHT	0.132026	0.348897	0.072884	0.192607	0.378411	0.707882
AV_SC	0.596645	0.116487	0.002315	0.000452	5.121998	1.81E-05
LNINVSAG	0.23475	0.349712	0.393274	0.585868	0.671268	0.507362

Appendix 6e:Model summary for location parameter in stem quality distribution model

Regression Summary for Dependent Variable: LNA
R= 0.73264719; R^2=0.53677191; Adjusted R^2= 0.47059646
F(4,28)=8.1113 p<.00018 Std.Error of estimate:0.03601

	BETA	St. Err. of BETA	B	St. Err. of B	t(28)	p-level
Intercept			0.758615	0.239626	3.165821	0.003712
LNTHT	0.830075	0.955716	0.458239	0.527598	0.868537	0.392484
AV_MHT	1.124189	0.792815	0.023409	0.016509	1.417971	0.167233
AV_SQ	-1.5147	0.643187	-0.03467	0.01472	-2.355	0.025764
LNINVSAG	0.197444	0.488977	0.330775	0.819177	0.403789	0.689435

Appendix 7: Model summary for scale parameter in stem quality distribution model

Regression Summary for Dependent Variable: LNB
R= .99740581 R^2= .99481835 Adjusted R^2= .99428232
F(3,29)=1855.9 p<.00000 Std.Error of estimate: .00976

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			-2.47077	0.028087	-87.9689	9.19E-37
LNTHT	-0.1508	0.046522	-0.21708	0.066968	-3.24152	0.002984
AV_SC	0.01168	0.015532	0.000118	0.000157	0.75197	0.458129
LNINVSAG	1.134945	0.046631	4.957948	0.203703	24.33908	7.55E-21

Appendix 8:Model summary for shape parameter in stem quality distribution model

Regression Summary for Dependent Variable: LN_A_C_

R=0.84188924; R^2= 0.70877749; Adjusted R^2=0.67865102

F(3,29)=23.527 p<.00000 Std.Error of estimate:0.02697

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			0.996961	0.077624	12.84349	1.71E-13
LNTHT	0.13222	0.348767	0.070165	0.185081	0.379106	0.707371
AV_SC	0.597233	0.116443	0.002227	0.000434	5.128949	1.77E-05
LNINVSAG	0.234029	0.349582	0.376885	0.562975	0.669452	0.508502

Appendix 9: Model summary for mean quadratic diameter model

Quadratic mean diameter model

Regression Summary for Dependent Variable: LNQMD2

R=0.99026818; R^2=0.98063107; Adjusted R^2=0.98000627

F(1,31)=1569.5 p<.00000 Std.Error of estimate: .01828

	BETA	St. Err. of BETA	B	St. Err. of B	t(31)	p-level
Intercept			1.802311	0.011574	155.7245	0
INVS_AGE	-0.99027	0.024996	-9.7158	0.245244	-39.6169	4.04E-28

Appendix 10:Model summary for mean stem volume model

Regression Summary for Dependent Variable: AV_SQ

R=0.97657135; R^2=0.95369160; Adjusted R^2= .94890108

F(3,29)=199.08 p<.00000 Std.Error of estimate:0.48889

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			-16.987	1.120003	-15.1669	2.52E-15
LNTHT	1.035852	0.052238	24.98628	1.260063	19.82939	2.07E-18
AV_SC	-0.20292	0.066015	-0.0344	0.011191	-3.07389	0.004569
SI	0.047763	0.074617	0.040471	0.063225	0.640113	0.527125

Appendix 11:Model summary for annual stem quality model

Regression Summary for Dependent Variable: LNSQ
R=0.98576346; R²= .97172961; Adjusted R²=0.96880508
F(3,29)=332.27 p<.00000 Std.Error of estimate: .01779

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			1.595713	0.472949	3.373961	0.002119
LNTHT	1.053312	0.036544	1.183012	0.041044	28.82283	6.77E-23
AV_SC	1.068569	0.302827	0.008435	0.00239	3.528647	0.001414
LNAGE	-1.20182	0.305158	-1.38127	0.350723	-3.93835	0.000473

Appendix 12a:Model summary for annual stem volume model

Regression Summary for Dependent Variable: LNASV
R= .96320365 R²= .92776128 Adjusted R²= .92294536
F(2,30)=192.64 p<.00000 Std.Error of estimate: .04150

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			2.3383	0.08853	26.41254	2.49E-22
LNABA	-0.93581	0.052379	-4.20597	0.235419	-17.8659	1.54E-17
LNQMD2	-0.07164	0.052379	-0.08285	0.060578	-1.36763	0.181587

Appendix 12b:Model summary for annual stem volume model

Regression Summary for Dependent Variable: LNASV
R= .99986103 R²= .99972207 Adjusted R²= .99969332
F(3,29)=34772. p<0.0000 Std.Error of estimate: .00024

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			-0.77599	0.001754	-442.489	0
SI	0.000384	0.003433	2.06E-06	1.84E-05	0.111998	0.911597
INVS_AGE	0.000496	0.00317	0.000515	0.00329	0.156455	0.876759
LNABA	1.00011	0.003487	0.953155	0.003323	286.8124	0

Appendix 13:Model summary for annual basal area model

Regression Summary for Dependent Variable: LNABA
R= .97177399 R²= .94434469 Adjusted R²= .93858724
F(3,29)=164.02 p<.00000 Std.Error of estimate: .00824

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			0.566043	0.024144	23.44408	2.13E-20
LNASV	-0.9464	0.044034	-0.21057	0.009797	-21.4924	2.31E-19
CPA_HA	0.013492	0.044864	6.56E-08	2.18E-07	0.30074	0.765758
SI	-0.14822	0.045074	-0.00193	0.000587	-3.28834	0.002645

Appendix 14:Model summary for site index model

Regression Summary for Dependent Variable: SI
R= .70725507 R²= .50020973 Adjusted R²= .44850729
F(3,29)=9.6748 p<.00014 Std.Error of estimate: 1.8955

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			3.40603	5.775266	0.589762	0.559918
LNTHT	0.697453	0.137285	19.85485	3.908183	5.080326	2.03E-05
LNASV	-0.09354	0.136621	-1.59713	2.332598	-0.6847	0.49897
CPA_HA	0.281731	0.131948	0.000105	4.93E-05	2.135176	0.041322

Appendix 15: Model summary for stem quality model

Regression Summary for Dependent Variable: LNSQ
R= .84343458 R²= .71138188 Adjusted R²= .68152484
F(3,29)=23.826 p<.00000 Std.Error of estimate: .01539

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			0.081078	0.015476	5.238869	1.31E-05
AGE	0.561262	0.174233	0.002116	0.000657	3.221334	0.003142
NUMTREE	-0.33171	0.119399	-2.3E-05	8.35E-06	-2.77817	0.009487
AV_THT	0.143399	0.160261	0.00149	0.001666	0.894781	0.378271

Appendix 16:Model summary for mean diameter at breast height model

Regression Summary for Dependent Variable: AN_DBH

R= .85140606 R^2= .72489228 Adjusted R^2= .69643287

F(3,29)=25.471 p<.00000 Std.Error of estimate: .01396

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			0.149551	0.147036	1.017106	0.317514
LNABA	0.568544	0.352358	0.433137	0.268439	1.613538	0.117458
LNASV	-0.24895	0.352351	-0.0422	0.059725	-0.70654	0.485494
CPA_HA	-0.25627	0.097615	-9.5E-07	3.62E-07	-2.62531	0.013674

Appendix 17: Model summary for yield (stem volume) model

YIELD MODEL

stem volume

LNSV=b0 +b1iNVAGE+B2lnba

Regression Summary for Dependent Variable: LNASV

R= .96311529 R^2= .92759105 Adjusted R^2= .92276379

F(2,30)=192.16 p<.00000 Std.Error of estimate: .04155

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			2.487795	0.026909	92.45355	2.07E-38
INVS_AGE	-0.06894	0.051448	-0.78224	0.583779	-1.33996	0.190321
LNABA	-0.9404	0.051448	-4.22661	0.231231	-18.2787	8.23E-18

Appendix 18: Model summary for basal area model

Basal area

Regression Summary for Dependent Variable: LNABA

R= .96170056 R^2= .92486796 Adjusted R^2= .91985916

F(2,30)=184.65 p<.00000 Std.Error of estimate: .00942

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			0.542121	0.028942	18.73116	4.19E-18
INVS_AGE	-0.04281	0.053383	-0.10808	0.134773	-0.80193	0.428901
LNASV	-0.97576	0.053383	-0.2171	0.011877	-18.2787	8.23E-18

Appendix 19: Model summary for stem quality model

stem quality

Model: v10=b0*v6^b1*exp(b2*v29+b3*v20)

Dep. var: LNSQ Loss: (OBS-PRED)**2
Final loss: .007398252 R=.83014
Variance explained: 68.912%

					R^2	0.6891
					SE	0.002966
	B0	B1	B2	B3		
Estimate	0.000435	1.802428	-10.7634	7.774891		

Appendix 19b:Model summary for stem quality model

Model: v10=b0*v6*exp(b1*v3+b2*v29+b3*v20)

Dep. var: LNSQ Loss: (OBS-PRED)**2

Final loss: .005280468 R=.88211 Variance explained: 77.811%

					SE	0.002506
					R^2	0.7781
	B0	B1	B2	B3		
Estimate	0.017478	-0.35421	-8.48903	4.224069		

Appendix 20:Model summary for stem number model

NUMBER OF STEM

Model: v3=b0+b1*v19+b2*v29+b3*v33 (percentile m_oyebade.sta)

Dep. var: LNN0TREE Loss: (OBS-PRED)**2
Final loss: .782069063 R=.63783
Variance explained: 40.682%

					SE	0.029478
					R^2	0.4068
	B0	B1	B2	B3		
Estimate	7.692037	-5.59722	-32.73	-3.86569		

Appendix 21:Model summary for tree number model

Regression Summary for Dependent Variable: LNN0TREE
R= .70824140 R²= .50160588 Adjusted R²= .45004787
F(3,29)=9.7290 p<.00013 Std.Error of estimate: .15053

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			4.031605	1.084822	3.716376	0.000859
LNASV	-0.04698	0.163728	-0.69731	2.430244	-0.28693	0.776207
LNTHT	-0.59275	0.149968	-1.37432	0.347711	-3.95249	0.000455
SI	0.266448	0.144899	0.021189	0.011523	1.838849	0.076198

Appendix 22a:Model summary for mean crown projection area model

CPA

lnCPA=b0exp(b1lnCR+lnAGE)
Model: v24=b0*exp(b1*v21+b2*v27)
Dep. var: LNCPA Loss: (OBS-PRED)**2
Final loss: 1.106299996 R=.73084 Variance explained: 53.413%

SE	0.03506
R^2	0.5341

	B0	B1	B2
Estimate	0.69112	-0.81246	-3.10459

Appendix 22b:Model summary for mean crown projection area model

Regression Summary for Dependent Variable: LNCPA
R= .73541160 R²= .54083023 Adjusted R²= .51021891
F(2,30)=17.668 p<.00001 Std.Error of estimate: .19065

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			5.326754	0.620584	8.583458	1.41E-09
LNTHT	-0.7287	0.127789	-2.26746	0.397636	-5.70236	3.21E-06
LNAGE	0.390208	0.127789	4.111648	1.346521	3.053534	0.004709

Appendix 23: Model summary for mean crown ratio model

CROWN RATIO

Regression Summary for Dependent Variable: LNCR

R= .96638878 R²= .93390728 Adjusted R²= .92707010

F(3,29)=136.59 p<.00000 Std.Error of estimate: .03634

	BETA	St. Err. of BETA	B	St. Err. of B	t(29)	p-level
Intercept			-2.13786	0.219899	-9.72201	1.25E-10
LNTHT	0.318216	0.071184	0.489111	0.109413	4.470322	0.00011
LNCPA	-0.12335	0.070452	-0.06093	0.0348	-1.75084	0.090547
LNAGE	-0.93205	0.056457	-4.85121	0.293851	-16.5091	2.76E-16

Appendix 24a:Model summary for mean crown ratio model

Regression Summary for Dependent Variable: LNCR

R= .96276734 R²= .92692096 Adjusted R²= .92204902

F(2,30)=190.26 p<.00000 Std.Error of estimate: .03757

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			-2.46242	0.122293	-20.1353	5.59E-19
LNTHT	0.408101	0.05098	0.627267	0.078359	8.005049	6.18E-09
LNAGE	-0.98018	0.05098	-5.10173	0.265348	-19.2266	2.03E-18

Appendix 24b:Model summary for mean crown ratio model

Regression Summary for Dependent Variable: LNCR

R= .96546204 R²= .93211695 Adjusted R²= .92759141

F(2,30)=205.97 p<.00000 Std.Error of estimate: .03621

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			-1.87116	0.086836	-21.5481	8.3E-20
LNSQ	0.415869	0.049257	2.052016	0.243047	8.44287	2.02E-09
LNAGE	-0.98591	0.049257	-5.13156	0.256377	-20.0157	6.6E-19

Appendix 24c: Model summary for mean crown ratio model

MEAN CROWN RATIO MODEL

Regression Summary for Dependent Variable: LNCR

R= .91112367 R²= .83014635 Adjusted R²= .81882277

F(2,30)=73.311 p<.00000 Std.Error of estimate: .05728

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			-1.87888	0.138999	-13.5172	2.69E-14
AV_SQ	0.246127	0.076036	0.015313	0.004731	3.236973	0.002944
LNAGE	-0.91338	0.076036	-4.75405	0.39576	-12.0124	5.44E-13

Appendix 25:Model summary for stem volume growth model

STEM VOLUME GROWTH MODEL

Regression Summary for Dependent Variable: LNASV

R= .99986143 R²= .99972289 Adjusted R²= .99970441

F(2,30)=54114. p<0.0000 Std.Error of estimate: .00024

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			-0.77549	0.001602	-484.082	0
LNABA	0.999574	0.003148	0.952644	0.003	317.5001	0
LNAGE	-0.0011	0.003148	-0.00058	0.001665	-0.34986	0.728887

Appendix 26:Model summary for mean stem quality model

Mean stem quality model

Regression Summary for Dependent Variable: LNSQ

R= .99924970 R²= .99849997 Adjusted R²= .99839997

F(2,30)=9984.8 p<.00000 Std.Error of estimate: .00109

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			-0.29323	0.003551	-82.5802	6.06E-37
LNTHT	0.996717	0.007304	0.310479	0.002275	136.4629	1.81E-43
LNAGE	0.009927	0.007304	0.010472	0.007705	1.359184	0.184219

Appendix 27a: Model summary for mean total height growth model

MEAN TOTAL GROWTH MODEL

Model: v7=b0*exp(b2*v27+b3*v33)

Dep. var: LNTHT Loss: (OBS-PRED)**2

Final loss: .094808217 R=.78322 Variance explained: 61.343%

				SE	0.009933
				R^2	0.6134
	B0	B2	B3		
Estimate	0.812507	-0.08403	0.397243		

Appendix 27b: Model summary for mean total growth model in height

Regression Summary for Dependent Variable: AV_THT

R= .86121543 R^2= .74169203 Adjusted R^2= .72447149

F(2,30)=43.070 p<.00000 Std.Error of estimate: 1.3773

	BETA	St. Err. of BETA	B	St. Err. of B	t(30)	p-level
Intercept			14.00094	1.474908	9.492757	1.52E-10
AV_SC	0.45255	0.092808	0.093074	0.019088	4.876188	3.3E-05
INVS_AGE	-0.72423	0.092808	-144.235	18.48319	-7.80357	1.04E-08