Biomass Equations for Important Tree Species of Meghalaya

Submitted to:

Forest and Environment Department
Government of Meghalaya

By:

Dr. Krishna Giri
Scientist-C

Rain Forest Research Institute, Jorhat-785 001, Assam
(Indian Council of Forestry Research and Education)

(An Autonomous body of Ministry of Environment,
Forest and Climate Change, Govt. of India)

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MEGHALAYA SHILLONG

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RAIN FOREST RESEARCH INSTITUTE
भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्
Indian Council of Forestry Research & Education
(पर्यावरण एवं वन मंत्रालय, भारत सरकार के अधीनस्थ एक स्वायत्त परिषद्)
(An Autonomous body under Ministry of Enviroment & Forest, Govt. of India)

Preface

As the adage goes, "What cannot be measured cannot be managed." Therefore, for sustainable forest management periodic measurement of volume, biomass and carbon in the forest growing stock is essential. It will show whether the management inputs have really led to any improvement in the growing stock. Measurement is also important from utilization point of view to assign an economic value to the standing tree or a plantation and to plan its harvest and disposal. The estimation of carbon content has become important in order to assess the ecological value in terms of carbon sequestration and also to claim carbon credits.

In this context, the initiative of the Meghalaya forest department is a pioneering effort in Northeast India, trying to estimate the stem volume, stem biomass and carbon content of four important timber species of the State. Rain Forest Research Institute is grateful to the Meghalaya forest department, for entrusting this task to us. The Institute has used the latest equipments and prepared the stem volume, biomass and carbon tables in a non destructive way.

These tables would be of great use to the foresters and tree farmers of the State of Meghalaya and would contribute to the sustainable management of timber recourses in the State.

(Dr. R.S.C. Jayaraj)
Director

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Acronyms and Abbreviations

AGB	Above ground biomass
Adj. R^2	Coefficient of determination
BEFs	Biomass Expansion Factors
CO_2	Carbon dioxide
DBH	Diameter at breast height
DF	Degree of freedom
GBH	Girth at breast height
GPS	Global Positioning System
IPCC	Intergovernmental Panel on Climate Change
REDD	Reducing Emission from Deforestation and Forest Degradation
RF	Reserve Forest
SE	Standard error
UNFCCC	United Nations Framework Convention on Climate Change
V	Volume

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Introduction

The ultimate objective of forest mensuration is to estimate quantity of wood/timber contained in the forest. The volume of trees is calculated either after felling the tree or in the standing crop. For volume estimation of standing trees, mathematical models developed through multiple regression analyses are the most suitable methods which avoid felling of trees or destructive approach for volume and biomass estimation in the forest ecosystems. Modeling has a long history in forestry and as early as mid 1880s the Central European Foresters were using graphical methods to model the growth and production of forests and these models continued to be used in other places also until the development of mechanical calculators in combination with new ideas for statistical analysis. These new statistical tools and techniques enabled us to prepare yield and volume tables more efficiently (Pandey et al. 1998). Stiellfor (1957) and Woessner (1973) proposed regression equations for volume/biomass prediction of different parts of trees like bole, roots and branches. Wagner (1983) proposed methods for determination of tree volume in standing trees using diameter at breast height (dbh), height and diameter at height of 30% of total height. Harding and Griger (1985) developed allometric models $Y = ad^b$ and $Y = ad^bh^c$ where Y is mass, d is dbh, h is height and a, b, c are mathematical constants.

The yield and volume of timber are required by the stand managers (Yamamoto, 1994; Tewari and Gadow, 1999) easily measurable dependent on tree diameter, height, basal area, form, bark thickness and other parameters. The relationship between these parameters serves as a key to tree volume estimation. Volume equations/regression models have been most widely used for estimating tree volume. A model should provide information that is sufficiently precise and comprehensive to execute the intended purpose with its simplicity and should be easily understood and helpful for drawing inferences.

Allometry generally relates easily measured independent variables like DBH to other components and provides relatively accurate estimates (Phillips et al. 2002). Allometric models vary widely but the easiest and most commonly used method is linear models in the form of $Y = a + bx$, where Y is the biomass, a & b are slopes and intercepts and x is the tree diameter at breast height (Dudley and Fownes, 1991). The accurate estimation of biomass in tropical forests is crucial for many applications, from the commercial exploitation of timber to the global carbon cycle. Particularly in the latter context estimation of total above-ground biomass (AGB) with accuracy sufficient to establish the increments or decrements in carbon stored in the forest over relatively short periods of time (2-10 years) is important.

Assessment of carbon sequestration potential in terrestrial ecosystems through biomass estimation is the most prominent and appropriate approach (Brown, 1997; Brown et al. 1989; Chambers et al. 2001). Regression models are used for biomass estimation because of their relative simplicity and ease of converting inventory data into biomass estimate. Although it is difficult and tedious at the initial stage to develop the best-fit models, tree dimension values as the input data requirement for subsequent estimations have made the regression-based biomass estimation method extremely popular (Brown, 1997). Several regression models have been developed to estimate biomass or biomass-related parameters (Brown et al. 1989; Schmidt et al. 2009), which are being used to prepare volume tables for several forestry species (Li and Weiskittel, 2010) and to estimate carbon in tropical, temperate, boreal, and semi-arid forest ecosystems (Schroeder et al. 1997). The total biomass data obtained from such models are then converted into carbon content for estimating carbon pools in different compartments, by multiplying with a conversion factor of 0.5 on the assumption that the tree biomass contains 50% carbon (Ravindranath et al. 1997).

Although several workers have used tree height, trunk diameter [i.e. diameter at breast height (DBH)] and wood density as independent variables for estimating tree aboveground biomass (AGB), the allometric relationship between AGB and DBH has been proved to be the best fit for tree biomass estimation in several forests (Brown, 1997; Brown et al. 1989). The carbon present in other compartments of the ecosystem such as shrubs, herbs, litter, woody debris, root, and soil is added to the tree carbon data to obtain the total carbon pool in a forest ecosystem. Since AGB of trees contains a large fraction of the total forest carbon stock, many studies on forest carbon budget have focused only on tree AGB estimation. Although these studies do provide empirical data on the major carbon pool of the forest, total ecosystem level carbon data for most ecosystems is lacking (Baisya and Barik, 2011).

Under the United Nations Framework Convention on Climate Change (UNFCCC), countries have to report regularly the state of their forest resources and emerging mechanisms, such as Reducing Emissions from Deforestation and degradation in Developing Countries (REDD), and they are likely to require temporally and spatially fine-gained assessments of carbon stock (UNFCCC, 2008; Basuki et al. 2009). The most accurate method for the estimation of biomass is through cutting of trees and weighing their parts. This destructive method is often used to validate other, less invasive and costly methods, such as the estimation of carbon stock using non-destructive in-situ measurements and remote sensing (Clark et al., 2001; Wang et al., 2003). Allometric equations developed on the basis of sparse measurements from destructive sampling are related to more easily collected

biophysical properties of trees, such as diameter at breast height (DBH) and commercial bole/ branch dry weight and then used to model leaf dry weight. For instance results of Joshi et al. (2015) developed allometric equations for *Paulownia tomentosa* (Thunb.) to estimate biomass and carbon stocks of two 0.1 ha plots in ICIMOD Knowledge park, Godavari, Nepal using harvest method.

Presently more emphasis is being given to the non destructive methods of biomass and carbon stock estimation because they are less time consuming and cost effective than the harvest method. Species specific, regional and local volume equations give more accurate estimates of forest biomass and carbon as well as the merchantable timber wealth of a particular forest area. Forest and Environment Department, Govt. of Meghalaya felt the need of volume equations of some important tree species and suggested to develop equations for four ecologically as well as economically important tree species of the state. The detailed description and economic importance of the selected tree species is given below:

Description of selected tree species

1. ***Betula alnoides*** **(Himalayan birch, Indian Birch, Family- Betulaceae)**

Distribution

This species is naturally distributed in Bhutan, China, Laos, Myanmar, Nepal, Thailand and Vietnam. In India it is naturally distributed in Arunachal Pradesh, Assam, Darjeeling, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Himachal Pradesh and Uttarakhand.

Lower elevation limit (metre): 500

Upper elevation limit (metre): 3000

Habitat and Ecology

This species grows in tropical to subtropical forests in association with oaks, alder (*Alnus nepalensis*) and herbaceous subtropical ground flora. In the Himalayas, this species is one of the main elements in temperate deciduous forests associated with Green Oak, Deodar and Silver fir trees.

This species is also reported as a primary colonizer following disturbance such as landslides or road buildings. It is also found along the rivers exposed by gravels due to floods, tolerant to varying ranges of soil texture and moisture. It has been reported that trees in the wild near Kalimpong, West Bengal develop new shoots in mid October while still retaining their old leaves therefore considered as evergreen tree species. The species is

widespread and common across most of its distribution. However, it is listed as locally rare in Garhwal North West Himalayas.

Use and Trade

The wood of *B. alnoides* is hard, coarse and used for timber as well as furniture, cabinet and household utensil making. The bark is used as a medicine for dislocated bones and snake antidote when mixed with hot butter. The bark was also used as a substitute for paper. The aromatic oils can be used in the leather industry and the leaves are lopped for fodder. It is also a holy plant of Chadar (Tagin) tribe in Arunachal Pradesh, India (Shaw et al. 2014).

2. *Duabanga grandiflora* (Family- Lythraceae)

Distribution

D. grandiflora is native to Cambodia, Eastern India, Laos, Malaysia, Myanmar, Thailand, and Vietnam found in evergreen rain forests between 900-1500 m elevations. It is found in open forests including vegetation adjacent to river banks and in valleys. In India it is indigenous to the Eastern Himalayas and found in Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and Andaman Islands.

Lower elevation limit (metre): 900

Upper elevation limit (metre): 1500

Habitat and ecology

This species is mainly found in Valley forests and open places particularly on river banks. *D. grandiflora* grows up to 30 m in height and has large buttresses as support structures that grow at the base of a tree trunk which provide a wide base and additional support to prevent them from tipping over.

Use and trade

The wood of *D. grandiflora* is used for timber, preparation of boxes, crates, tea boxes, furniture components, houses, block board, fibre boards and pulp (Haining et al. 2007).

3. *Magnolia champaca* (Family-Magnoliaceae)

Distribution

M. champaca is native to south and central China and India. It is also commonly found in Bangladesh, Indonesia, Malaysia, Vietnam, Laos, Cambodia, Myanmar, Nepal and Thailand between 200 to 1,600 m a.s.l. In India it is mainly found in Arunachal Pradesh, Assam, Meghalaya, Manipur, Tripura, Nagaland, Mizoram, Sikkim and Western Ghats.

Habitat and ecology

M. champaca is an evergreen or semi-deciduous, medium-tall sized emergent canopy tree up to 50 m tall and 200 cm in diameter. It is found scattered in riparian primary lowland to montane evergreen broadleaf forests in moist vegetation. It flowers from June to July and September to October. It is described as a remarkable tree, worshipped for its great antiquity.

Use and trade

M. champaca is used as an ornamental tree in urban landscaping. Flowers are also used for perfume, worn as hair decoration and room decoration. The wood is used for fuel and furniture making. It is also used for making doors, windows, general carpentry and light construction. The heartwood is light yellowish to olive brown. It is straight grained and medium-fine-textured, somewhat lustrous with smooth feel. It has potential for commercial oil extraction for various uses. It also has medicinal values; a decoction of the bark and leaves are given after child birth; the bark is used as a febrifuge. Its fatty oils extracted from the seeds have antibacterial activity. In India and Southeast Asia, it is logged for its valuable timber (Khela, 2014).

3. *Toona ciliata* (Family- Meliaceae)

Distribution

T. ciliata is found naturally across much of South and Southeast Asia from Pakistan and western China to Indonesia, Malaysia and parts of Oceania, including Australia and islands of the western Pacific Ocean. On the Indian subcontinent, *T. ciliata* is distributed from eastern Pakistan to Bangladesh, North East including the tropical parts of the sub-Himalayan tract and the Western Ghats (Conn and Damas, 2006).

Habitat and ecology

In the western sub-Himalayan tract of India, *T. ciliata* is found in moist localities, sheltered ravines, along streams and even in swamp forest, while in the Western Ghats, it is found mostly in wet evergreen forests. In India, the climate of the natural habitat comprises rainfall from 1100–4000 mm per year and temperatures range from about 0-35°C. The species is frost tolerant, however, sensitive to drought.

Use and trade

T. ciliata is mostly grown for its versatile timber, which is used for building houses, high-value goods such as furniture, musical instruments and carvings. The flowers yield reddish dye stuff, while the bark is used to tan leather or to produce string. Leaves and bark are used in traditional medicine. *T. ciliata* is commonly cultivated as an avenue tree in India

(Edmonds, 1995) and as an ornamental and wayside tree throughout much of tropical Africa and Asia (Fenton et al. 1977).

Description of the study area

Meghalaya state of NE India comprises Khasi Hills, Garo Hills, Jaintia Hills and Ri-Bhoi, covering an area of 22,720 Km^2, and lies between 25^0 47′ to 26^0 10′ N latitude and 89^0 45′ to 92^0 45′ E longitude. The altitude ranges from 50 to 1960 m (m.s.l.). The mean maximum and mean minimum temperature of the state is 24.3^0C and 17.8^0C, respectively. The average annual rain fall in Meghalaya is about 1200 mm and known as wettest place on earth. The floral diversity of Meghalaya is well reputed for its richness and as an abode of many endemic flora and fauna. Considering the importance of regression equations for estimating stem volume, AGB, carbon stock and merchantable timber of the forest ecosystem, the present study was undertaken with the objective to develop biomass equations for the selected tree species.

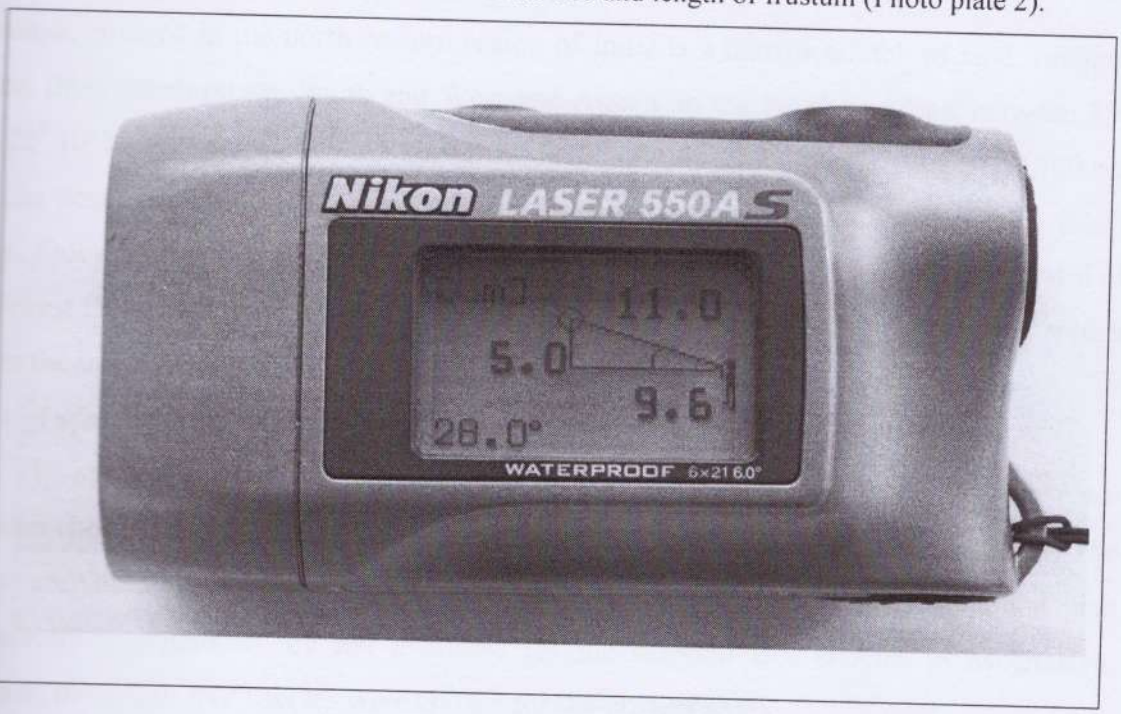
Materials and Methods

Materials

1. **Hand held GPS, Garmin make, model-etrax 10:** Used for recording geo-coordinates of the survey and sampling sites in the field (Photo plate 1).



2. **Nikon Laser 550A Range Finder:** Used for measurement of total tree height, height at the occurrence of first branch of each individual tree and length of frustum (Photo plate 2).



3. **Mantax Black Calliper with Gator Eyes, Make: Haglof Sweden:** Used for measurement of diameter from a distance with laser beam (diameter measurement at different height of each tree) (Photo plate 3).



4. **Digital Camera, Sony Make 10.2 MP Model DSLR-A 200:** Used for capturing photographs of field survey and data collection from each sampling locations.
5. **Measuring tape:** Used for measurement of basal girth and girth at breast height (GBH) of tree species.

Methodology

Study site

Meghalaya, situated in the north eastern region of India is a narrow stretch of land, running between Bangladesh on the South and West and Assam on the North and East between 25^0 47′ to 26^0 10′ N latitudes and 89^0 45′ to 92^0 45′ E l longitudes. It covers an area of 22,720 sq. Km. The State has most of its land covered by hills interspersed with gorges and small valleys. Out of the 15,657 Sq km forest area in the state, 1,027.20 km^2 is under the control of State Forest Department and remaining area is either private or clan/community owned which is under the indirect control and management of Autonomous District Councils.

Choice of species

The species that are important for the people of Meghalaya in terms of timber use have been chosen for the study, in consultation with the Meghalaya Forest Department. The species are listed in Table 1. Based on the existing literature, it was found that volume/biomass equations are not available for the selected tree species in Meghalaya. Therefore, these four tree species were chosen for the present study.

Table 1 Important tree species of Meghalaya forest

S. No.	Name of the species	Status of volume equation
1	*Betula alnoides*	FSI (1996) has developed volume equation for Arunachal Pradesh. Not developed for Meghalaya.
2	*Duabanga grandiflora*	FSI (2013) has developed volume equation for Eastern Himalaya. Regional volume table exists for Manipur (Sharma and Jain, 1977). Regional volume table exists for Assam (Sharma and Jain, 1979). Not developed for Meghalaya.
3	*Magnolia champaca*	FSI (1996) has developed volume equations for Arunachal Pradesh and Assam. FSI (2013) developed volume equation for North Eastern Himalaya. Sivananthawerl and Premakantha, (2010), developed volume equations in Sri Lanka. Not developed for Meghalaya.
4	*Toona ciliata*	FSI (1996) has developed volume equations for Arunachal Pradesh, Assam and Tripura. Sivananthawerl and Premakantha, (2010), developed volume equations in Sri Lanka. Not developed for Meghalaya.

Field surveys and data collection

Extensive field surveys were conductec in the entire state for data collection of selected tree species. The detailed information of the sites is given in the Table 2 and map is given in Fig.1.

Table 2 Areas visited for data collection in Meghalaya

S. No	Name of the places	District
1.	Lumsohpetbnneng R. F. (Umiam)	North Khasi Hills
2.	Barapani	North Khasi Hills
3.	Riat Khwan	North Khasi Hills
4.	Upper Shillong R. F.	East Khasi Hills
5.	Cherrapunji	East Khasi Hills
6.	Nongstoin	West Khasi Hills
7.	Nongkhyllem R. F.	Ri-Bhoi
8.	Umsaw R. F.	Ri-Bhoi
9.	Samanda Forest	Williamnagar, East Garo Hills
10.	Khera Forest	Williamnagar, East Garo Hills
11.	Songsak R. F.	Williamnagar, East Garo Hills
12.	Darogre	Williamnagar, East Garo Hills
13.	Tura Peak/ Tura Catchment R. F.	Tura, West Garo Hills
14.	Baghmara R. F.	South Garo Hills
15.	Narpuh R. F.	East Jaintia Hills
16.	Jowai	West Jaintia Hills
17.	Umkiang	East Jaintia Hills
18.	Sonapur	East Jaintia Hills

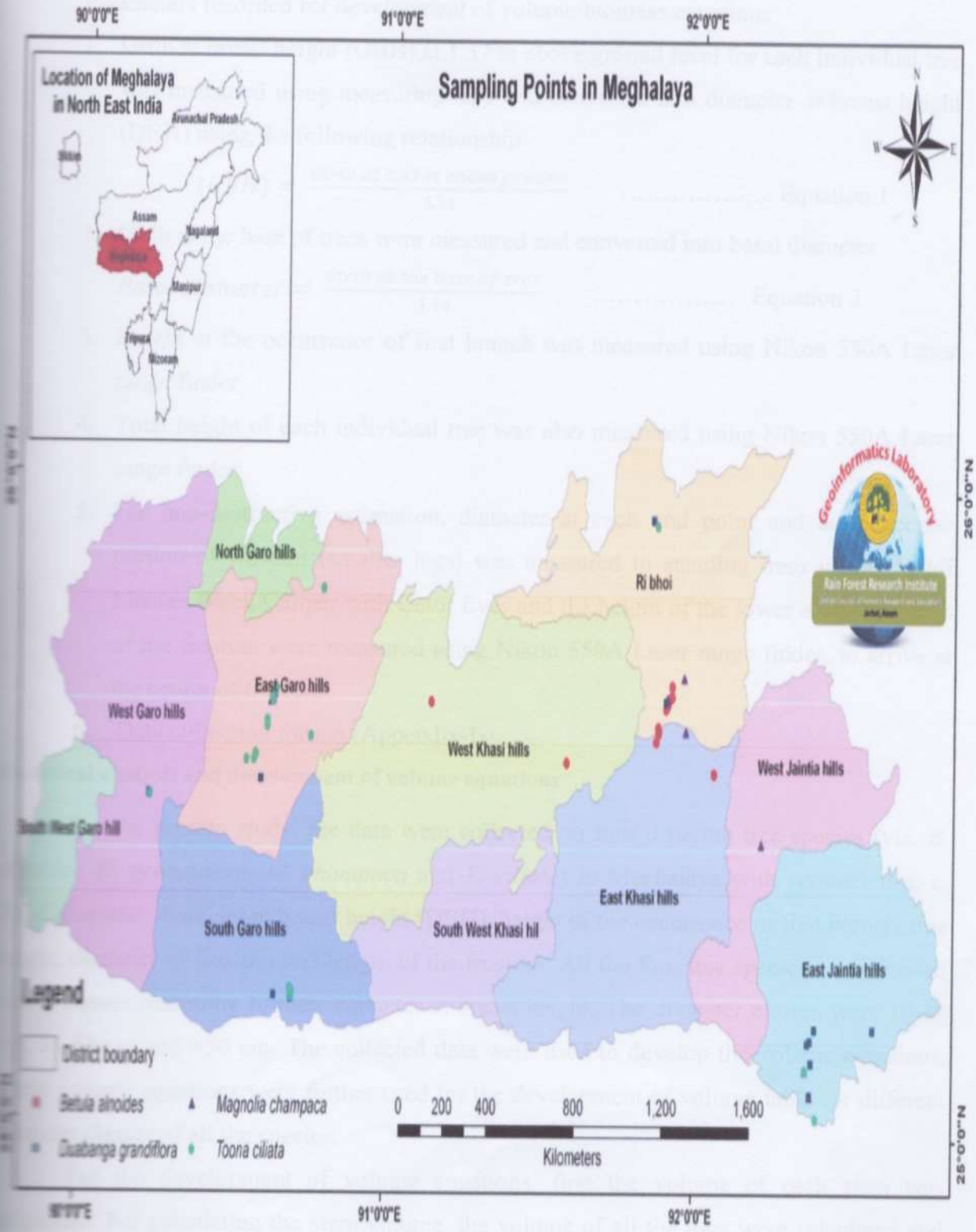


Figure 1 Species wise sampling points in Meghalaya

Tree diameter and height measurement

Parameters recorded for development of volume/biomass equations

1. Girth at breast height (GBH) at 1.37 m above ground level for each individual tree was measured using measuring tape and converted into diameter at breast height (DBH) using the following relationship

$$(DBH) = \frac{Girth\ at\ 1.37\ m\ above\ ground}{3.14} \quad \text{..... Equation 1}$$

2. Girth at the base of trees were measured and converted into basal diameter

$$Basal\ diameter = \frac{Girth\ at\ the\ base\ of\ tree}{3.14} \quad \text{..... Equation 2}$$

3. Height at the occurrence of first branch was measured using Nikon 550A Laser range finder
4. Total height of each individual tree was also measured using Nikon 550A Laser range finder
5. For non-destructive estimation, diameter at each end point and at the center portion of frustum (smaller logs) was measured in standing trees using Haglof Mantax Black Caliper with Gator Eyes and the height of the lower and upper ends of the frustum were measured using Nikon 550A Laser range finder, to arrive at the centre of frustum
6. Data collection format (Appendix-I)

Statistical analysis and development of volume equations

For the present study, the data were collected on four different tree species (viz. *B. alnoides, D. grandiflora, M. champaca* and *T. ciliata*) in Meghalaya with parameters i. e. Basal diameter, diameter at breast height (DBH), height of the occurrence of first branch, tree height, diameter of frustum and length of the frustum. All the four tree species were divided into 3 classes according to their diameter at breast height. The diameter classes were 10-30 cm, 31-50 cm and >50 cm. The collected data were used to develop the volume equations. These volume equations were further used for the development of volume table for different diameter classes of all the species.

For the development of volume equations, first the volume of each stem was calculated. For calculating the stem volume, the volume of all the logs were calculated and summed to find the stem volume. The volume of frustum of each tree (which includes diameter and length of the frustum) was calculated using Newton's Formula (Husch et al. 1982) for estimating individual stem volume, which is given as

$$V = \frac{1}{6}(A_l + 4A_m + A_u) * h$$

where, A_l is the lower end area of the frustum

A_m is the middle portion area of the frustum

A_u is the upper end area of the frustum

and h is frustum length

This volume equation may also be expressed as

$$V = \frac{\pi}{24}(d_l^2 + 4d_m^2 + d_u^2) * h$$

where, d_l is at lower end diameter of the frustum

d_m is at middle portion diameter of the frustum

d_u is at upper end diameter of the frustum

and h is the frustum length

Diameter at breast height and diameter of frustum were recorded in cm, however, length of the frustum and total tree height were measured in metre. Therefore, all the parameter were converted into metre. Hence the volume calculated was in cubic metres.

Regression analysis

Regression analysis is a quantitative method used to find out the relationship between a dependent variable and one or more independent variables. It, specifies the relation of dependent variable (Y) to a functional combination of independent variables (X) and an unknown parameters (β), which can be expressed as

$$Y = f(X, \beta)$$

Volume of the tree was taken as the dependent variable and diameter at breast height (DBH) and tree height were taken as independent variables, transformed in the form of d^2h to develop regression equation. Also, the model was of the form where the constant term was ignored as it would predict the volume of the stem in spite of the fact that the diameter and tree height are zero. Hence the constant term does not have any significance. Minimum 25 trees in each diameter class were taken for regression analysis.

Development of Volume and biomass equations based on d^2 as an independent variable

Diameter class wise stem volume and biomass equations for selected tree species were developed using linear model $[(V = f(d^2)]$. Tree volume was taken as a dependent variable and DBH as an independent variable.

For the development of regression model, SPSS V16.0 software was used. Initially a number of models of different forms were run on the data in order to select the one which

would prove to be the best fit. Comparison was made on the basis of the adjusted adj. R^2 values obtained for the different models. The adj. R^2 of linear model ($V = f(d^2h)$) was more than 0.900 for all the four tree species. However, R^2 of linear model ($V = f(d^2)$ was > 0.8500 for all the four tree species. Hence linear regression model was selected. Using this model the volume tables were prepared to estimate the volume based on two variables viz. diameter (DBH) and tree height as well as DBH alone.

Preparation of Biomass and carbon tables

Based on the volume tables prepared using diameter class wise regression models, biomass and carbon tables (kg/tree) were also prepared. Volume of each individual tree was multiplied with corresponding wood specific gravities to get the biomass. Thereafter, biomass of each individual tree was converted into carbon (kg/tree) using 0.5 multiplication factor (Ravi et al. 2011).

Results

Field survey and data collection

Field surveys were carried out in entire state for data collection of each tree species. A total of 18 locations were covered in Garo Hills, Khasi Hills, Jaintia Hills and Ri-Bhoi district of the state.

The following parameters were recorded using various equipments described in the material and methods section and data recording format given in the Annexure I.

1. Basal diameter (cm)
2. Diameter at breast height (1.37 m) above the ground surface (m)
3. Height at the occurrence of the first branch (m)
4. Total tree height (m)
5. Lower end, middle portion and upper end diameters of frustum (cm).
6. Length of frustum (m)

Development of Volume Equations

In present investigation species specific regression models were developed to estimate the stem volume and biomass of important tree species of Meghalaya. On the basis of comparison made between adj. R^2 values obtained for the different models, linear model ($V = f(d^2h)$) was more than 0.900 for all the four tree species. Hence linear regression model was selected for development of diameter class wise volume equations.

Betula alnoides

The volume equations were developed for *B. alnoides* in three diameter classes viz. 10-30 cm, 31-50 cm and >50 cm diameter classes. The volume equations for each diameter class are given below:

Table 3a Volume equation of *B. alnoides* for diameter class 10 - 30 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.365*d^2*h$	0.93	0.11	296.61 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

Table 3b Volume equation of *B. alnoides* for diameter class 31 - 50 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.289*d^2*h$	0.92	0.30	260.80 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

Table 3c Volume equation of *B. alnoides* for diameter class >50 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.255*d^2*h$	0.92	0.67	217.09 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

The corresponding volume tables of each diameter class are given in the appendix II, III & IV

Estimation of biomass

The above ground biomass of *B. alnoides* can be estimated using the following equation:

$$Biomass = Stem\ Volume\ x\ wood\ specific\ gravity$$

or

$$Biomass = Stem\ Volume\ x\ 0.573$$

Where 0.573 is wood specific gravity (g/cm^3) of *B. alnoides* (Table 11)

Duabanga grandiflora

Similarly diameter class wise volume equations were developed for *D. grandiflora*. Volume equations for each diameter classes are given in the table (4a, 4 b & 4 c).

Table 4a Volume equation of *D. grandiflora* for diameter class 10 - 30 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.320*d^2*h$	0.95	0.08	438.72 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

Table 4b Volume equation of *D. grandiflora* for diameter class 31 - 50 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.328*d^2*h$	0.91	0.41	249.89 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

Table 4c Volume equation of *D. grandiflora* for diameter class >50 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.286*d^2*h$	0.91	1.12	234.52 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

The volume tables of each diameter class are given in the appendix V, VI & VII

Estimation of biomass

The above ground biomass of *D. grandiflora* can be estimated using the following equation:

$$Biomass = Stem\ Volume\ x\ wood\ specific\ gravity$$

or

$$Biomass = Stem\ Volume\ x\ 0.382$$

Where 0.382 is wood specific gravity (g/cm^3) of *D. grandiflora* (Table 11)

Magnolia champaca

Volume equations for *M. champaca* were also developed using linear regression analysis of the data in different diameter classes. Diameter class wise equations/regression models are given in the table 5a, 5b & 5c respectively:

Table 5a Volume equation of *M. champaca* for diameter class 10 - 30 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.372*d^2*h$	0.93	0.11	491.69 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

Table 5b Volume equation of *M. champaca* for diameter class 31 - 50 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.272*d^2*h$	0.92	0.25	410.06 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

Table 5c Volume equation of *M. champaca* for diameter class >50 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.265*d^2*h$	0.98	0.37	407.46 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

The volume tables of each diameter class are given in the appendix VIII, IX & X

Estimation of biomass

The above ground biomass of *M. champaca* can be estimated using the following equation:

$$Biomass = Stem\ Volume\ x\ wood\ specific\ gravity$$

or

$$Biomass = Stem\ Volume\ x\ 0.670$$

Where 0.670 is wood specific gravity (g/cm^3) of *M. champaca* (Table 11)

Volume equations of *Toona ciliata*

These volume equations of 10-30, 31-50 and above 50 cm diameter classes were developed in order to estimate stem volume and above ground biomass of *T. ciliata* found in Meghalaya. These regression models can be used for effective and accurate timber estimation as well as carbon stock estimation in the natural forests. The diameter class wise volume equations are given in the Table (6a, 6b & 6c):

Table 6a Volume equation of *T. ciliata* for diameter class 10 - 30 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.298*d^2*h$	0.88	0.11	171.55 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

Table 6b Volume equation of *T. ciliata* for diameter class 31 - 50 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.186*d^2*h$	0.93	0.21	297.57 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

Table 6c Volume equation of *T. ciliata* for diameter class >50 cm

Model for volume	Adj. R^2	SE	F (p-value)
$V = 0.253*d^2*h$	0.94	0.82	288.29 (0.00)

(n=25, adj.R^2 is coefficient of determination, SE-standard error)

The volume tables of each diameter class are given in the appendix- XI, XII & XIII

Estimation of biomass

The above ground biomass of *T. ciliata* can be estimated using following equation:

$$Biomass = Stem\ Volume\ x\ wood\ specific\ gravity$$

or

$$Biomass = Stem\ Volume\ x\ 0.560$$

Where 0.560 is wood specific gravity (g/cm^3) of *T. ciliata* (Table 11)

Unlike the linear regression equations developed considering volume as a dependent variable and DBH as well as tree height as independent variables, linear regression equations were also developed considering volume as dependent variable and DBH as an independent variable. Diameter class wise volume and biomass equations for *B. alnoides* are given in the Table 7. These equations can be used for estimation of bole volume as well as biomass and carbon content.

Table 7 Volume and biomass equations for *Betula alnoides*

Diameter class 10-30 cm			
Model for volume	**Adj. R^2**	**SE**	**F (p-value)**
$V = 6.814*d^2$	0.92	0.12	244.07 (0.00)
Diameter class 31-50 cm			
$V = 6.272*d^2$	0.92	0.30	260.77 (0.00)

Diameter class > 50 cm			
$V = 6.086*d^2$	0.87	0.83	135.82 (0.00)
$Biomass = Stem\ Volume\ x\ wood\ specific\ gravity$			
$Biomass = Stem\ Volume\ x\ 0.573$			

(n=75, 25 trees for each diameter class, adj.R^2 is coefficient of determination, SE-standard error)

Similarly volume and biomass equations were also developed for *D. grandiflora, M. champaca* and *T. ciliata* (Table 8-10). These equations are simple and easiest linear regression models to estimate stem volume and biomass based on the measurement of DBH only.

Table 8 Volume and biomass equations for *Duabanga grandiflora*

Diameter class 10-30 cm			
Model for volume	**Adj. R^2**	**SE**	**F (p-value)**
$V = 4.926*d^2$	0.91	0.11	239.72 (0.00)
Diameter class 31-50 cm			
$V = 7.177*d^2$	0.91	0.39	266.15 (0.00)
Diameter class > 50 cm			
$V = 7.889*d^2$	0.92	1.03	285.52 (0.00)
$Biomass = Stem\ Volume\ x\ wood\ specific\ gravity$			
$Biomass = Stem\ Volume\ x\ 0.382$			

(n=75, 25 trees for each diameter class, adj.R^2 is coefficient of determination, SE-standard error)

Table 9 Volume and Biomass equations for *Magnolia champaca*

Diameter class 10-30 cm			
Model for volume	**Adj. R^2**	**SE**	**F (p-value)**
$V = 6.120*d^2$	0.92	0.11	429.85 (0.00)
Diameter class 31-50 cm			
$V = 5.727*d^2$	0.86	0.34	218.30 (0.00)
Diameter class > 50 cm			
$V = 6.535*d^2$	0.99	0.31	582.37 (0.00)
$Biomass = Tree\ Volume\ x\ wood\ specific\ gravity$			
$Biomass = Tree\ Volume\ x\ 0.670$			

(n=75, 25 trees for each diameter class, adj.R^2 is coefficient of determination, SE-standard error)

Table 10 **Volume and biomass equations for *Toona ciliata***

Diameter class 10-30 cm			
Model for volume	**Adj. R^2**	**SE**	**F (p-value)**
$V = 4.897*d^2$	0.81	0.13	105.74 (0.00)
Diameter class 31-50 cm			
$V = 4.253*d^2$	0.91	0.24	211.96 (0.00)
Diameter class > 50 cm			
$V = 6.591*d^2$	0.95	0.74	352.87 (0.00)
$Biomass = Tree\ Volume\ x\ wood\ specific\ gravity$			
$Biomass = Tree\ Volume\ x\ 0.560$			

(n=75, 25 trees for each diameter class, adj.R^2 is coefficient of determination, SE-standard error)

The specific gravity (SG) of wood is a measure of the amount of structural material a tree species allocates to support and strength. In recent years, wood specific gravity, traditionally a forester's variable, has become the domain of ecologists exploring the universality of plant functional traits and estimating global carbon stocks. The wood specific gravity data of several tree species is available in the Global Wood Density Data base. This data base was compiled by Zanne et al. (2009) based on the research work done by various researchers across the globe. The wood density/specific gravity of the selected tree species is given in the table 11, which is useful for estimation of tree biomass after determination of stem volume. Multiplication of above ground biomass with a conversion factor of 0.5 gives the actual carbon stock available in above ground pool of forest ecosystem.

Table 11 **Wood specific gravity data for all the selected tree species**

Sl. No.	**Name of the species**	**Wood Specific gravity g/cm^3**	**Reference**
1	*B. alnoides*	0.573	Cheng et al. 1992
2	*D. grandiflora*	0.382	Cheng et al. 1992
3	*M. champaca*	0.670	Benthall, A.P. 1984.
4	*T. ciliata*	0.560	Benthall, A.P. 1984.

(Source: Zanne et al. 2009).

Biomass and carbon tables

Biomass and carbon (kg/tree) was calculated using diameter class wise volume equations developed for each species. Biomass tables are given in the Appendices (XIII-XXV) and carbon tables are given in the appendices (XXVI-XXXVII).

Discussion

Estimation of stem volume and biomass is required for both planning sustainable use of forest resources and for studies on the energy and nutrients flows in ecosystems. In addition, the United Nations Framework Convention on Climate Change recognises the importance of forest carbon sink and the need to monitor, preserve and enhance terrestrial carbon stocks, since changes in the forest carbon stock influence the atmospheric CO_2 concentration. Terrestrial carbon stocks and changes are difficult to assess (IPCC, 2003) and most estimates are subject to uncertainty (Lowe et al. 2000, Clark et al. 2001, Jenkins et al. 2003). The reliability of the estimates of the forest carbon stock and the understanding of ecosystem carbon dynamics can be improved by applying existing knowledge on the allometry of trees that is available in the form of biomass and volume equations (Lehtonen et al. 2004; Zianis et al. 2005). The biomass equations can be applied directly to tree level inventory data (the measured dimensions of trees; diameter, height), or biomass expansion factors (BEFs) applicable to stand level inventory data can be developed and tested with the help of representative volume and biomass equations (Lehtonen et al. 2004).

Two methods of field measurement are available for volume and biomass estimation. The first one is destructive method of tree biomass estimation and another is non destructive one. Among all the available biomass estimation method, the destructive method, or harvest method, is the most direct method for estimation of above-ground biomass and carbon stocks stored in the forest ecosystems (Gibbs et al. 2007). This method involves harvesting of all the trees in the known area and measuring the weight of different components of the harvested tree like tree trunk, leaves and branches after oven drying. This method of biomass estimation is limited to a small area or small tree sample sizes. Although this method determines the biomass accurately for a particular area, it is time and resource consuming, strenuous, destructive and expensive, and it is not feasible for a large scale analysis. This method is also not applicable for degraded forests containing threatened species (Montes et al. 2000). Usually, this method is used for developing biomass equation to be applied for assessing biomass on a larger-scale. Rai and Proctor (1986) carried out a study in the Western Ghats to estimate the above-ground tree biomass using harvest method and derived a regression equation relating the biomass fraction with the log transformations of diameter at breast height. The study found that the total bole and branch biomass was always within 95% confidence limit of the total, above-ground biomass estimates. Baisya and Barik (2011) developed allometric equations for *Pinus kesiya* in Meghalaya using harvest method and

found the regression models of the form $Log(Y)=a + b \log D+c (\log D)^2+d (\log D)^3$ as best fits for biomass estimation of total tree and its various components. The total forest biomass which includes live and dead compartments of trees, shrubs and herbs was 460.5 Mg/ha of which 91.2% was in the aboveground and 8.8% in the belowground compartment. *P. kesiya* contributed 77%, broad-leaved tree species 13.5%, shrubs 0.12%, herbs 0.03% and litter 0.5% to the total forest biomass in Meghalaya.

The second method of tree biomass estimation is the non-destructive one without cutting of trees. The non-destructive method of biomass estimation is applicable for those ecosystems with rare or protected tree species where harvesting of such species is not very practical or feasible (Vasum and Jayakumar, 2012). Volume equations developed without felling of trees or using non destructive measurement of standing trees require wood specific gravity to transform stem volume into biomass and carbon stock. Generally volume equations are developed using DBH and tree height as independent variables. The regression models using DBH and tree height can estimate the volume of the stem. This stem volume can be converted into biomass using wood specific gravity of the particular tree species. In the present investigation attempt was made to develop species specific volume equations for *B. alnoides, D. grandiflora, M. champaca and T. ciliata* found in Meghalaya. A complete non destructive approach was used for data collection in standing trees using various scientific equipments. The experimental results revealed that tree stem volume have strong linear relationship with DBH and height ($R^2 > 0.900$). Sharma and Jain (1977) made the first attempt to prepare regional volume tables for *D. grandiflora* in Manipur, North East India without felling the trees. A linear regression model $V= a + b D^2H$ was developed with correlation coefficient (R= 0.993). The regression equation obtained from the data was V= 0.000671 + 0.319025 D^2H. Based on this regression model a regional volume table of *D. grandiflora* was prepared for Manipur state. Since 1977, the present study is the second attempt to develop regression models for important timber species of Meghalaya without felling of trees. The stem volume values for *D. grandiflora* were compared with the volume table prepared by Sharma and Jain (1977) and it was found that they had almost similar values. Montes et al. (2000) had developed a non- destructive method for the above-ground biomass estimation of *Juniperus thurifera* in Morocco. In this study the biomass of the individual tree was estimated by taking into account the tree shape (by taking two photographs of the tree at orthogonal angles), physical samples of different components of the trees like branches and leaves and dendrometric measurements, volume and bulk density of the different components. Although it is a non-destructive method, to validate the

estimated biomass, the trees had to be harvested and weighed. Another way of estimating the above-ground forest biomass by non-destructive method is by climbing the tree to measure the various parts (Aboal et al. 2005) or by simply measuring the diameter at breast height, height of the tree, volume of the tree and wood density (Ravindranath and Ostwald, 2008) and calculate the biomass using allometric equations.

Previously local volume equation for *B. alnoides* in Arunachal Pradesh and *M. champaca* in Arunachal Pradesh and Assam have been developed by FSI (1996) for Arunachal Pradesh, which can be used to estimate volume, biomass and carbon stock of this tree found in Arunachal Pradesh. Similarly, regional volume equations for D. grandiflora and M. champaca have been developed for Eastern Himalayas (FSI, 2013).

Local volume equations for *T. ciliata* were also developed for Lohit & Tirap, Arunachal Pradesh, Assam and Tripura (FSI, 1996). None of the volume equation for these selected tree species was developed earlier for Meghalaya. The regression equation developed in present study will be very much useful in estimation of tree volume, biomass and carbon content in context to Meghalaya forests. Present study utilized Mantax Black Calliper with Gator Eyes for measurement of frustum diameter from a distance and Nikon Rangefinder to measure the length of frustum well as total tree height. Applications of such kind of equipments/approaches avoid physical measurements in standing trees by climbing which is a troublesome, time taking and labour intensive method for non destructive measurement of tree volume and biomass.

Utility of Yield Tables

Diameter, height and wood specific gravity of a tree are the important variables to determine the yield in terms of volume, biomass and carbon stock. These tables can be used effectively for calculation of tree volume, biomass and carbon content of standing trees without felling. These tables shows yield and carbon values of particular diameter and height classes (having diameter class interval of 1 cm and height class interval of 1 m). Ravi et al. (2011) also conducted a study for preparation of regional yield tables and carbon tables for plantations of *Casuarina equisetifolia* in Tamil Nadu, India and suggested that regional yield tables and best fit regression models can be useful to researchers and plantation managers as well as for developing projects under Clean Development Mechanism (CDM).

Conclusion

Development of species-specific volume equations/regression models is essential to achieve higher levels of accuracy in above ground biomass and carbon stock estimation of a forest ecosystem. Apart from biomass and carbon stock accounting, estimation of net merchantable timber of a forest area is essential for extraction of timber from it. These kinds of operations require species specific volume equations or allometric models for precise estimation. Development of volume equations as well as biomass equations requires felling of sufficient number of trees in different diameter classes, which are time consuming and expensive than non destructive methods. In the present work an attempt was made to develop regression models for the selected tree species of Meghalaya using modern scientific equipments. Application of such equipments for measurement of required variables is a rapid and less time consuming process which avoids felling of trees and minimizes the cost of the process also. Therefore, the study concludes that species specific local/regional volume equations can be developed within short time span without destruction at minimal expenditure. Similar studies can be carried out in other parts of the North East India for development of species specific volume equations for ecologically and economically important tree species in order to achieve accuracy in volume and biomass estimation as well as carbon stock estimation and green house gas inventory data preparation for the country.

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Photographs of Field Survey and Data Collection



Betula alnoides



Duabanga grandiflora



Michelia champaca



Toona ciliata



DBH Measurement, Baghmara South Garo Hills



DBH Measurement using Hagloff Mantax Black Caliper with Gator Eyes

Appendix-I

Data Recording Format for Development of Model for Estimation of Volume of Standing Trees in Meghalaya

DATA SHEET NO: ___

General Information

Date of Survey		**Forest Division**		**GPS Data**	
District		**Forest Range**		**Latitude (N)**	
Place		**Forest Beat**		**Longitude (E)**	
Forest Type		**Compartment**		**Altitude (m)**	

Tree Parameters:

Name of the tree Species

[ ] *Betula alnoides* [ ] *Duabanga grandiflora* [ ] *Magnolia champaca* [ ] *Toona ciliata*

[1] S No.	[2] Basal diameter (cm)	[3] DBH (cm)	[4] Height of the occurrence of the first branch (m)	[5] Tree height (m)	Frustum Details	Frustum Details	[6] Frustum Diameter (cm)	[7] Frustum Length (m)
					1st Frustum	Lower End Diameter		
						Middle portion Diameter		
						Upper End Diameter		
					2nd Frustum	Lower End Diameter		
						Middle portion Diameter		
						Upper End Diameter		
					3rd Frustum	Lower End Diameter		
						Middle portion Diameter		
						Upper End Diameter		
					4th Frustum	Lower End Diameter		
						Middle portion Diameter		
						Upper End Diameter		

Appendix II: Volume table for *Betula alnoides* (10-30 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)														
	11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
10	0.040	0.044	0.047	0.051	0.055	0.058	0.062	0.066	0.069	0.073	0.077	0.080	0.084	0.088	0.091
11	0.049	0.053	0.057	0.062	0.066	0.071	0.075	0.079	0.084	0.088	0.093	0.097	0.102	0.106	0.110
12	0.058	0.063	0.068	0.074	0.079	0.084	0.089	0.095	0.100	0.105	0.110	0.116	0.121	0.126	0.131
13	0.068	0.074	0.080	0.086	0.093	0.099	0.105	0.111	0.117	0.123	0.130	0.136	0.142	0.148	0.154
14	0.079	0.086	0.093	0.100	0.107	0.114	0.122	0.129	0.136	0.143	0.150	0.157	0.165	0.172	0.179
15	0.090	0.099	0.107	0.115	0.123	0.131	0.140	0.148	0.156	0.164	0.172	0.181	0.189	0.197	0.205
16	0.103	0.112	0.121	0.131	0.140	0.150	0.159	0.168	0.178	0.187	0.196	0.206	0.215	0.224	0.234
17	**0.116**	**0.127**	**0.137**	**0.148**	**0.158**	**0.169**	**0.179**	**0.190**	**0.200**	**0.211**	**0.222**	0.232	0.243	0.253	0.264
18	0.130	0.142	**0.154**	**0.166**	**0.177**	**0.189**	**0.201**	**0.213**	**0.225**	**0.237**	**0.248**	0.260	0.272	0.284	0.296
19	0.145	0.158	0.171	**0.184**	**0.198**	**0.211**	**0.224**	**0.237**	**0.250**	**0.264**	**0.277**	0.290	0.303	0.316	0.329
20	0.161	0.175	0.190	0.204	**0.219**	**0.234**	**0.248**	**0.263**	**0.277**	**0.292**	**0.307**	0.321	0.336	0.350	0.365
21	0.177	0.193	0.209	0.225	0.241	**0.258**	**0.274**	**0.290**	**0.306**	**0.322**	**0.338**	**0.354**	0.370	0.386	0.402
22	0.194	0.212	0.230	0.247	0.265	**0.283**	**0.300**	**0.318**	**0.336**	**0.353**	**0.371**	**0.389**	**0.406**	**0.424**	0.442
23	0.212	0.232	0.251	0.270	0.290	**0.309**	**0.328**	**0.348**	**0.367**	**0.386**	**0.405**	**0.425**	**0.444**	**0.463**	0.483
24	0.231	0.252	0.273	0.294	0.315	**0.336**	**0.357**	**0.378**	**0.399**	**0.420**	**0.442**	**0.463**	**0.484**	**0.505**	0.526
25	0.251	0.274	0.297	0.319	0.342	**0.365**	**0.388**	**0.411**	**0.433**	**0.456**	**0.479**	**0.502**	**0.525**	**0.548**	0.570
26	0.271	0.296	0.321	0.345	0.370	**0.395**	**0.419**	**0.444**	**0.469**	**0.493**	**0.518**	**0.543**	**0.568**	**0.592**	0.617
27	0.293	0.319	0.346	0.373	0.399	0.426	0.452	0.479	**0.506**	**0.532**	**0.559**	**0.585**	**0.612**	**0.639**	0.665
28	0.315	0.343	0.372	0.401	0.429	0.458	0.486	0.515	**0.544**	**0.572**	**0.601**	**0.630**	**0.658**	**0.687**	0.715
29	0.338	0.368	0.399	0.430	0.460	0.491	0.522	0.553	0.583	0.614	**0.645**	**0.675**	**0.706**	**0.737**	0.767
30	0.361	0.394	0.427	0.460	0.493	0.526	0.558	0.591	0.624	0.657	0.690	0.723	0.756	0.788	0.821

(The values which are bold are within the range of observed data)

Appendix III: Volume table for *Betula alnoides* (31-50 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	0.417	0.444	**0.472**	**0.500**	**0.528**	**0.555**	**0.583**	0.611	0.639	0.667	0.694	0.722	0.750	0.778	0.805	0.833
32	0.444	0.473	**0.503**	**0.533**	**0.562**	**0.592**	**0.621**	0.651	0.681	0.710	0.740	0.769	0.799	0.829	0.858	0.888
33	0.472	0.504	**0.535**	**0.566**	**0.598**	**0.629**	**0.661**	**0.692**	**0.724**	0.755	0.787	0.818	0.850	0.881	0.913	0.944
34	0.501	0.535	**0.568**	**0.601**	**0.635**	**0.668**	**0.702**	**0.735**	**0.768**	0.802	0.835	0.869	0.902	0.935	0.969	1.002
35	0.531	**0.566**	**0.602**	**0.637**	**0.673**	**0.708**	**0.743**	**0.779**	**0.814**	**0.850**	**0.885**	0.920	0.956	0.991	1.027	1.062
36	0.562	**0.599**	**0.637**	**0.674**	**0.712**	**0.749**	**0.787**	**0.824**	**0.861**	**0.899**	**0.936**	0.974	1.011	1.049	1.086	1.124
37	0.593	**0.633**	**0.673**	**0.712**	**0.752**	**0.791**	**0.831**	**0.870**	**0.910**	**0.950**	**0.989**	1.029	1.068	1.108	1.147	1.187
38	0.626	**0.668**	**0.709**	**0.751**	**0.793**	**0.835**	**0.876**	**0.918**	**0.960**	**1.002**	**1.043**	1.085	1.127	1.168	1.210	1.252
39	0.659	**0.703**	**0.747**	**0.791**	**0.835**	**0.879**	**0.923**	**0.967**	**1.011**	**1.055**	**1.099**	1.143	1.187	1.231	1.275	1.319
40	0.694	**0.740**	**0.786**	**0.832**	**0.879**	**0.925**	**0.971**	**1.017**	**1.064**	**1.110**	**1.156**	1.202	1.248	1.295	1.341	1.387
41	0.729	**0.777**	**0.826**	**0.874**	**0.923**	**0.972**	**1.020**	**1.069**	**1.117**	**1.166**	**1.215**	1.263	1.312	1.360	1.409	1.457
42	0.765	**0.816**	**0.867**	**0.918**	**0.969**	**1.020**	**1.071**	**1.122**	**1.173**	**1.224**	**1.274**	1.325	1.376	1.427	1.478	1.529
43	0.802	0.855	0.908	0.962	1.015	**1.069**	**1.122**	**1.176**	**1.229**	**1.282**	**1.336**	1.389	1.443	1.496	1.550	1.603
44	0.839	0.895	0.951	1.007	1.063	**1.119**	**1.175**	**1.231**	**1.287**	**1.343**	**1.399**	**1.455**	**1.511**	1.567	1.623	1.679
45	0.878	0.936	0.995	1.053	1.112	**1.170**	**1.229**	**1.287**	**1.346**	**1.405**	**1.463**	**1.522**	**1.580**	1.639	1.697	1.756
46	0.917	0.978	1.040	1.101	1.162	**1.223**	**1.284**	**1.345**	1.407	1.468	1.529	1.590	1.651	1.712	1.773	1.835
47	0.958	1.021	1.085	1.149	1.213	**1.277**	**1.341**	**1.404**	1.468	1.532	1.596	1.660	1.724	1.788	1.851	1.915
48	0.999	1.065	1.132	1.199	1.265	**1.332**	**1.398**	**1.465**	1.531	1.598	1.665	1.731	1.798	1.864	1.931	1.998
49	1.041	1.110	1.180	1.249	1.318	1.388	1.457	1.527	1.596	1.665	1.735	1.804	1.874	1.943	2.012	2.082
50	1.084	1.156	1.228	1.301	1.373	1.445	1.517	1.590	1.662	1.734	1.806	1.879	1.951	2.023	2.095	2.168

(The values which are bold are within the range of observed data)

Appendix IV: Volume table for *Betula alnoides* (>50 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	0.995	1.061	1.128	1.194	**1.260**	**1.327**	**1.393**	**1.459**	1.525	1.592	1.658	1.724	1.791	1.857	1.923	1.990	2.056	2.122	2.189	2.255	2.321
52	1.034	1.103	1.172	1.241	**1.310**	**1.379**	**1.448**	**1.517**	**1.586**	1.655	1.724	1.793	1.862	1.931	2.000	2.069	2.138	2.206	2.275	2.344	2.413
53	1.074	1.146	1.218	**1.289**	**1.361**	**1.433**	**1.504**	**1.576**	**1.647**	1.719	1.791	1.862	1.934	2.006	2.077	2.149	2.221	2.292	2.364	2.435	2.507
54	1.115	1.190	1.264	**1.338**	**1.413**	**1.487**	**1.562**	**1.636**	**1.710**	**1.785**	**1.859**	**1.933**	**2.008**	**2.082**	**2.156**	**2.231**	2.305	2.379	2.454	2.528	2.603
55	1.157	1.234	1.311	**1.388**	**1.466**	**1.543**	**1.620**	**1.697**	**1.774**	**1.851**	**1.928**	**2.006**	**2.083**	**2.160**	**2.237**	**2.314**	2.391	2.468	2.546	2.623	2.700
56	1.200	1.279	1.359	**1.439**	**1.519**	**1.599**	**1.679**	**1.759**	**1.839**	**1.919**	**1.999**	**2.079**	**2.159**	2.239	**2.319**	2.399	2.479	2.559	2.639	2.719	2.799
57	1.243	1.326	1.408	**1.491**	**1.574**	**1.657**	**1.740**	**1.823**	**1.906**	**1.988**	**2.071**	**2.154**	**2.237**	2.320	**2.403**	2.485	2.568	2.651	2.734	2.817	2.900
58	1.287	1.373	**1.458**	**1.544**	**1.630**	**1.716**	**1.801**	**1.887**	**1.973**	**2.059**	**2.145**	**2.230**	**2.316**	**2.402**	**2.488**	2.573	2.659	2.745	2.831	2.917	3.002
59	1.331	1.420	1.509	1.598	**1.687**	**1.775**	**1.864**	**1.953**	**2.042**	**2.130**	**2.219**	**2.308**	**2.397**	**2.485**	**2.574**	2.663	2.752	2.840	2.929	3.018	3.107
60	1.377	1.469	1.561	1.652	**1.744**	**1.836**	**1.928**	**2.020**	**2.111**	**2.203**	**2.295**	**2.387**	**2.479**	**2.570**	**2.662**	2.754	2.846	2.938	3.029	3.121	3.213
61	1.423	1.518	1.613	1.708	**1.803**	**1.898**	**1.993**	**2.087**	**2.182**	**2.277**	**2.372**	**2.467**	**2.562**	**2.657**	**2.752**	2.847	2.941	3.036	3.131	3.226	3.321
62	1.470	1.568	1.666	1.764	**1.862**	**1.960**	**2.058**	**2.156**	**2.255**	**2.353**	**2.451**	**2.549**	**2.647**	**2.745**	**2.843**	2.941	3.039	3.137	3.235	3.333	3.431
63	1.518	1.619	1.721	1.822	**1.923**	**2.024**	**2.125**	**2.227**	**2.328**	**2.429**	**2.530**	**2.631**	**2.733**	**2.834**	**2.935**	3.036	3.137	3.239	3.340	3.441	3.542
64	1.567	1.671	1.776	1.880	1.985	2.089	2.193	2.298	2.402	2.507	**2.611**	**2.716**	**2.820**	**2.925**	**3.029**	3.133	3.238	3.342	3.447	3.551	3.656
65	1.616	1.724	1.832	1.939	2.047	2.155	2.262	2.370	2.478	2.586	**2.693**	**2.801**	**2.909**	**3.017**	**3.124**	3.232	3.340	3.448	3.555	3.663	3.771
66	1.666	1.777	1.888	1.999	2.110	2.222	2.333	2.444	2.555	2.666	**2.777**	**2.888**	**2.999**	**3.110**	**3.221**	3.332	3.443	3.554	3.666	3.777	3.888
67	1.717	1.832	1.946	2.060	2.175	2.289	2.404	2.518	2.633	2.747	**2.862**	**2.976**	**3.091**	**3.205**	**3.320**	3.434	3.549	3.663	3.777	3.892	4.006
68	1.769	1.887	2.005	2.122	2.240	2.358	2.476	2.594	2.712	2.830	**2.948**	**3.066**	**3.184**	**3.302**	**3.419**	3.537	3.655	3.773	3.891	4.009	4.127
69	1.821	1.942	2.064	2.185	2.307	2.428	2.550	2.671	2.792	2.914	**3.035**	**3.157**	3.278	3.399	3.521	3.642	3.764	3.885	4.006	4.128	4.249
70	1.874	1.999	2.124	2.249	2.374	2.499	2.624	2.749	2.874	2.999	**3.124**	**3.249**	3.374	3.499	3.624	3.749	3.873	3.998	4.123	4.248	4.373

(The values which are bold are within the range of observed data)

Appendix V: Volume table for *Duabanga grandiflora* (10-30 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)														
	11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
10	0.035	0.038	0.042	0.045	0.048	0.051	0.054	0.058	0.061	0.064	0.067	0.070	0.074	0.077	0.080
11	0.043	0.046	0.050	0.054	0.058	0.062	0.066	0.070	0.074	0.077	0.081	0.085	0.089	0.093	0.097
12	0.051	0.055	0.060	0.065	0.069	0.074	0.078	0.083	0.088	0.092	0.097	0.101	0.106	0.111	0.115
13	0.059	0.065	0.070	0.076	0.081	0.087	0.092	0.097	0.103	0.108	0.114	0.119	0.124	0.130	0.135
14	0.069	0.075	0.082	0.088	0.094	0.100	0.107	0.113	0.119	0.125	0.132	0.138	0.144	0.151	0.157
15	0.079	0.086	0.094	0.101	0.108	0.115	0.122	0.130	0.137	0.144	0.151	0.158	0.166	0.173	0.180
16	0.090	0.098	0.106	0.115	0.123	0.131	0.139	0.147	0.156	0.164	0.172	0.180	0.188	0.197	0.205
17	0.102	0.111	0.120	0.129	0.139	0.148	0.157	0.166	0.176	0.185	0.194	0.203	0.213	0.222	0.231
18	0.114	0.124	0.135	0.145	0.156	0.166	0.176	0.187	0.197	0.207	0.218	0.228	0.238	0.249	0.259
19	0.127	0.139	**0.150**	0.162	0.173	0.185	0.196	0.208	0.219	0.231	0.243	0.254	0.266	0.277	0.289
20	0.141	0.154	**0.166**	0.179	0.192	0.205	0.218	0.230	0.243	0.256	0.269	0.282	0.294	0.307	0.320
21	0.155	0.169	**0.183**	0.198	0.212	0.226	0.240	0.254	0.268	0.282	0.296	0.310	0.325	0.339	0.353
22	0.170	0.186	**0.201**	0.217	0.232	0.248	0.263	0.279	0.294	0.310	0.325	0.341	0.356	0.372	0.387
23	0.186	0.203	**0.220**	**0.237**	**0.254**	**0.271**	0.288	0.305	0.322	0.339	0.355	0.372	0.389	0.406	0.423
24	0.203	0.221	0.240	0.258	0.276	0.295	0.313	0.332	0.350	0.369	0.387	0.406	0.424	0.442	0.461
25	0.220	0.240	0.260	0.280	**0.300**	**0.320**	**0.340**	**0.360**	**0.380**	**0.400**	0.420	0.440	0.460	0.480	0.500
26	0.238	**0.260**	**0.281**	**0.303**	**0.324**	**0.346**	**0.368**	**0.389**	**0.411**	**0.433**	0.454	0.476	0.498	0.519	0.541
27	0.257	**0.280**	**0.303**	**0.327**	**0.350**	**0.373**	**0.397**	**0.420**	**0.443**	**0.467**	0.490	0.513	0.537	0.560	0.583
28	0.276	**0.301**	**0.326**	**0.351**	**0.376**	**0.401**	**0.426**	**0.452**	**0.477**	**0.502**	0.527	0.552	0.577	0.602	0.627
29	0.296	0.323	0.350	**0.377**	**0.404**	**0.431**	**0.458**	**0.484**	**0.511**	**0.538**	0.565	0.592	0.619	0.646	0.673
30	0.317	0.346	0.374	**0.403**	**0.432**	**0.461**	**0.490**	**0.518**	**0.547**	**0.576**	0.605	0.634	0.662	0.691	0.720

(The values which are bold are within the range of observed data)

Appendix VI: Volume table for *Duabanga grandiflora* (31-50 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	**0.473**	**0.504**	0.536	0.567	0.599	0.630	0.662	0.693	0.725	0.756	0.788	0.820	0.851	0.883	0.914	0.946
32	0.504	**0.537**	**0.571**	**0.605**	**0.638**	0.672	0.705	0.739	0.773	0.806	0.840	0.873	0.907	0.940	0.974	1.008
33	0.536	**0.572**	**0.607**	**0.643**	**0.679**	0.714	0.750	0.786	0.822	0.857	0.893	0.929	0.964	1.000	1.036	1.072
34	0.569	**0.607**	**0.645**	**0.683**	**0.720**	**0.758**	0.796	0.834	0.872	0.910	0.948	0.986	1.024	1.062	1.100	1.138
35	0.603	**0.643**	**0.683**	**0.723**	**0.763**	**0.804**	0.844	0.884	0.924	0.964	1.005	1.045	1.085	1.125	1.165	1.205
36	0.638	0.680	**0.723**	**0.765**	**0.808**	**0.850**	0.893	0.935	0.978	1.020	1.063	1.105	1.148	1.190	1.233	1.275
37	0.674	0.718	**0.763**	**0.808**	**0.853**	**0.898**	0.943	0.988	1.033	1.078	1.123	1.167	1.212	1.257	1.302	1.347
38	0.710	0.758	**0.805**	**0.853**	**0.900**	**0.947**	0.995	**1.042**	**1.089**	**1.137**	1.184	1.231	1.279	1.326	1.374	1.421
39	0.748	0.798	**0.848**	**0.898**	**0.948**	**0.998**	**1.048**	**1.098**	**1.147**	**1.197**	1.247	1.297	1.347	1.397	1.447	1.497
40	0.787	0.840	**0.892**	**0.945**	**0.997**	**1.050**	**1.102**	**1.155**	**1.207**	**1.260**	1.312	1.364	1.417	1.469	1.522	1.574
41	0.827	0.882	**0.937**	**0.992**	**1.048**	**1.103**	**1.158**	**1.213**	**1.268**	**1.323**	1.378	1.434	1.489	1.544	1.599	1.654
42	0.868	0.926	**0.984**	**1.041**	**1.099**	**1.157**	**1.215**	**1.273**	**1.331**	**1.389**	1.446	1.504	1.562	1.620	1.678	1.736
43	0.910	0.970	1.031	**1.092**	**1.152**	**1.213**	**1.274**	**1.334**	**1.395**	**1.456**	1.516	1.577	1.637	1.698	1.759	1.819
44	0.953	1.016	1.080	**1.143**	**1.207**	**1.270**	**1.334**	**1.397**	**1.461**	**1.524**	1.588	1.651	1.715	1.778	1.842	1.905
45	0.996	1.063	1.129	**1.196**	**1.262**	**1.328**	**1.395**	**1.461**	**1.528**	**1.594**	1.661	1.727	1.793	1.860	1.926	1.993
46	1.041	1.110	1.180	**1.249**	**1.319**	**1.388**	**1.458**	**1.527**	**1.596**	**1.666**	1.735	1.805	1.874	1.943	2.013	2.082
47	1.087	1.159	1.232	**1.304**	**1.377**	**1.449**	**1.522**	**1.594**	**1.666**	**1.739**	**1.811**	**1.884**	**1.956**	2.029	2.101	2.174
48	1.134	1.209	1.285	**1.360**	**1.436**	**1.511**	**1.587**	**1.663**	**1.738**	**1.814**	**1.889**	**1.965**	**2.040**	2.116	2.192	2.267
49	1.181	1.260	1.339	**1.418**	**1.496**	**1.575**	**1.654**	**1.733**	**1.811**	**1.890**	**1.969**	**2.048**	**2.126**	2.205	2.284	2.363
50	1.230	1.312	1.394	**1.476**	**1.558**	**1.640**	**1.722**	**1.804**	**1.886**	**1.968**	**2.050**	**2.132**	**2.214**	2.296	2.378	2.460

(The values which are bold are within the range of observed data)

Appendix VII: Volume table for *Duabanga grandiflora* (>50 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	1.116	1.190	1.265	1.339	1.413	1.488	1.562	**1.637**	**1.711**	**1.785**	**1.860**	**1.934**	**2.008**	**2.083**	**2.157**	**2.232**	2.306	2.380	2.455	2.529	2.604
52	1.160	1.237	1.315	1.392	1.469	1.547	1.624	**1.701**	**1.779**	**1.856**	**1.933**	**2.011**	**2.088**	**2.165**	**2.243**	**2.320**	2.397	2.475	2.552	2.629	2.707
53	1.205	1.285	1.366	**1.446**	**1.526**	**1.607**	**1.687**	**1.767**	**1.848**	**1.928**	**2.008**	**2.089**	**2.169**	**2.249**	**2.330**	**2.410**	2.490	2.571	2.651	2.731	2.812
54	1.251	1.334	1.418	**1.501**	**1.585**	**1.668**	**1.751**	**1.835**	**1.918**	**2.002**	**2.085**	**2.168**	**2.252**	**2.335**	**2.419**	**2.502**	2.585	2.669	2.752	2.836	2.919
55	1.298	1.384	1.471	**1.557**	**1.644**	**1.730**	**1.817**	**1.903**	**1.990**	**2.076**	**2.163**	**2.249**	**2.336**	**2.422**	**2.509**	**2.595**	2.682	2.768	2.855	2.942	3.028
56	1.345	1.435	1.525	**1.614**	**1.704**	**1.794**	**1.883**	**1.973**	**2.063**	**2.153**	**2.242**	**2.332**	**2.422**	**2.511**	**2.601**	**2.691**	2.780	2.870	2.960	3.049	3.139
57	1.394	1.487	1.580	**1.673**	**1.766**	**1.858**	**1.951**	**2.044**	**2.137**	**2.230**	**2.323**	**2.416**	**2.509**	**2.602**	**2.695**	**2.788**	2.881	2.973	3.066	3.159	3.252
58	1.443	1.539	1.636	**1.732**	**1.828**	**1.924**	**2.020**	**2.117**	**2.213**	**2.309**	**2.405**	**2.501**	**2.598**	**2.694**	**2.790**	**2.886**	2.983	3.079	3.175	3.271	3.367
59	1.493	1.593	1.692	**1.792**	**1.892**	**1.991**	**2.091**	**2.190**	**2.290**	**2.389**	**2.489**	**2.588**	**2.688**	**2.788**	**2.887**	**2.987**	3.086	3.186	3.285	3.385	3.484
60	1.544	1.647	1.750	**1.853**	**1.956**	**2.059**	**2.162**	**2.265**	**2.368**	**2.471**	**2.574**	**2.677**	**2.780**	**2.883**	**2.986**	**3.089**	3.192	3.295	3.398	3.501	3.604
61	1.596	1.703	1.809	**1.916**	**2.022**	**2.128**	**2.235**	**2.341**	**2.448**	**2.554**	**2.661**	**2.767**	**2.873**	**2.980**	**3.086**	**3.193**	3.299	3.405	3.512	3.618	3.725
62	1.649	1.759	1.869	**1.979**	**2.089**	**2.199**	**2.309**	**2.419**	**2.529**	**2.639**	**2.748**	**2.858**	**2.968**	**3.078**	**3.188**	**3.298**	3.408	3.518	3.628	3.738	3.848
63	1.703	1.816	1.930	**2.043**	**2.157**	**2.270**	**2.384**	**2.497**	**2.611**	**2.724**	**2.838**	**2.951**	**3.065**	**3.178**	**3.292**	**3.405**	3.519	3.632	3.746	3.859	3.973
64	1.757	1.874	1.991	**2.109**	**2.226**	**2.343**	**2.460**	**2.577**	**2.694**	**2.811**	**2.929**	**3.046**	**3.163**	**3.280**	**3.397**	**3.514**	3.632	3.749	3.866	3.983	4.100
65	1.813	1.933	2.054	**2.175**	**2.296**	**2.417**	**2.538**	**2.658**	**2.779**	**2.900**	**3.021**	**3.142**	**3.263**	**3.383**	**3.504**	**3.625**	3.746	3.867	3.988	4.108	4.229
66	1.869	1.993	2.118	**2.242**	**2.367**	**2.492**	**2.616**	**2.741**	**2.865**	**2.990**	**3.115**	**3.239**	**3.364**	**3.488**	**3.613**	**3.737**	3.862	3.987	4.111	4.236	4.360
67	1.926	2.054	2.183	**2.311**	**2.439**	**2.568**	**2.696**	**2.824**	**2.953**	**3.081**	**3.210**	**3.338**	**3.466**	**3.595**	**3.723**	**3.852**	3.980	4.108	4.237	4.365	4.493
68	1.984	2.116	2.248	**2.380**	**2.513**	**2.645**	**2.777**	**2.909**	**3.042**	**3.174**	**3.306**	**3.438**	**3.571**	**3.703**	**3.835**	**3.967**	4.100	4.232	4.364	4.496	4.629
69	2.042	2.179	2.315	**2.451**	**2.587**	**2.723**	**2.859**	**2.996**	**3.132**	**3.268**	**3.404**	**3.540**	**3.676**	**3.813**	**3.949**	**4.085**	4.221	4.357	4.493	4.630	4.766
70	2.102	2.242	2.382	**2.523**	**2.663**	**2.803**	**2.943**	**3.083**	**3.223**	**3.363**	**3.504**	**3.644**	**3.784**	**3.924**	**4.064**	**4.204**	4.344	4.484	4.625	4.765	4.905

(The values which are bold are within the range of observed data)

Appendix VIII: Volume table for *Magnolia champaca* (10-30 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)														
	11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
10	0.036	0.039	0.043	0.046	0.049	0.052	0.056	0.059	0.062	0.065	0.069	0.072	0.075	0.078	0.082
11	0.044	0.047	0.051	0.055	0.059	0.063	0.067	0.071	0.075	0.079	0.083	0.087	0.091	0.095	0.099
12	0.052	0.057	0.061	0.066	0.071	0.075	0.080	0.085	0.089	0.094	0.099	0.104	0.108	0.113	0.118
13	0.061	0.066	0.072	0.077	0.083	0.088	0.094	0.099	0.105	0.111	0.116	0.122	0.127	0.133	0.138
14	0.071	0.077	0.083	0.090	0.096	0.103	0.109	0.115	0.122	0.128	0.135	0.141	0.147	0.154	0.160
15	0.081	**0.088**	0.096	0.103	0.110	0.118	0.125	0.132	0.140	0.147	0.155	0.162	0.169	0.177	0.184
16	**0.092**	**0.100**	0.109	0.117	0.126	0.134	0.142	0.151	0.159	0.167	0.176	0.184	0.193	0.201	0.209
17	**0.104**	**0.113**	0.123	0.132	0.142	0.151	0.161	0.170	0.180	0.189	0.198	0.208	0.217	0.227	0.236
18	**0.117**	**0.127**	0.138	0.148	0.159	0.170	0.180	0.191	0.201	0.212	0.222	0.233	0.244	0.254	0.265
19	0.130	**0.142**	**0.153**	**0.165**	0.177	0.189	0.201	0.212	0.224	0.236	0.248	0.260	0.272	0.283	0.295
20	0.144	**0.157**	**0.170**	**0.183**	**0.196**	**0.209**	**0.222**	**0.235**	**0.249**	**0.262**	**0.275**	0.288	0.301	0.314	0.327
21	0.159	**0.173**	**0.187**	**0.202**	**0.216**	**0.231**	**0.245**	**0.260**	**0.274**	**0.288**	**0.303**	0.317	0.332	0.346	0.361
22	0.174	**0.190**	**0.206**	**0.222**	**0.237**	**0.253**	**0.269**	**0.285**	**0.301**	**0.317**	**0.332**	0.348	0.364	0.380	0.396
23	0.190	**0.208**	**0.225**	**0.242**	**0.259**	**0.277**	**0.294**	**0.311**	**0.329**	**0.346**	**0.363**	0.381	0.398	0.415	0.432
24	0.207	**0.226**	**0.245**	**0.264**	**0.283**	**0.301**	**0.320**	**0.339**	**0.358**	**0.377**	**0.396**	**0.414**	**0.433**	0.452	0.471
25	0.225	**0.245**	**0.266**	**0.286**	**0.307**	**0.327**	**0.347**	**0.368**	**0.388**	**0.409**	**0.429**	**0.450**	**0.470**	0.491	0.511
26	0.243	0.265	**0.287**	**0.309**	**0.332**	**0.354**	**0.376**	**0.398**	**0.420**	**0.442**	**0.464**	**0.486**	**0.508**	0.531	0.553
27	0.262	0.286	**0.310**	**0.334**	**0.358**	**0.381**	**0.405**	**0.429**	**0.453**	**0.477**	**0.501**	**0.524**	**0.548**	**0.572**	**0.596**
28	0.282	0.308	0.333	**0.359**	**0.385**	**0.410**	**0.436**	**0.461**	**0.487**	**0.513**	**0.538**	**0.564**	**0.590**	**0.615**	**0.641**
29	0.303	0.330	0.358	**0.385**	**0.413**	**0.440**	**0.468**	**0.495**	**0.523**	**0.550**	**0.578**	**0.605**	**0.633**	**0.660**	**0.688**
30	0.324	0.353	0.383	0.412	**0.441**	**0.471**	**0.500**	**0.530**	**0.559**	**0.589**	**0.618**	**0.647**	**0.677**	**0.706**	**0.736**

(The values which are bold are within the range of observed data)

Appendix IX: Volume table for *Magnolia champaca* (31-50 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	**0.392**	**0.418**	**0.444**	**0.471**	**0.497**	**0.523**	**0.549**	**0.575**	**0.601**	**0.627**	0.653	0.680	0.706	0.732	0.758	0.784
32	**0.418**	**0.446**	**0.473**	**0.501**	**0.529**	**0.557**	**0.585**	**0.613**	**0.641**	**0.668**	0.696	0.724	0.752	0.780	0.808	0.836
33	**0.444**	**0.474**	**0.504**	**0.533**	**0.563**	**0.592**	**0.622**	**0.652**	**0.681**	**0.711**	**0.741**	**0.770**	0.800	0.829	0.859	0.889
34	**0.472**	**0.503**	**0.535**	**0.566**	**0.597**	**0.629**	**0.660**	**0.692**	**0.723**	**0.755**	**0.786**	**0.818**	0.849	0.880	0.912	0.943
35	**0.500**	**0.533**	**0.566**	**0.600**	**0.633**	**0.666**	**0.700**	**0.733**	**0.766**	**0.800**	**0.833**	**0.866**	0.900	0.933	0.966	1.000
36	0.529	0.564	0.599	0.635	0.670	**0.705**	**0.740**	**0.776**	**0.811**	**0.846**	**0.881**	**0.917**	**0.952**	**0.987**	1.022	1.058
37	0.559	0.596	0.633	0.670	0.707	**0.745**	**0.782**	**0.819**	**0.856**	**0.894**	**0.931**	**0.968**	**1.005**	**1.043**	1.080	1.117
38	0.589	0.628	0.668	0.707	0.746	**0.786**	**0.825**	**0.864**	**0.903**	**0.943**	**0.982**	**1.021**	**1.060**	**1.100**	1.139	1.178
39	0.621	0.662	0.703	0.745	0.786	**0.827**	**0.869**	**0.910**	**0.952**	**0.993**	**1.034**	**1.076**	**1.117**	**1.158**	1.200	1.241
40	0.653	0.696	0.740	0.783	0.827	**0.870**	**0.914**	**0.957**	**1.001**	**1.044**	**1.088**	**1.132**	**1.175**	**1.219**	1.262	1.306
41	0.686	0.732	0.777	0.823	0.869	**0.914**	**0.960**	**1.006**	**1.052**	**1.097**	**1.143**	**1.189**	**1.235**	**1.280**	1.326	1.372
42	0.720	0.768	0.816	0.864	0.912	**0.960**	**1.008**	**1.056**	**1.104**	**1.152**	**1.200**	**1.248**	**1.295**	**1.343**	1.391	1.439
43	0.754	0.805	0.855	0.905	0.956	1.006	1.056	1.106	**1.157**	**1.207**	**1.257**	**1.308**	**1.358**	**1.408**	1.458	1.509
44	0.790	0.843	0.895	0.948	1.001	1.053	1.106	1.159	**1.211**	**1.264**	**1.316**	**1.369**	**1.422**	**1.474**	1.527	1.580
45	0.826	0.881	0.936	0.991	1.047	1.102	1.157	1.212	**1.267**	**1.322**	**1.377**	**1.432**	**1.487**	**1.542**	1.597	1.652
46	0.863	0.921	0.978	1.036	1.094	1.151	1.209	1.266	1.324	1.381	1.439	1.496	1.554	1.612	1.669	1.727
47	0.901	0.961	1.021	1.082	1.142	1.202	1.262	1.322	1.382	1.442	1.502	1.562	1.622	1.682	1.742	1.803
48	0.940	1.003	1.065	1.128	1.191	1.253	1.316	1.379	1.441	1.504	1.567	1.629	1.692	1.755	1.817	1.880
49	0.980	1.045	1.110	1.176	1.241	1.306	1.371	1.437	1.502	1.567	1.633	1.698	1.763	1.829	1.894	1.959
50	1.020	1.088	1.156	1.224	1.292	1.360	1.428	1.496	1.564	1.632	1.700	1.768	1.836	1.904	1.972	2.040

(The values which are bold are within the range of observed data)

Appendix X: Volume table for *Magnolia champaca* (>50 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	1.034	1.103	1.172	**1.241**	**1.310**	**1.379**	**1.447**	**1.516**	**1.585**	**1.654**	**1.723**	1.792	1.861	1.930	1.999	2.068	2.137	2.206	2.275	2.344	2.412
52	1.075	1.146	1.218	**1.290**	**1.361**	**1.433**	**1.505**	**1.576**	**1.648**	**1.720**	**1.791**	1.863	1.935	2.006	2.078	2.150	2.221	2.293	2.365	2.436	2.508
53	1.117	1.191	1.265	**1.340**	**1.414**	**1.489**	**1.563**	**1.638**	**1.712**	**1.787**	**1.861**	1.935	2.010	2.084	2.159	2.233	2.308	2.382	2.456	2.531	2.605
54	1.159	1.236	1.314	**1.391**	**1.468**	**1.545**	**1.623**	**1.700**	**1.777**	**1.855**	**1.932**	2.009	2.086	2.164	2.241	2.318	2.395	2.473	2.550	2.627	2.705
55	1.202	1.283	1.363	**1.443**	**1.523**	**1.603**	**1.683**	**1.764**	**1.844**	**1.924**	**2.004**	2.084	2.164	2.245	2.325	2.405	2.485	2.565	2.645	2.726	2.806
56	1.247	1.330	1.413	**1.496**	**1.579**	**1.662**	**1.745**	**1.828**	**1.911**	**1.994**	**2.078**	2.161	2.244	2.327	2.410	2.493	2.576	2.659	2.742	2.826	2.909
57	1.291	1.378	1.464	**1.550**	**1.636**	**1.722**	**1.808**	**1.894**	**1.980**	**2.066**	**2.152**	**2.239**	**2.325**	**2.411**	2.497	2.583	2.669	2.755	2.841	2.927	3.013
58	1.337	1.426	1.515	**1.605**	**1.694**	**1.783**	**1.872**	**1.961**	**2.050**	**2.140**	**2.229**	**2.318**	**2.407**	**2.496**	2.585	2.674	2.764	2.853	2.942	3.031	3.120
59	1.384	1.476	1.568	**1.660**	**1.753**	**1.845**	**1.937**	**2.029**	**2.122**	**2.214**	**2.306**	**2.398**	**2.491**	**2.583**	2.675	2.767	2.860	2.952	3.044	3.136	3.229
60	1.431	1.526	1.622	**1.717**	**1.813**	**1.908**	**2.003**	**2.099**	**2.194**	**2.290**	**2.385**	**2.480**	**2.576**	**2.671**	2.767	2.862	2.957	3.053	3.148	3.244	3.339
61	1.479	1.578	1.676	**1.775**	**1.874**	**1.972**	**2.071**	**2.169**	**2.268**	**2.367**	**2.465**	**2.564**	**2.662**	**2.761**	2.860	2.958	3.057	3.155	3.254	3.353	3.451
62	1.528	1.630	1.732	**1.834**	**1.935**	**2.037**	**2.139**	**2.241**	**2.343**	**2.445**	**2.547**	**2.649**	**2.750**	**2.852**	2.954	3.056	3.158	3.260	3.362	3.463	3.565
63	1.578	1.683	1.788	**1.893**	**1.998**	**2.104**	**2.209**	**2.314**	**2.419**	**2.524**	**2.629**	**2.735**	**2.840**	**2.945**	3.050	3.155	3.261	3.366	3.471	3.576	3.681
64	1.628	1.737	1.845	**1.954**	**2.062**	**2.171**	**2.279**	**2.388**	**2.497**	**2.605**	**2.714**	**2.822**	**2.931**	**3.039**	3.148	3.256	3.365	3.473	3.582	3.690	3.799
65	1.679	1.791	1.903	**2.015**	**2.127**	**2.239**	**2.351**	**2.463**	**2.575**	**2.687**	**2.799**	**2.911**	**3.023**	**3.135**	3.247	3.359	3.471	3.583	3.695	3.807	3.919
66	1.732	1.847	1.962	2.078	2.193	2.309	2.424	2.540	2.655	2.770	**2.886**	**3.001**	**3.117**	**3.232**	3.348	3.463	3.578	3.694	3.809	3.925	4.040
67	1.784	1.903	2.022	2.141	2.260	2.379	2.498	2.617	2.736	2.855	**2.974**	**3.093**	**3.212**	**3.331**	3.450	3.569	3.688	3.807	3.926	4.045	4.164
68	1.838	1.961	2.083	2.206	2.328	2.451	2.573	2.696	2.818	2.941	**3.063**	**3.186**	**3.308**	**3.431**	3.554	3.676	3.799	3.921	4.044	4.166	4.289
69	1.892	2.019	2.145	2.271	2.397	2.523	2.649	2.776	2.902	3.028	**3.154**	**3.280**	**3.406**	**3.533**	3.659	3.785	3.911	4.037	4.163	4.290	4.416
70	1.948	2.078	2.207	2.337	2.467	2.597	2.727	2.857	2.987	3.116	**3.246**	**3.376**	**3.506**	**3.636**	3.766	3.896	4.025	4.155	4.285	4.415	4.545

(The values which are bold are within the range of observed data)

Appendix XI: Volume table for *Toona ciliata* (10-30 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	0.033	0.036	0.039	0.042	0.045	0.048	0.051	0.054	0.057	0.060	0.063	0.066	0.069	0.072	0.075
11	**0.040**	0.043	0.047	0.050	0.054	0.058	0.061	0.065	0.069	0.072	0.076	0.079	0.083	0.087	0.090
12	**0.047**	0.051	0.056	0.060	0.064	0.069	0.073	0.077	0.082	0.086	0.090	0.094	0.099	0.103	0.107
13	**0.055**	**0.060**	0.065	0.071	0.076	0.081	0.086	0.091	0.096	0.101	0.106	0.111	0.116	0.121	0.126
14	**0.064**	**0.070**	0.076	0.082	0.088	0.093	0.099	0.105	0.111	0.117	0.123	0.128	0.134	0.140	0.146
15	**0.074**	**0.080**	0.087	0.094	0.101	0.107	0.114	0.121	0.127	0.134	0.141	0.148	0.154	0.161	0.168
16	**0.084**	**0.092**	**0.099**	0.107	0.114	0.122	0.130	0.137	0.145	0.153	0.160	0.168	0.175	0.183	0.191
17	**0.095**	**0.103**	**0.112**	0.121	0.129	0.138	0.146	0.155	0.164	0.172	0.181	0.189	0.198	0.207	0.215
18	**0.106**	**0.116**	**0.126**	**0.135**	**0.145**	**0.154**	**0.164**	0.174	0.183	0.193	0.203	0.212	0.222	0.232	0.241
19	0.118	**0.129**	**0.140**	**0.151**	**0.161**	**0.172**	**0.183**	0.194	0.204	0.215	0.226	0.237	0.247	0.258	0.269
20	0.131	**0.143**	**0.155**	**0.167**	**0.179**	**0.191**	**0.203**	0.215	0.226	0.238	0.250	0.262	0.274	0.286	0.298
21	0.145	**0.158**	**0.171**	**0.184**	**0.197**	**0.210**	**0.223**	0.237	0.250	0.263	0.276	0.289	0.302	0.315	0.329
22	0.159	**0.173**	**0.188**	**0.202**	**0.216**	**0.231**	**0.245**	0.260	0.274	0.288	0.303	0.317	0.332	0.346	0.361
23	0.173	**0.189**	**0.205**	**0.221**	**0.236**	**0.252**	**0.268**	**0.284**	**0.300**	**0.315**	0.331	0.347	0.363	0.378	0.394
24	0.189	**0.206**	**0.223**	**0.240**	**0.257**	**0.275**	**0.292**	**0.309**	**0.326**	**0.343**	0.360	0.378	0.395	0.412	0.429
25	0.205	**0.224**	**0.242**	**0.261**	**0.279**	**0.298**	**0.317**	**0.335**	**0.354**	**0.373**	0.391	0.410	0.428	0.447	0.466
26	0.222	**0.242**	**0.262**	**0.282**	**0.302**	**0.322**	**0.342**	**0.363**	**0.383**	**0.403**	0.423	0.443	0.463	0.483	0.504
27	0.239	0.261	0.282	0.304	0.326	0.348	**0.369**	**0.391**	**0.413**	**0.434**	0.456	0.478	0.500	0.521	0.543
28	0.257	0.280	0.304	0.327	0.350	0.374	**0.397**	**0.421**	**0.444**	**0.467**	0.491	0.514	0.537	0.561	0.584
29	0.276	0.301	0.326	0.351	0.376	0.401	**0.426**	**0.451**	**0.476**	**0.501**	**0.526**	**0.551**	**0.576**	**0.601**	0.627
30	0.295	0.322	0.349	0.375	0.402	0.429	**0.456**	**0.483**	**0.510**	**0.536**	**0.563**	**0.590**	**0.617**	**0.644**	0.671

(The values which are bold are within the range of observed data)

Appendix XII: Volume table for *Toona ciliata* (31-50 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	**0.268**	**0.286**	0.304	0.322	0.340	0.357	0.375	0.393	0.411	0.429	0.447	0.465	0.483	0.500	0.518	0.536
32	**0.286**	**0.305**	0.324	0.343	0.362	0.381	0.400	0.419	0.438	0.457	0.476	0.495	0.514	0.533	0.552	0.571
33	**0.304**	**0.324**	**0.344**	**0.365**	**0.385**	**0.405**	**0.425**	**0.446**	**0.466**	**0.486**	0.506	0.527	0.547	0.567	0.587	0.608
34	0.323	**0.344**	**0.366**	**0.387**	**0.409**	**0.430**	**0.452**	**0.473**	**0.495**	**0.516**	0.538	0.559	0.581	0.602	0.624	0.645
35	0.342	**0.365**	**0.387**	**0.410**	**0.433**	**0.456**	**0.478**	**0.501**	**0.524**	**0.547**	0.570	0.592	0.615	0.638	0.661	0.684
36	0.362	**0.386**	**0.410**	**0.434**	**0.458**	**0.482**	**0.506**	**0.530**	**0.554**	**0.579**	0.603	0.627	0.651	0.675	0.699	0.723
37	0.382	**0.407**	**0.433**	**0.458**	**0.484**	**0.509**	**0.535**	**0.560**	**0.586**	**0.611**	0.637	0.662	0.688	0.713	0.738	0.764
38	0.403	**0.430**	**0.457**	**0.483**	**0.510**	**0.537**	**0.564**	**0.591**	**0.618**	**0.645**	**0.671**	0.698	0.725	0.752	0.779	0.806
39	0.424	**0.453**	**0.481**	**0.509**	**0.538**	**0.566**	**0.594**	**0.622**	**0.651**	**0.679**	**0.707**	0.736	0.764	0.792	0.820	0.849
40	0.446	**0.476**	**0.506**	**0.536**	**0.565**	**0.595**	**0.625**	**0.655**	**0.684**	**0.714**	**0.744**	0.774	0.804	0.833	0.863	0.893
41	0.469	**0.500**	**0.532**	**0.563**	**0.594**	**0.625**	**0.657**	**0.688**	**0.719**	**0.750**	**0.782**	**0.813**	**0.844**	0.875	0.907	0.938
42	0.492	**0.525**	**0.558**	**0.591**	**0.623**	**0.656**	**0.689**	**0.722**	**0.755**	**0.787**	**0.820**	**0.853**	**0.886**	0.919	0.952	0.984
43	0.516	**0.550**	**0.585**	**0.619**	**0.653**	**0.688**	**0.722**	**0.757**	**0.791**	**0.825**	**0.860**	**0.894**	**0.929**	0.963	0.997	1.032
44	0.540	**0.576**	**0.612**	**0.648**	**0.684**	**0.720**	**0.756**	**0.792**	**0.828**	**0.864**	**0.900**	**0.936**	**0.972**	1.008	1.044	1.080
45	0.565	**0.603**	**0.640**	**0.678**	**0.716**	**0.753**	**0.791**	**0.829**	**0.866**	**0.904**	**0.942**	**0.979**	**1.017**	1.055	1.092	1.130
46	0.590	**0.630**	**0.669**	**0.708**	**0.748**	**0.787**	**0.827**	**0.866**	**0.905**	**0.945**	**0.984**	**1.023**	**1.063**	1.102	1.141	1.181
47	0.616	**0.657**	**0.698**	**0.740**	**0.781**	**0.822**	**0.863**	**0.904**	**0.945**	**0.986**	**1.027**	**1.068**	**1.109**	1.150	1.192	1.233
48	0.643	**0.686**	**0.729**	**0.771**	**0.814**	**0.857**	**0.900**	**0.943**	**0.986**	**1.029**	**1.071**	**1.114**	**1.157**	1.200	1.243	1.286
49	0.670	0.715	**0.759**	**0.804**	**0.849**	**0.893**	**0.938**	**0.982**	**1.027**	**1.072**	**1.116**	**1.161**	**1.206**	1.250	1.295	1.340
50	0.698	0.744	**0.791**	**0.837**	**0.884**	**0.930**	**0.977**	**1.023**	**1.070**	**1.116**	**1.163**	**1.209**	**1.256**	1.302	1.349	1.395

(The values which are bold are within the range of observed data)

Appendix XIII: Volume table for *Toona ciliata* (>50 cm diameter class) in m^3

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	0.987	1.053	1.119	1.184	1.250	1.316	1.382	1.448	**1.514**	**1.579**	**1.645**	1.711	**1.777**	1.843	1.908	1.974	2.040	2.106	2.172	2.237	2.303
52	1.026	1.095	1.163	1.231	1.300	1.368	**1.437**	**1.505**	**1.573**	**1.642**	**1.710**	**1.779**	**1.847**	1.916	1.984	2.052	2.121	2.189	2.258	2.326	2.394
53	1.066	1.137	1.208	1.279	1.350	1.421	**1.492**	**1.563**	**1.635**	**1.706**	**1.777**	**1.848**	**1.919**	1.990	2.061	2.132	2.203	2.274	2.345	2.416	2.487
54	1.107	**1.180**	**1.254**	**1.328**	**1.402**	**1.475**	**1.549**	**1.623**	**1.697**	**1.771**	**1.844**	**1.918**	**1.992**	2.066	2.139	2.213	2.287	2.361	2.435	2.508	2.582
55	1.148	**1.225**	**1.301**	**1.378**	**1.454**	**1.531**	**1.607**	**1.684**	**1.760**	**1.837**	**1.913**	**1.990**	**2.066**	2.143	2.219	2.296	2.373	2.449	2.526	2.602	2.679
56	1.190	**1.269**	**1.349**	**1.428**	**1.507**	**1.587**	**1.666**	**1.745**	**1.825**	**1.904**	**1.984**	**2.063**	**2.142**	2.222	2.301	2.380	2.460	2.539	2.618	2.698	2.777
57	1.233	**1.315**	**1.397**	**1.480**	**1.562**	**1.644**	**1.726**	**1.808**	**1.891**	**1.973**	**2.055**	**2.137**	**2.219**	2.302	2.384	2.466	2.548	2.630	2.713	2.795	2.877
58	1.277	**1.362**	**1.447**	**1.532**	**1.617**	**1.702**	**1.787**	**1.872**	**1.958**	**2.043**	**2.128**	**2.213**	**2.298**	2.383	2.468	2.553	2.638	2.723	2.809	2.894	2.979
59	1.321	1.409	1.497	1.585	**1.673**	**1.761**	**1.849**	**1.938**	**2.026**	**2.114**	**2.202**	**2.290**	**2.378**	2.466	2.554	2.642	2.730	2.818	2.906	2.994	3.082
60	1.366	1.457	1.548	1.639	**1.731**	**1.822**	**1.913**	**2.004**	**2.095**	**2.186**	**2.277**	**2.368**	**2.459**	**2.550**	2.641	2.732	2.823	2.915	3.006	3.097	3.188
61	1.412	1.506	1.600	1.695	**1.789**	**1.883**	**1.977**	**2.071**	**2.165**	**2.259**	**2.354**	**2.448**	**2.542**	**2.636**	2.730	2.824	2.918	3.013	3.107	3.201	3.295
62	1.459	1.556	1.653	1.751	1.848	**1.945**	**2.042**	**2.140**	**2.237**	**2.334**	**2.431**	**2.529**	**2.626**	**2.723**	2.820	2.918	3.015	3.112	3.209	3.307	3.404
63	1.506	1.607	1.707	1.807	1.908	**2.008**	**2.109**	**2.209**	**2.310**	**2.410**	**2.510**	**2.611**	**2.711**	**2.812**	2.912	3.012	3.113	3.213	3.314	3.414	3.515
64	1.554	1.658	1.762	1.865	1.969	**2.073**	**2.176**	**2.280**	**2.383**	**2.487**	**2.591**	**2.694**	**2.798**	**2.902**	3.005	3.109	3.212	3.316	3.420	3.523	3.627
65	1.603	1.710	1.817	1.924	2.031	2.138	2.245	2.352	2.459	2.565	**2.672**	**2.779**	**2.886**	**2.993**	3.100	3.207	3.314	3.421	3.527	3.634	3.741
66	1.653	1.763	1.874	1.984	2.094	2.204	2.314	2.425	2.535	2.645	**2.755**	**2.865**	**2.976**	**3.086**	3.196	3.306	3.416	3.527	3.637	3.747	3.857
67	1.704	1.817	1.931	2.044	2.158	2.271	2.385	2.499	2.612	2.726	**2.839**	**2.953**	**3.066**	**3.180**	3.294	3.407	3.521	3.634	3.748	3.861	3.975
68	1.755	1.872	1.989	2.106	2.223	2.340	2.457	2.574	2.691	2.808	**2.925**	**3.042**	**3.159**	**3.276**	3.393	3.510	3.627	3.744	3.861	3.978	4.095
69	1.807	1.927	2.048	2.168	2.289	2.409	2.530	2.650	2.770	2.891	**3.011**	**3.132**	**3.252**	**3.373**	**3.493**	**3.614**	**3.734**	3.855	3.975	4.095	4.216
70	1.860	1.984	2.107	2.231	2.355	2.479	2.603	2.727	2.851	2.975	**3.099**	**3.223**	**3.347**	**3.471**	**3.595**	**3.719**	**3.843**	3.967	4.091	4.215	4.339

(The values which are bold are within the range of observed data)

Appendix XIV: Biomass table for *Betula alnoides* (10-30 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)														
	11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
10	23.01	25.10	27.19	29.28	31.37	33.46	35.55	37.65	39.74	41.83	43.92	46.01	48.10	50.19	52.29
11	27.84	30.37	32.90	35.43	37.96	40.49	43.02	45.55	48.08	50.61	53.14	55.67	58.21	60.74	63.27
12	33.13	36.14	39.15	42.16	45.18	48.19	51.20	54.21	57.22	60.23	63.25	66.26	69.27	72.28	75.29
13	38.88	42.41	45.95	49.48	53.02	56.55	60.09	63.62	67.16	70.69	74.23	77.76	81.29	84.83	88.36
14	45.09	49.19	53.29	57.39	61.49	65.59	69.69	73.79	77.89	81.98	86.08	90.18	94.28	98.38	102.48
15	51.76	56.47	61.17	65.88	70.59	75.29	80.00	84.70	89.41	94.12	98.82	103.53	108.23	112.94	117.64
16	58.90	64.25	69.60	74.96	80.31	85.67	91.02	96.37	101.73	107.08	112.44	117.79	123.14	128.50	133.85
17	66.49	72.53	78.58	84.62	90.66	96.71	102.75	108.80	114.84	120.89	126.93	132.97	139.02	145.06	151.11
18	74.54	81.32	88.09	94.87	101.64	108.42	115.20	121.97	128.75	135.53	142.30	149.08	155.85	162.63	169.41
19	83.05	90.60	98.15	105.70	113.25	120.80	128.35	135.90	143.45	151.00	158.55	166.10	173.65	181.20	188.75
20	92.02	100.39	108.76	117.12	125.49	133.85	142.22	150.58	158.95	167.32	175.68	184.05	192.41	200.78	209.15
21	101.46	110.68	119.90	129.13	138.35	147.57	156.80	166.02	175.24	184.47	193.69	202.91	212.14	221.36	230.58
22	111.35	121.47	131.59	141.72	151.84	161.96	172.08	182.21	192.33	202.45	212.57	222.70	232.82	242.94	253.07
23	121.70	132.77	143.83	154.89	165.96	177.02	188.08	199.15	210.21	221.28	232.34	243.40	254.47	265.53	276.59
24	132.51	144.56	156.61	168.65	180.70	192.75	204.79	216.84	228.89	240.94	252.98	265.03	277.08	289.12	301.17
25	143.79	156.86	169.93	183.00	196.07	209.15	222.22	235.29	248.36	261.43	274.50	287.57	300.65	313.72	326.79
26	155.52	169.66	183.80	197.93	212.07	226.21	240.35	254.49	268.63	282.76	296.90	311.04	325.18	339.32	353.46
27	167.71	182.96	198.21	213.45	228.70	243.95	259.19	274.44	289.69	304.93	320.18	335.43	350.67	365.92	381.17
28	180.37	196.76	213.16	229.56	245.95	262.35	278.75	295.15	311.54	327.94	344.34	360.73	377.13	393.53	409.92
29	193.48	211.07	228.66	246.25	263.84	281.43	299.01	316.60	334.19	351.78	369.37	386.96	404.55	422.14	439.73
30	207.05	225.88	244.70	263.52	282.35	301.17	319.99	338.81	357.64	376.46	395.28	414.11	432.93	451.75	470.58

Appendix XV: Biomass table for *Betula alnoides* (31-50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	238.71	254.62	270.54	286.45	318.28	318.28	334.19	350.11	366.02	381.93	397.85	413.76	429.67	445.59	461.50	477.42
32	254.36	271.31	288.27	305.23	339.14	339.14	356.10	373.06	390.01	406.97	423.93	440.89	457.84	474.80	491.76	508.71
33	270.50	288.54	306.57	324.60	360.67	360.67	378.70	396.74	414.77	432.80	450.84	468.87	486.90	504.94	522.97	541.01
34	287.15	306.29	325.43	344.57	382.86	382.86	402.00	421.15	440.29	459.43	478.58	497.72	516.86	536.00	555.15	574.29
35	304.28	324.57	344.86	365.14	405.71	405.71	426.00	446.28	466.57	486.86	507.14	527.43	547.71	568.00	588.28	608.57
36	321.92	343.38	364.84	386.30	429.23	429.23	450.69	472.15	493.61	515.07	536.53	558.00	579.46	600.92	622.38	643.84
37	340.05	362.72	385.39	408.06	453.40	453.40	476.07	498.75	521.42	544.09	566.76	589.43	612.10	634.77	657.44	680.11
38	358.68	382.60	406.51	430.42	478.24	478.24	502.16	526.07	549.98	573.89	597.81	621.72	645.63	669.54	693.45	717.37
39	377.81	403.00	428.18	453.37	503.75	503.75	528.93	554.12	579.31	604.50	629.68	654.87	680.06	705.24	730.43	755.62
40	397.43	423.93	450.42	476.92	529.91	529.91	556.41	582.90	609.40	635.89	662.39	688.88	715.38	741.87	768.37	794.87
41	417.55	445.39	473.23	501.06	556.74	556.74	584.57	612.41	640.25	668.08	695.92	723.76	751.60	779.43	807.27	835.11
42	438.17	467.38	496.59	525.80	584.23	584.23	613.44	642.65	671.86	701.07	730.28	759.49	788.71	817.92	847.13	876.34
43	459.28	489.90	520.52	551.14	612.38	612.38	643.00	673.62	704.23	734.85	765.47	796.09	826.71	857.33	887.95	918.57
44	480.89	512.95	545.01	577.07	641.19	641.19	673.25	705.31	737.37	769.43	801.49	833.55	865.61	897.67	929.73	961.79
45	503.00	536.53	570.07	603.60	670.67	670.67	704.20	737.73	771.27	804.80	838.33	871.87	905.40	938.93	972.47	1006.00
46	525.60	560.65	595.69	630.73	700.81	700.81	735.85	770.89	805.93	840.97	876.01	911.05	946.09	981.13	1016.17	1051.21
47	548.71	585.29	621.87	658.45	731.61	731.61	768.19	804.77	841.35	877.93	914.51	951.09	987.67	1024.25	1060.83	1097.41
48	572.30	610.46	648.61	686.76	763.07	763.07	801.22	839.38	877.53	915.69	953.84	991.99	1030.15	1068.30	1106.45	1144.61
49	596.40	636.16	675.92	715.68	795.20	795.20	834.96	874.72	914.48	954.24	994.00	1033.76	1073.52	1113.28	1153.04	1192.80
50	620.99	662.39	703.79	745.19	827.99	827.99	869.38	910.78	952.18	993.58	1034.98	1076.38	1117.78	1159.18	1200.58	1241.98

Appendix XVI: Biomass table for *Betula alnoides* (>50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	570.07	608.07	646.08	684.08	722.09	760.09	798.09	836.10	874.10	912.11	950.11	988.12	1026.12	1064.13	1102.13	1140.14	1178.14	1216.14	1254.15	1292.15	1330.16
52	592.64	632.15	671.66	711.17	750.68	790.19	829.70	869.21	908.72	948.23	987.74	1027.25	1066.76	1106.27	1145.78	1185.28	1224.79	1264.30	1303.81	1343.32	1382.83
53	615.66	656.70	697.74	738.79	779.83	820.87	861.92	902.96	944.01	985.05	1026.09	1067.14	1108.18	1149.22	1190.27	1231.31	1272.35	1313.40	1354.44	1395.49	1436.53
54	639.11	681.71	724.32	766.93	809.54	852.14	894.75	937.36	979.96	1022.57	1065.18	1107.79	1150.39	1193.00	1235.61	1278.21	1320.82	1363.43	1406.04	1448.64	1491.25
55	663.00	707.20	751.40	795.60	839.80	884.00	928.20	972.40	1016.60	1060.79	1104.99	1149.19	1193.39	1237.59	1281.79	1325.99	1370.19	1414.39	1458.59	1502.79	1546.99
56	687.32	733.15	778.97	824.79	870.61	916.43	962.25	1008.08	1053.90	1099.72	1145.54	1191.36	1237.18	1283.01	1328.83	1374.65	1420.47	1466.29	1512.11	1557.94	1603.76
57	712.09	759.56	807.04	854.51	901.98	949.46	996.93	1044.40	1091.87	1139.35	1186.82	1234.29	1281.76	1329.24	1376.71	1424.18	1471.66	1519.13	1566.60	1614.07	1661.55
58	737.30	786.45	835.60	884.76	933.91	983.06	1032.21	1081.37	1130.52	1179.67	1228.83	1277.98	1327.13	1376.29	1425.44	1474.59	1523.75	1572.90	1622.05	1671.20	1720.36
59	762.94	813.80	864.66	915.53	966.39	1017.25	1068.12	1118.98	1169.84	1220.70	1271.57	1322.43	1373.29	1424.15	1475.02	1525.88	1576.74	1627.60	1678.47	1729.33	1780.19
60	789.02	841.62	894.22	946.83	999.43	1052.03	1104.63	1157.23	1209.83	1262.43	1315.04	1367.64	1420.24	1472.84	1525.44	1578.04	1630.64	1683.24	1735.85	1788.45	1841.05
61	815.54	869.91	924.28	978.65	1033.02	1087.39	1141.76	1196.13	1250.50	1304.87	1359.23	1413.60	1467.97	1522.34	1576.71	1631.08	1685.45	1739.82	1794.19	1848.56	1902.93
62	842.50	898.67	954.83	1011.00	1067.17	1123.33	1179.50	1235.67	1291.83	1348.00	1404.17	1460.33	1516.50	1572.66	1628.83	1685.00	1741.16	1797.33	1853.50	1909.66	1965.83
63	869.90	927.89	985.88	1043.87	1101.87	1159.86	1217.85	1275.85	1333.84	1391.83	1449.83	1507.82	1565.81	1623.81	1681.80	1739.79	1797.78	1855.78	1913.77	1971.76	2029.76
64	897.73	957.58	1017.43	1077.28	1137.13	1196.97	1256.82	1316.67	1376.52	1436.37	1496.22	1556.07	1615.92	1675.76	1735.61	1795.46	1855.31	1915.16	1975.01	2034.86	2094.70
65	926.00	987.74	1049.47	1111.20	1172.94	1234.67	1296.41	1358.14	1419.87	1481.61	1543.34	1605.07	1666.81	1728.54	1790.27	1852.01	1913.74	1975.47	2037.21	2098.94	2160.68
66	954.72	1018.36	1082.01	1145.66	1209.31	1272.95	1336.60	1400.25	1463.90	1527.54	1591.19	1654.84	1718.49	1782.14	1845.78	1909.43	1973.08	2036.73	2100.37	2164.02	2227.67
67	983.87	1049.46	1115.05	1180.64	1246.23	1311.82	1377.41	1443.00	1508.59	1574.18	1639.78	1705.37	1770.96	1836.55	1902.14	1967.73	2033.32	2098.91	2164.50	2230.09	2295.69
68	1013.45	1081.02	1148.58	1216.14	1283.71	1351.27	1418.84	1486.40	1553.96	1621.53	1689.09	1756.65	1824.22	1891.78	1959.34	2026.91	2094.47	2162.03	2229.60	2297.16	2364.73
69	1043.48	1113.05	1182.61	1252.18	1321.74	1391.31	1460.87	1530.44	1600.00	1669.57	1739.13	1808.70	1878.26	1947.83	2017.40	2086.96	2156.53	2226.09	2295.66	2365.22	2434.79
70	1073.95	1145.54	1217.14	1288.73	1360.33	1431.93	1503.52	1575.12	1646.72	1718.31	1789.91	1861.51	1933.10	2004.70	2076.29	2147.89	2219.49	2291.08	2362.68	2434.28	2505.87

Appendix XVII: Biomass table for *Duabanga grandiflora* (10-30 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	13.45	14.67	15.89	17.11	18.34	19.56	20.78	22.00	23.23	24.45	25.67	26.89	28.12	29.34	30.56
11	16.27	17.75	19.23	20.71	22.19	23.67	25.14	26.62	28.10	29.58	31.06	32.54	34.02	35.50	36.98
12	19.36	21.12	22.88	24.64	26.40	28.16	29.92	31.68	33.44	35.21	36.97	38.73	40.49	42.25	44.01
13	22.72	24.79	26.86	28.92	30.99	33.05	35.12	37.19	39.25	41.32	43.38	45.45	47.51	49.58	51.65
14	26.35	28.75	31.15	33.54	35.94	38.33	40.73	43.13	45.52	47.92	50.31	52.71	55.11	57.50	59.90
15	30.25	33.00	35.76	38.51	41.26	44.01	46.76	49.51	52.26	55.01	57.76	60.51	63.26	66.01	68.76
16	34.42	37.55	40.68	43.81	46.94	50.07	53.20	56.33	59.46	62.59	65.72	68.85	71.97	75.10	78.23
17	38.86	42.39	45.93	49.46	52.99	56.52	60.06	63.59	67.12	70.65	74.19	77.72	81.25	84.79	88.32
18	43.57	47.53	51.49	55.45	59.41	63.37	67.33	71.29	75.25	79.21	83.17	87.13	91.09	95.05	99.01
19	48.54	52.95	57.37	61.78	66.19	70.61	75.02	79.43	83.84	88.26	92.67	97.08	101.50	105.91	110.32
20	53.79	58.68	63.56	68.45	73.34	78.23	83.12	88.01	92.90	97.79	102.68	107.57	112.46	117.35	122.24
21	59.30	64.69	70.08	75.47	80.86	86.25	91.64	97.03	102.42	107.82	113.21	118.60	123.99	129.38	134.77
22	65.08	71.00	76.91	82.83	88.75	94.66	100.58	106.50	112.41	118.33	124.24	130.16	136.08	141.99	147.91
23	71.13	77.60	84.06	90.53	97.00	103.46	109.93	116.40	122.86	129.33	135.80	142.26	148.73	155.20	161.66
24	77.45	84.49	91.53	98.57	105.62	112.66	119.70	126.74	133.78	140.82	147.86	154.90	161.94	168.98	176.03
25	84.04	91.68	99.32	106.96	114.60	122.24	129.88	137.52	145.16	152.80	160.44	168.08	175.72	183.36	191.00
26	90.90	99.16	107.42	115.69	123.95	132.21	140.48	148.74	157.01	165.27	173.53	181.80	190.06	198.32	206.59
27	98.02	106.94	115.85	124.76	133.67	142.58	151.49	160.40	169.31	178.23	187.14	196.05	204.96	213.87	222.78
28	105.42	115.00	124.59	134.17	143.75	153.34	162.92	172.51	182.09	191.67	201.26	210.84	220.42	230.01	239.59
29	113.08	123.36	133.64	143.93	154.21	164.49	174.77	185.05	195.33	205.61	215.89	226.17	236.45	246.73	257.01
30	121.02	132.02	143.02	154.02	165.02	176.03	187.03	198.03	209.03	220.03	231.03	242.04	253.04	264.04	275.04

Appendix XVIII: Biomass table for *Duabanga grandiflora* (31-50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	180.61	192.66	204.70	216.74	228.78	240.82	252.86	264.90	276.94	288.98	301.81	313.06	325.11	337.15	349.19	361.23
32	192.45	205.28	218.12	230.95	243.78	256.61	269.44	282.27	295.10	307.93	321.60	333.59	346.42	359.25	372.08	384.91
33	204.67	218.32	231.96	245.61	259.25	272.89	286.54	300.18	313.83	327.47	342.01	354.76	368.41	382.05	395.70	409.34
34	217.26	231.75	246.23	260.72	275.20	289.68	304.17	318.65	333.14	347.62	363.05	376.59	391.07	405.56	420.04	434.53
35	230.23	245.58	260.93	276.28	291.63	306.98	322.32	337.67	353.02	368.37	384.72	399.07	414.42	429.77	445.11	460.46
36	243.58	259.81	276.05	292.29	308.53	324.77	341.01	357.24	373.48	389.72	407.02	422.20	438.44	454.67	470.91	487.15
37	257.30	274.45	291.60	308.75	325.91	343.06	360.21	377.37	394.52	411.67	429.95	445.98	463.13	480.28	497.44	514.59
38	271.39	289.48	307.58	325.67	343.76	361.85	379.95	398.04	416.13	434.23	453.50	470.41	488.50	506.60	524.69	542.78
39	285.86	304.92	323.98	343.04	362.09	381.15	400.21	419.27	438.32	457.38	477.69	495.50	514.55	533.61	552.67	571.73
40	300.71	320.76	340.81	360.85	380.90	400.95	420.99	441.04	461.09	481.14	502.50	521.23	541.28	561.33	581.37	601.42
41	315.93	337.00	358.06	379.12	400.18	421.25	442.31	463.37	484.43	505.49	527.93	547.62	568.68	589.74	610.81	631.87
42	331.53	353.64	375.74	397.84	419.94	442.04	464.15	486.25	508.35	530.45	554.00	574.66	596.76	618.86	640.96	663.07
43	347.51	370.68	393.84	417.01	440.18	463.34	486.51	509.68	532.85	556.01	580.70	602.35	625.52	648.68	671.85	695.02
44	363.86	388.12	412.37	436.63	460.89	485.15	509.40	533.66	557.92	582.18	608.02	630.69	654.95	679.20	703.46	727.72
45	380.59	405.96	431.33	456.70	482.08	507.45	532.82	558.19	583.57	608.94	635.97	659.68	685.06	710.43	735.80	761.17
46	397.69	424.20	450.71	477.23	503.74	530.25	556.77	583.28	609.79	636.30	664.55	689.33	715.84	742.35	768.87	795.38
47	415.17	442.85	470.52	498.20	525.88	553.56	581.24	608.91	636.59	664.27	693.76	719.63	747.30	774.98	802.66	830.34
48	433.02	461.89	490.76	519.63	548.50	577.36	606.23	635.10	663.97	692.84	723.59	750.57	779.44	808.31	837.18	866.05
49	451.25	481.34	511.42	541.50	571.59	601.67	631.75	661.84	691.92	722.01	754.06	782.17	812.26	842.34	872.42	902.51
50	469.86	501.18	532.51	563.83	595.16	626.48	657.80	689.13	720.45	751.78	785.15	814.42	845.75	877.07	908.40	939.72

Appendix XIX: Biomass table for *Duabanga grandiflora* (>50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	426.25	454.66	483.08	511.50	539.91	568.33	596.75	625.16	653.58	681.99	710.41	738.83	767.24	795.66	824.08	852.49	880.91	909.33	966.16	966.16	994.58
52	443.13	472.67	502.21	531.75	561.29	590.83	620.38	649.92	679.46	709.00	738.54	768.09	797.63	827.17	856.71	886.25	915.79	945.34	1004.42	1004.42	1033.96
53	460.33	491.02	521.71	552.40	583.09	613.78	644.47	675.16	705.84	736.53	767.22	797.91	828.60	859.29	889.98	920.67	951.36	982.04	1043.42	1043.42	1074.11
54	477.87	509.73	541.58	573.44	605.30	637.16	669.02	700.87	732.73	764.59	796.45	828.30	860.16	892.02	923.88	955.74	987.59	1019.45	1083.17	1083.17	1115.03
55	495.73	528.78	561.83	594.88	627.93	660.97	694.02	727.07	760.12	793.17	826.22	859.27	892.32	925.36	958.41	991.46	1024.51	1057.56	1123.66	1123.66	1156.71
56	513.92	548.18	582.44	616.71	650.97	685.23	719.49	753.75	788.01	822.27	856.54	890.80	925.06	959.32	993.58	1027.84	1062.10	1096.37	1164.89	1164.89	1199.15
57	532.44	567.94	603.43	638.93	674.42	709.92	745.42	780.91	816.41	851.90	887.40	922.90	958.39	993.89	1029.38	1064.88	1100.38	1135.87	1206.86	1206.86	1242.36
58	551.29	588.04	624.79	661.54	698.30	735.05	771.80	808.55	845.30	882.06	918.81	955.56	992.31	1029.07	1065.82	1102.57	1139.32	1176.08	1249.58	1249.58	1286.33
59	570.46	608.49	646.52	684.55	722.58	760.61	798.64	836.67	874.70	912.73	950.77	988.80	1026.83	1064.86	1102.89	1140.92	1178.95	1216.98	1293.04	1293.04	1331.07
60	589.96	629.29	668.62	707.95	747.28	786.61	825.95	865.28	904.61	943.94	983.27	1022.60	1061.93	1101.26	1140.59	1179.92	1219.25	1258.58	1337.24	1337.24	1376.58
61	609.79	650.44	691.10	731.75	772.40	813.05	853.71	894.36	935.01	975.66	1016.32	1056.97	1097.62	1138.27	1178.93	1219.58	1260.23	1300.89	1382.19	1382.19	1422.84
62	629.95	671.94	713.94	755.94	797.93	839.93	881.93	923.92	965.92	1007.92	1049.91	1091.91	1133.90	1175.90	1217.90	1259.89	1301.89	1343.89	1427.88	1427.88	1469.88
63	650.43	693.79	737.16	780.52	823.88	867.24	910.60	953.97	997.33	1040.69	1084.05	1127.42	1170.78	1214.14	1257.50	1300.86	1344.23	1387.59	1474.31	1474.31	1517.67
64	671.24	715.99	760.74	805.49	850.24	894.99	939.74	984.49	1029.24	1073.99	1118.74	1163.49	1208.24	1252.99	1297.74	1342.49	1387.24	1431.99	1521.49	1521.49	1566.24
65	692.38	738.54	784.70	830.86	877.02	923.18	969.34	1015.50	1061.66	1107.82	1153.97	1200.13	1246.29	1292.45	1338.61	1384.77	1430.93	1477.09	1569.40	1569.40	1615.56
66	713.85	761.44	809.03	856.62	904.21	951.80	999.39	1046.98	1094.57	1142.16	1189.75	1237.34	1284.93	1332.52	1380.11	1427.71	1475.30	1522.89	1618.07	1618.07	1665.66
67	735.65	784.69	833.73	882.78	931.82	980.86	1029.91	1078.95	1127.99	1177.04	1226.08	1275.12	1324.17	1373.21	1422.25	1471.30	1520.34	1569.38	1667.47	1667.47	1716.51
68	757.77	808.29	858.81	909.33	959.84	1010.36	1060.88	1111.40	1161.92	1212.43	1262.95	1313.47	1363.99	1414.51	1465.03	1515.54	1566.06	1616.58	1717.62	1717.62	1768.13
69	780.22	832.24	884.25	936.27	988.28	1040.30	1092.31	1144.33	1196.34	1248.36	1300.37	1352.39	1404.40	1456.42	1508.43	1560.45	1612.46	1664.48	1768.51	1768.51	1820.52
70	803.00	856.54	910.07	963.60	1017.14	1070.67	1124.20	1177.74	1231.27	1284.80	1338.34	1391.87	1445.40	1498.94	1552.47	1606.00	1659.54	1713.07	1820.14	1820.14	1873.67

Appendix XX: Biomas table for *Magnolia champaca* (10-30 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	27.42	29.91	32.40	34.89	37.39	39.88	42.37	44.86	47.36	49.85	52.34	54.83	57.33	59.82	62.31
11	33.17	36.19	39.21	42.22	45.24	48.25	51.27	54.28	57.30	60.32	63.33	66.35	69.36	72.38	75.40
12	39.48	43.07	46.66	50.25	53.84	57.42	61.01	64.60	68.19	71.78	75.37	78.96	82.55	86.14	89.73
13	46.33	50.55	54.76	58.97	63.18	67.39	71.61	75.82	80.03	84.24	88.46	92.67	96.88	101.09	105.30
14	53.74	58.62	63.51	68.39	73.28	78.16	83.05	87.93	92.82	97.70	102.59	107.47	112.36	117.24	122.13
15	61.69	67.29	72.90	78.51	84.12	89.73	95.33	100.94	106.55	112.16	117.77	123.37	128.98	134.59	140.20
16	70.19	76.57	82.95	89.33	95.71	102.09	108.47	114.85	121.23	127.61	133.99	140.37	146.75	153.13	159.51
17	79.23	86.44	93.64	100.84	108.05	115.25	122.45	129.65	136.86	144.06	151.26	158.47	165.67	172.87	180.08
18	88.83	96.90	104.98	113.06	121.13	129.21	137.28	145.36	153.43	161.51	169.58	177.66	185.73	193.81	201.88
19	98.97	107.97	116.97	125.97	134.96	143.96	152.96	161.96	170.95	179.95	188.95	197.95	206.94	215.94	224.94
20	109.67	119.64	129.60	139.57	149.54	159.51	169.48	179.45	189.42	199.39	209.36	219.33	229.30	239.27	249.24
21	120.91	131.90	142.89	153.88	164.87	175.86	186.86	197.85	208.84	219.83	230.82	241.81	252.80	263.80	274.79
22	132.70	144.76	156.82	168.89	180.95	193.01	205.07	217.14	229.20	241.26	253.33	265.39	277.45	289.52	301.58
23	145.03	158.22	171.40	184.59	197.77	210.96	224.14	237.33	250.51	263.70	276.88	290.07	303.25	316.44	329.62
24	157.92	172.27	186.63	200.99	215.34	229.70	244.06	258.41	272.77	287.12	301.48	315.84	330.19	344.55	358.91
25	171.35	186.93	202.51	218.09	233.66	249.24	264.82	280.40	295.97	311.55	327.13	342.71	358.28	373.86	389.44
26	185.33	202.18	219.03	235.88	252.73	269.58	286.43	303.28	320.12	336.97	353.82	370.67	387.52	404.37	421.22
27	199.87	218.04	236.20	254.37	272.54	290.71	308.88	327.05	345.22	363.39	381.56	399.73	417.90	436.07	454.24
28	214.94	234.48	254.03	273.57	293.11	312.65	332.19	351.73	371.27	390.81	410.35	429.89	449.43	468.97	488.51
29	230.57	251.53	272.49	293.46	314.42	335.38	356.34	377.30	398.26	419.22	440.18	461.14	482.10	503.07	524.03
30	246.75	269.18	291.61	314.04	336.47	358.91	381.34	403.77	426.20	448.63	471.06	493.50	515.93	538.36	560.79

Appendix XXI: Biomass table for *Magnolia champaca* (31-50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	262.70	280.21	297.73	315.24	332.75	350.27	367.78	385.29	402.81	420.32	437.83	455.34	472.86	490.37	507.88	525.40
32	279.92	298.58	317.24	335.90	354.57	373.23	391.89	410.55	429.21	447.87	466.53	485.20	503.86	522.52	541.18	559.84
33	297.69	317.53	337.38	357.23	377.07	396.92	416.76	436.61	456.46	476.30	496.15	515.99	535.84	555.69	575.53	595.38
34	316.00	337.07	358.14	379.20	400.27	421.34	442.41	463.47	484.54	505.61	526.67	547.74	568.81	589.87	610.94	632.01
35	334.87	357.19	379.51	401.84	424.16	446.49	468.81	491.14	513.46	535.79	558.11	580.43	602.76	625.08	647.41	669.73
36	354.27	377.89	401.51	425.13	448.75	472.37	495.98	519.60	543.22	566.84	590.46	614.08	637.69	661.31	684.93	708.55
37	374.23	399.18	424.13	449.08	474.02	498.97	523.92	548.87	573.82	598.77	623.72	648.67	673.61	698.56	723.51	748.46
38	394.73	421.05	447.36	473.68	499.99	526.31	552.62	578.94	605.26	631.57	657.89	684.20	710.52	736.83	763.15	789.46
39	415.78	443.50	471.22	498.94	526.66	554.37	582.09	609.81	637.53	665.25	692.97	720.69	748.41	776.12	803.84	831.56
40	437.38	466.53	495.69	524.85	554.01	583.17	612.33	641.48	670.64	699.80	728.96	758.12	787.28	816.44	845.59	874.75
41	459.52	490.15	520.79	551.42	582.06	612.69	643.33	673.96	704.59	735.23	765.86	796.50	827.13	857.77	888.40	919.04
42	482.21	514.35	546.50	578.65	610.80	642.94	675.09	707.24	739.38	771.53	803.68	835.83	867.97	900.12	932.27	964.41
43	505.44	539.14	572.83	606.53	640.23	673.92	707.62	741.32	775.01	808.71	842.40	876.10	909.80	943.49	977.19	1010.89
44	529.22	564.51	599.79	635.07	670.35	705.63	740.91	776.20	811.48	846.76	882.04	917.32	952.60	987.89	1023.17	1058.45
45	553.55	590.46	627.36	664.26	701.17	738.07	774.98	811.88	848.78	885.69	922.59	959.49	996.40	1033.30	1070.20	1107.11
46	578.43	616.99	655.55	694.12	732.68	771.24	809.80	848.36	886.93	925.49	964.05	1002.61	1041.17	1079.74	1118.30	1156.86
47	603.85	644.11	684.37	724.62	764.88	805.14	845.39	885.65	925.91	966.16	1006.42	1046.68	1086.93	1127.19	1167.45	1207.70
48	629.82	671.81	713.80	755.79	797.77	839.76	881.75	923.74	965.73	1007.71	1049.70	1091.69	1133.68	1175.67	1217.65	1259.64
49	656.34	700.09	743.85	787.60	831.36	875.12	918.87	962.63	1006.38	1050.14	1093.90	1137.65	1181.41	1225.16	1268.92	1312.67
50	683.40	728.96	774.52	820.08	865.64	911.20	956.76	1002.32	1047.88	1093.44	1139.00	1184.56	1230.12	1275.68	1321.24	1366.80

Appendix XXII: Biomass table for *Magnolia champaca* (>50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	692.71	738.89	785.07	831.25	877.43	923.62	969.80	1015.98	1062.16	1108.34	1154.52	1200.70	1246.88	1293.06	1339.24	1385.42	1431.60	1477.78	1523.96	1570.15	1616.33
52	720.14	768.15	816.16	864.17	912.18	960.19	1008.20	1056.21	1104.22	1152.23	1200.24	1248.25	1296.26	1344.27	1392.28	1440.29	1488.30	1536.30	1584.31	1632.32	1680.33
53	748.11	797.98	847.85	897.73	947.60	997.48	1047.35	1097.22	1147.10	1196.97	1246.84	1296.72	1346.59	1396.47	1446.34	1496.21	1546.09	1595.96	1645.84	1695.71	1745.58
54	776.60	828.38	880.15	931.92	983.70	1035.47	1087.25	1139.02	1190.79	1242.57	1294.34	1346.11	1397.89	1449.66	1501.43	1553.21	1604.98	1656.75	1708.53	1760.30	1812.08
55	805.63	859.34	913.05	966.76	1020.47	1074.18	1127.89	1181.60	1235.30	1289.01	1342.72	1396.43	1450.14	1503.85	1557.56	1611.27	1664.98	1718.68	1772.39	1826.10	1879.81
56	835.20	890.87	946.55	1002.23	1057.91	1113.59	1169.27	1224.95	1280.63	1336.31	1391.99	1447.67	1503.35	1559.03	1614.71	1670.39	1726.07	1781.75	1837.43	1893.11	1948.79
57	865.29	922.98	980.66	1038.35	1096.03	1153.72	1211.41	1269.09	1326.78	1384.46	1442.15	1499.84	1557.52	1615.21	1672.89	1730.58	1788.27	1845.95	1903.64	1961.32	2019.01
58	895.92	955.65	1015.37	1075.10	1134.83	1194.56	1254.28	1314.01	1373.74	1433.47	1493.20	1552.92	1612.65	1672.38	1732.11	1791.83	1851.56	1911.29	1971.02	2030.75	2090.47
59	927.08	988.88	1050.69	1112.49	1174.30	1236.10	1297.91	1359.71	1421.52	1483.32	1545.13	1606.93	1668.74	1730.54	1792.35	1854.15	1915.96	1977.76	2039.57	2101.38	2163.18
60	958.77	1022.69	1086.61	1150.52	1214.44	1278.36	1342.28	1406.20	1470.11	1534.03	1597.95	1661.87	1725.79	1789.70	1853.62	1917.54	1981.46	2045.38	2109.29	2173.21	2237.13
61	991.00	1057.06	1123.13	1189.19	1255.26	1321.33	1387.39	1453.46	1519.53	1585.59	1651.66	1717.73	1783.79	1849.86	1915.92	1981.99	2048.06	2114.12	2180.19	2246.26	2312.32
62	1023.75	1092.00	1160.25	1228.50	1296.75	1365.00	1433.25	1501.50	1569.76	1638.01	1706.26	1774.51	1842.76	1911.01	1979.26	2047.51	2115.76	2184.01	2252.26	2320.51	2388.76
63	1057.04	1127.51	1197.98	1268.45	1338.92	1409.39	1479.86	1550.33	1620.80	1691.27	1761.74	1832.21	1902.68	1973.15	2043.62	2114.09	2184.56	2255.03	2325.50	2395.97	2466.44
64	1090.87	1163.59	1236.32	1309.04	1381.77	1454.49	1527.21	1599.94	1672.66	1745.39	1818.11	1890.84	1963.56	2036.29	2109.01	2181.73	2254.46	2327.18	2399.91	2472.63	2545.36
0.65	1125.22	1200.24	1275.25	1350.27	1425.28	1500.30	1575.31	1650.33	1725.34	1800.36	1875.37	1950.39	2025.40	2100.42	2175.43	2250.45	2325.46	2400.48	2475.49	2550.51	2625.52
66	1160.11	1237.45	1314.79	1392.13	1469.47	1546.82	1624.16	1701.50	1778.84	1856.18	1933.52	2010.86	2088.20	2165.54	2242.88	2320.22	2397.56	2474.90	2552.25	2629.59	2706.93
67	1195.53	1275.24	1354.94	1434.64	1514.34	1594.04	1673.75	1753.45	1833.15	1912.85	1992.55	2072.26	2151.96	2231.66	2311.36	2391.07	2470.77	2550.47	2630.17	2709.87	2789.58
68	1231.49	1313.59	1395.69	1477.78	1559.88	1641.98	1724.08	1806.18	1888.28	1970.38	2052.48	2134.58	2216.68	2298.78	2380.87	2462.97	2545.07	2627.17	2709.27	2791.37	2873.47
69	1267.97	1352.50	1437.04	1521.57	1606.10	1690.63	1775.16	1859.69	1944.23	2028.76	2113.29	2197.82	2282.35	2366.88	2451.42	2535.95	2620.48	2705.01	2789.54	2874.07	2958.60
70	1304.99	1391.99	1478.99	1565.99	1652.99	1739.99	1826.99	1913.99	2000.99	2087.99	2174.99	2261.99	2348.99	2435.99	2522.99	2609.99	2696.98	2783.98	2870.98	2957.98	3044.98

Appendix XXIII: Biomass table for *Toona ciliata* (10-30 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	18.36	20.03	21.69	23.36	25.03	26.70	28.37	30.04	31.71	33.38	35.04	36.71	38.38	40.05	41.72
11	22.21	24.23	26.25	28.27	30.29	32.31	34.33	36.35	38.37	40.38	42.40	44.42	46.44	48.46	50.48
12	26.43	28.84	31.24	33.64	36.05	38.45	40.85	43.26	45.66	48.06	50.46	52.87	55.27	57.67	60.08
13	31.02	33.84	36.66	39.48	42.30	45.12	47.94	50.76	53.59	56.41	59.23	62.05	64.87	67.69	70.51
14	35.98	39.25	42.52	45.79	49.06	52.33	55.60	58.88	62.15	65.42	68.69	71.96	75.23	78.50	81.77
15	41.30	45.06	48.81	52.57	56.32	60.08	63.83	67.59	71.34	75.10	78.85	82.61	86.36	90.12	93.87
16	46.99	51.27	55.54	59.81	64.08	68.35	72.63	76.90	81.17	85.44	89.71	93.99	98.26	102.53	106.80
17	53.05	57.87	62.70	67.52	72.34	77.17	81.99	86.81	91.63	96.46	101.28	106.10	110.93	115.75	120.57
18	59.48	64.88	70.29	75.70	81.10	86.51	91.92	97.32	102.73	108.14	113.55	118.95	124.36	129.77	135.17
19	66.27	72.29	78.32	84.34	90.37	96.39	102.41	108.44	114.46	120.49	126.51	132.54	138.56	144.58	150.61
20	73.43	80.10	86.78	93.45	100.13	106.80	113.48	120.15	126.83	133.50	140.18	146.85	153.53	160.20	166.88
21	80.95	88.31	95.67	103.03	110.39	117.75	125.11	132.47	139.83	147.19	154.55	161.91	169.27	176.63	183.99
22	88.85	96.92	105.00	113.08	121.15	129.23	137.31	145.39	153.46	161.54	169.62	177.69	185.77	193.85	201.92
23	97.11	105.94	114.76	123.59	132.42	141.25	150.08	158.90	167.73	176.56	185.39	194.21	203.04	211.87	220.70
24	105.74	115.35	124.96	134.57	144.18	153.80	163.41	173.02	182.63	192.25	201.86	211.47	221.08	230.69	240.31
25	114.73	125.16	135.59	146.02	156.45	166.88	177.31	187.74	198.17	208.60	219.03	229.46	239.89	250.32	260.75
26	124.09	135.37	146.65	157.94	169.22	180.50	191.78	203.06	214.34	225.62	236.90	248.18	259.47	270.75	282.03
27	133.82	145.99	158.15	170.32	182.48	194.65	206.81	218.98	231.15	243.31	255.48	267.64	279.81	291.97	304.14
28	143.92	157.00	170.08	183.17	196.25	209.33	222.42	235.50	248.58	261.67	274.75	287.83	300.92	314.00	327.08
29	154.38	168.42	182.45	196.48	210.52	224.55	238.59	252.62	266.66	280.69	294.73	308.76	322.80	336.83	350.87
30	165.21	180.23	195.25	210.27	225.29	240.31	255.33	270.35	285.36	300.38	315.40	330.42	345.44	360.46	375.48

Appendix XXIV: Biomass table for *Toona ciliata* (31-50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)																
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	150.15	160.16	170.17	180.18	190.19	200.20	210.21	220.22	230.22	240.23	250.24	260.25	270.26	280.27	290.28	300.29
32	159.99	170.66	181.32	191.99	202.65	213.32	223.99	234.65	245.32	255.98	266.65	277.32	287.98	298.65	309.31	319.98
33	170.15	181.49	192.83	204.17	215.52	226.86	238.20	249.55	260.89	272.23	283.58	294.92	306.26	317.60	328.95	340.29
34	180.61	192.65	204.70	216.74	228.78	240.82	252.86	264.90	276.94	288.98	301.02	313.06	325.10	337.15	349.19	361.23
35	191.39	204.15	216.91	229.67	242.43	255.19	267.95	280.71	293.47	306.23	318.99	331.75	344.51	357.27	370.03	382.79
36	202.49	215.99	229.49	242.98	256.48	269.98	283.48	296.98	310.48	323.98	337.48	350.98	364.48	377.98	391.47	404.97
37	213.89	228.15	242.41	256.67	270.93	285.19	299.45	313.71	327.97	342.23	356.49	370.75	385.01	399.27	413.53	427.79
38	225.61	240.65	255.69	270.73	285.77	300.81	315.85	330.90	345.94	360.98	376.02	391.06	406.10	421.14	436.18	451.22
39	237.64	253.48	269.33	285.17	301.01	316.85	332.70	348.54	364.38	380.23	396.07	411.91	427.75	443.60	459.44	475.28
40	249.98	266.65	283.32	299.98	316.65	333.31	349.98	366.64	383.31	399.97	416.64	433.31	449.97	466.64	483.30	499.97
41	262.64	280.15	297.66	315.17	332.68	350.19	367.70	385.20	402.71	420.22	437.73	455.24	472.75	490.26	507.77	525.28
42	275.61	293.98	312.36	330.73	349.10	367.48	385.85	404.22	422.60	440.97	459.35	477.72	496.09	514.47	532.84	551.21
43	288.89	308.15	327.41	346.67	365.92	385.18	404.44	423.70	442.96	462.22	481.48	500.74	520.00	539.26	558.52	577.78
44	302.48	322.65	342.81	362.98	383.14	403.31	423.47	443.64	463.80	483.97	504.13	524.30	544.47	564.63	584.80	604.96
45	316.39	337.48	358.57	379.66	400.76	421.85	442.94	464.03	485.13	506.22	527.31	548.40	569.49	590.59	611.68	632.77
46	330.60	352.64	374.68	396.72	418.76	440.81	462.85	484.89	506.93	528.97	551.01	573.05	595.09	617.13	639.17	661.21
47	345.13	368.14	391.15	414.16	437.17	460.18	483.19	506.20	529.21	552.21	575.22	598.23	621.24	644.25	667.26	690.27
48	359.98	383.98	407.97	431.97	455.97	479.97	503.97	527.97	551.96	575.96	599.96	623.96	647.96	671.96	695.96	719.95
49	375.13	400.14	425.15	450.16	475.17	500.18	525.19	550.19	575.20	600.21	625.22	650.23	675.24	700.25	725.26	750.26
50	390.60	416.64	442.68	468.72	494.76	520.80	546.84	572.88	598.92	624.96	651.00	677.04	703.08	729.12	755.16	781.20

Appendix XXV: Biomass table for *Toona ciliata* (>50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	552.76	589.62	626.47	663.32	700.17	737.02	773.87	810.72	847.57	884.42	921.27	958.13	994.98	1031.83	1068.68	1105.53	1142.38	1179.23	1216.08	1252.93	1289.78
52	574.65	612.96	651.27	689.58	727.90	766.21	804.52	842.83	881.14	919.45	957.76	996.07	1034.38	1072.69	1111.00	1149.31	1187.62	1225.93	1264.24	1302.55	1340.86
53	596.97	636.77	676.56	716.36	756.16	795.96	835.76	875.55	915.35	955.15	994.95	1034.75	1074.54	1114.34	1154.14	1193.94	1233.74	1273.53	1313.33	1353.13	1392.93
54	619.71	661.02	702.34	743.65	784.96	826.28	867.59	908.91	950.22	991.53	1032.85	1074.16	1115.47	1156.79	1198.10	1239.42	1280.73	1322.04	1363.36	1404.67	1445.99
55	642.87	685.73	728.59	771.45	814.31	857.16	900.02	942.88	985.74	1028.60	1071.46	1114.31	1157.17	1200.03	1242.89	1285.75	1328.60	1371.46	1414.32	1457.18	1500.04
56	666.46	710.89	755.32	799.76	844.19	888.62	933.05	977.48	1021.91	1066.34	1110.77	1155.20	1199.63	1244.06	1288.49	1332.93	1377.36	1421.79	1466.22	1510.65	1555.08
57	690.48	736.51	782.54	828.57	874.60	920.64	966.67	1012.70	1058.73	1104.76	1150.80	1196.83	1242.86	1288.89	1334.92	1380.95	1426.99	1473.02	1519.05	1565.08	1611.11
58	714.92	762.58	810.24	857.90	905.56	953.22	1000.88	1048.55	1096.21	1143.87	1191.53	1239.19	1286.85	1334.51	1382.17	1429.83	1477.50	1525.16	1572.82	1620.48	1668.14
59	739.78	789.10	838.42	887.74	937.06	986.38	1035.69	1085.01	1134.33	1183.65	1232.97	1282.29	1331.61	1380.93	1430.25	1479.56	1528.88	1578.20	1627.52	1676.84	1726.16
60	765.07	816.08	867.08	918.09	969.09	1020.10	1071.10	1122.11	1173.11	1224.12	1275.12	1326.12	1377.13	1428.13	1479.14	1530.14	1581.15	1632.15	1683.16	1734.16	1785.17
61	790.79	843.51	896.23	948.94	1001.66	1054.38	1107.10	1159.82	1212.54	1265.26	1317.98	1370.70	1423.42	1476.14	1528.85	1581.57	1634.29	1687.01	1739.73	1792.45	1845.17
62	816.93	871.39	925.85	980.31	1034.77	1089.24	1143.70	1198.16	1252.62	1307.08	1361.54	1416.01	1470.47	1524.93	1579.39	1633.85	1688.32	1742.78	1797.24	1851.70	1906.16
63	843.49	899.72	955.96	1012.19	1068.42	1124.66	1180.89	1237.12	1293.35	1349.59	1405.82	1462.05	1518.29	1574.52	1630.75	1686.98	1743.22	1799.45	1855.68	1911.91	1968.15
64	870.48	928.51	986.55	1044.58	1102.61	1160.64	1218.67	1276.71	1334.74	1392.77	1450.80	1508.84	1566.87	1624.90	1682.93	1740.96	1799.00	1857.03	1915.06	1973.09	2031.12
65	897.90	957.76	1017.62	1077.48	1137.34	1197.20	1257.06	1316.92	1376.78	1436.64	1496.50	1556.35	1616.21	1676.07	1735.93	1795.79	1855.65	1915.51	1975.37	2035.23	2095.09
66	925.74	987.45	1049.17	1110.88	1172.60	1234.32	1296.03	1357.75	1419.46	1481.18	1542.90	1604.61	1666.33	1728.04	1789.76	1851.47	1913.19	1974.91	2036.62	2098.34	2160.05
67	954.00	1017.60	1081.20	1144.80	1208.40	1272.00	1335.60	1399.20	1462.80	1526.40	1590.00	1653.60	1717.20	1780.80	1844.40	1908.00	1971.60	2035.20	2098.81	2162.41	2226.01
68	982.69	1048.21	1113.72	1179.23	1244.74	1310.26	1375.77	1441.28	1506.80	1572.31	1637.82	1703.33	1768.85	1834.36	1899.87	1965.38	2030.90	2096.41	2161.92	2227.44	2292.95
69	1011.81	1079.26	1146.72	1214.17	1281.62	1349.08	1416.53	1483.98	1551.44	1618.89	1686.35	1753.80	1821.25	1888.71	1956.16	2023.62	2091.07	2158.52	2225.98	2293.43	2360.88
70	1041.35	1110.77	1180.19	1249.62	1319.04	1388.46	1457.89	1527.31	1596.73	1666.16	1735.58	1805.00	1874.43	1943.85	2013.27	2082.70	2152.12	2221.54	2290.97	2360.39	2429.81

Appendix XXVI: Carbon table for *Betula alnoides* (10-30 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	11.50	12.55	13.59	14.64	15.69	16.73	17.78	18.82	19.87	20.91	21.96	23.01	24.05	25.10	26.14
11	13.92	15.18	16.45	17.71	18.98	20.25	21.51	22.78	24.04	25.31	26.57	27.84	29.10	30.37	31.63
12	16.56	18.07	19.58	21.08	22.59	24.09	25.60	27.11	28.61	30.12	31.62	33.13	34.63	36.14	37.65
13	19.44	21.21	22.97	24.74	26.51	28.28	30.04	31.81	33.58	35.35	37.11	38.88	40.65	42.41	44.18
14	22.55	24.60	26.65	28.69	30.74	32.79	34.84	36.89	38.94	40.99	43.04	45.09	47.14	49.19	51.24
15	25.88	28.23	30.59	32.94	35.29	37.65	40.00	42.35	44.70	47.06	49.41	51.76	54.12	56.47	58.82
16	29.45	32.12	34.80	37.48	40.16	42.83	45.51	48.19	50.86	53.54	56.22	58.90	61.57	64.25	66.93
17	33.24	36.27	39.29	42.31	45.33	48.35	51.38	54.40	57.42	60.44	63.47	66.49	69.51	72.53	75.55
18	37.27	40.66	44.05	47.43	50.82	54.21	57.60	60.99	64.37	67.76	71.15	74.54	77.93	81.32	84.70
19	41.53	45.30	49.08	52.85	56.63	60.40	64.18	67.95	71.73	75.50	79.28	83.05	86.83	90.60	94.38
20	46.01	50.19	54.38	58.56	62.74	66.93	71.11	75.29	79.48	83.66	87.84	92.02	96.21	100.39	104.57
21	50.73	55.34	59.95	64.56	69.17	73.79	78.40	83.01	87.62	92.23	96.84	101.46	106.07	110.68	115.29
22	55.67	60.74	65.80	70.86	75.92	80.98	86.04	91.10	96.16	101.23	106.29	111.35	116.41	121.47	126.53
23	60.85	66.38	71.91	77.45	82.98	88.51	94.04	99.57	105.11	110.64	116.17	121.70	127.23	132.77	138.30
24	66.26	72.28	78.30	84.33	90.35	96.37	102.40	108.42	114.44	120.47	126.49	132.51	138.54	144.56	150.58
25	71.89	78.43	84.97	91.50	98.04	104.57	111.11	117.64	124.18	130.72	137.25	143.79	150.32	156.86	163.39
26	77.76	84.83	91.90	98.97	106.04	113.11	120.17	127.24	134.31	141.38	148.45	155.52	162.59	169.66	176.73
27	83.86	91.48	99.10	106.73	114.35	121.97	129.60	137.22	144.84	152.47	160.09	167.71	175.34	182.96	190.58
28	90.18	98.38	106.58	114.78	122.98	131.18	139.37	147.57	155.77	163.97	172.17	180.37	188.57	196.76	204.96
29	96.74	105.53	114.33	123.12	131.92	140.71	149.51	158.30	167.10	175.89	184.69	193.48	202.27	211.07	219.86
30	103.53	112.94	122.35	131.76	141.17	150.58	160.00	169.41	178.82	188.23	197.64	207.05	216.47	225.88	235.29

Appendix XXVII: Carbon table for *Betula alnoides* (31-50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	119.35	127.31	135.27	143.22	151.18	159.14	167.10	175.05	183.01	190.97	198.92	206.88	214.84	222.79	230.75	238.71
32	127.18	135.66	144.14	152.61	161.09	169.57	178.05	186.53	195.01	203.49	211.96	220.44	228.92	237.40	245.88	254.36
33	135.25	144.27	153.28	162.30	171.32	180.34	189.35	198.37	207.39	216.40	225.42	234.44	243.45	252.47	261.49	270.50
34	143.57	153.14	162.72	172.29	181.86	191.43	201.00	210.57	220.14	229.72	239.29	248.86	258.43	268.00	277.57	287.15
35	152.14	162.29	172.43	182.57	192.71	202.86	213.00	223.14	233.28	243.43	253.57	263.71	273.86	284.00	294.14	304.28
36	160.96	171.69	182.42	193.15	203.88	214.61	225.34	236.08	246.81	257.54	268.27	279.00	289.73	300.46	311.19	321.92
37	170.03	181.36	192.70	204.03	215.37	226.70	238.04	249.37	260.71	272.04	283.38	294.71	306.05	317.38	328.72	340.05
38	179.34	191.30	203.25	215.21	227.17	239.12	251.08	263.03	274.99	286.95	298.90	310.86	322.81	334.77	346.73	358.68
39	188.90	201.50	214.09	226.69	239.28	251.87	264.47	277.06	289.65	302.25	314.84	327.43	340.03	352.62	365.22	377.81
40	198.72	211.96	225.21	238.46	251.71	264.96	278.20	291.45	304.70	317.95	331.19	344.44	357.69	370.94	384.19	397.43
41	208.78	222.69	236.61	250.53	264.45	278.37	292.29	306.21	320.12	334.04	347.96	361.88	375.80	389.72	403.63	417.55
42	219.08	233.69	248.30	262.90	277.51	292.11	306.72	321.32	335.93	350.54	365.14	379.75	394.35	408.96	423.56	438.17
43	229.64	244.95	260.26	275.57	290.88	306.19	321.50	336.81	352.12	367.43	382.74	398.05	413.35	428.66	443.97	459.28
44	240.45	256.48	272.51	288.54	304.57	320.60	336.63	352.66	368.69	384.71	400.74	416.77	432.80	448.83	464.86	480.89
45	251.50	268.27	285.03	301.80	318.57	335.33	352.10	368.87	385.63	402.40	419.17	435.93	452.70	469.47	486.23	503.00
46	262.80	280.32	297.84	315.36	332.88	350.40	367.92	385.44	402.96	420.48	438.00	455.52	473.04	490.56	508.08	525.60
47	274.35	292.64	310.93	329.22	347.51	365.80	384.09	402.38	420.67	438.96	457.25	475.54	493.84	512.13	530.42	548.71
48	286.15	305.23	324.31	343.38	362.46	381.54	400.61	419.69	438.77	457.84	476.92	496.00	515.07	534.15	553.23	572.30
49	298.20	318.08	337.96	357.84	377.72	397.60	417.48	437.36	457.24	477.12	497.00	516.88	536.76	556.64	576.52	596.40
50	310.49	331.19	351.89	372.59	393.29	413.99	434.69	455.39	476.09	496.79	517.49	538.19	558.89	579.59	600.29	620.99

Appendix XXVIII: Carbon table for *Betula alnoides* (>50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	285.03	304.04	323.04	342.04	361.04	380.05	399.05	418.05	437.05	456.05	475.06	494.06	513.06	532.06	551.07	570.07	589.07	608.07	627.07	646.08	665.08
52	296.32	316.08	335.83	355.59	375.34	395.09	414.85	434.60	454.36	474.11	493.87	513.62	533.38	553.13	572.89	592.64	612.40	632.15	651.91	671.66	691.42
53	307.83	328.35	348.87	369.39	389.92	410.44	430.96	451.48	472.00	492.52	513.05	533.57	554.09	574.61	595.13	615.66	636.18	656.70	677.22	697.74	718.26
54	319.55	340.86	362.16	383.46	404.77	426.07	447.37	468.68	489.98	511.29	532.59	553.89	575.20	596.50	617.80	639.11	660.41	681.71	703.02	724.32	745.62
55	331.50	353.60	375.70	397.80	419.90	442.00	464.10	486.20	508.30	530.40	552.50	574.60	596.70	618.80	640.90	663.00	685.10	707.20	729.30	751.40	773.50
56	343.66	366.57	389.48	412.39	435.31	458.22	481.13	504.04	526.95	549.86	572.77	595.68	618.59	641.50	664.41	687.32	710.24	733.15	756.06	778.97	801.88
57	356.05	379.78	403.52	427.25	450.99	474.73	498.46	522.20	545.94	569.67	593.41	617.15	640.88	664.62	688.36	712.09	735.83	759.56	783.30	807.04	830.77
58	368.65	393.22	417.80	442.38	466.95	491.53	516.11	540.68	565.26	589.84	614.41	638.99	663.57	688.14	712.72	737.30	761.87	786.45	811.03	835.60	860.18
59	381.47	406.90	432.33	457.76	483.19	508.63	534.06	559.49	584.92	610.35	635.78	661.21	686.65	712.08	737.51	762.94	788.37	813.80	839.23	864.66	890.10
60	394.51	420.81	447.11	473.41	499.71	526.01	552.31	578.62	604.92	631.22	657.52	683.82	710.12	736.42	762.72	789.02	815.32	841.62	867.92	894.22	920.52
61	407.77	434.96	462.14	489.32	516.51	543.69	570.88	598.06	625.25	652.43	679.62	706.80	733.99	761.17	788.36	815.54	842.73	869.91	897.09	924.28	951.46
62	421.25	449.33	477.42	505.50	533.58	561.67	589.75	617.83	645.92	674.00	702.08	730.17	758.25	786.33	814.42	842.50	870.58	898.67	926.75	954.83	982.92
63	434.95	463.94	492.94	521.94	550.93	579.93	608.93	637.92	666.92	695.92	724.91	753.91	782.91	811.90	840.90	869.90	898.89	927.89	956.89	985.88	1014.88
64	448.87	478.79	508.71	538.64	568.56	598.49	628.41	658.34	688.26	718.18	748.11	778.03	807.96	837.88	867.81	897.73	927.65	957.58	987.50	1017.43	1047.35
65	463.00	493.87	524.74	555.60	586.47	617.34	648.20	679.07	709.94	740.80	771.67	802.54	833.40	864.27	895.14	926.00	956.87	987.74	1018.60	1049.47	1080.34
66	477.36	509.18	541.01	572.83	604.65	636.48	668.30	700.12	731.95	763.77	795.60	827.42	859.24	891.07	922.89	954.72	986.54	1018.36	1050.19	1082.01	1113.83
67	491.93	524.73	557.52	590.32	623.11	655.91	688.71	721.50	754.30	787.09	819.89	852.68	885.48	918.27	951.07	983.87	1016.66	1049.46	1082.25	1115.05	1147.84
68	506.73	540.51	574.29	608.07	641.85	675.64	709.42	743.20	776.98	810.76	844.54	878.33	912.11	945.89	979.67	1013.45	1047.24	1081.02	1114.80	1148.58	1182.36
69	521.74	556.52	591.31	626.09	660.87	695.65	730.44	765.22	800.00	834.78	869.57	904.35	939.13	973.91	1008.70	1043.48	1078.26	1113.05	1147.83	1182.61	1217.39
70	536.97	572.77	608.57	644.37	680.17	715.96	751.76	787.56	823.36	859.16	894.95	930.75	966.55	1002.35	1038.15	1073.95	1109.74	1145.54	1181.34	1217.14	1252.94

Appendix XXIX: Carbon table for *Duabanga grandiflora* (10-30 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	6.72	7.33	7.95	8.56	9.17	9.78	10.39	11.00	11.61	12.22	12.84	13.45	14.06	14.67	15.28
11	8.14	8.87	9.61	10.35	11.09	11.83	12.57	13.31	14.05	14.79	15.53	16.27	17.01	17.75	18.49
12	9.68	10.56	11.44	12.32	13.20	14.08	14.96	15.84	16.72	17.60	18.48	19.36	20.24	21.12	22.00
13	11.36	12.40	13.43	14.46	15.49	16.53	17.56	18.59	19.63	20.66	21.69	22.72	23.76	24.79	25.82
14	13.18	14.38	15.57	16.77	17.97	19.17	20.37	21.56	22.76	23.96	25.16	26.35	27.55	28.75	29.95
15	15.13	16.50	17.88	19.25	20.63	22.00	23.38	24.75	26.13	27.50	28.88	30.25	31.63	33.00	34.38
16	17.21	18.78	20.34	21.91	23.47	25.03	26.60	28.16	29.73	31.29	32.86	34.42	35.99	37.55	39.12
17	19.43	21.20	22.96	24.73	26.50	28.26	30.03	31.79	33.56	35.33	37.09	38.86	40.63	42.39	44.16
18	21.78	23.76	25.74	27.72	29.70	31.68	33.66	35.65	37.63	39.61	41.59	43.57	45.55	47.53	49.51
19	24.27	26.48	28.68	30.89	33.10	35.30	37.51	39.72	41.92	44.13	46.34	48.54	50.75	52.95	55.16
20	26.89	29.34	31.78	34.23	36.67	39.12	41.56	44.01	46.45	48.90	51.34	53.79	56.23	58.68	61.12
21	29.65	32.34	35.04	37.74	40.43	43.13	45.82	48.52	51.21	53.91	56.60	59.30	61.99	64.69	67.38
22	32.54	35.50	38.46	41.41	44.37	47.33	50.29	53.25	56.21	59.16	62.12	65.08	68.04	71.00	73.96
23	35.57	38.80	42.03	45.27	48.50	51.73	54.97	58.20	61.43	64.66	67.90	71.13	74.36	77.60	80.83
24	38.73	42.25	45.77	49.29	52.81	56.33	59.85	63.37	66.89	70.41	73.93	77.45	80.97	84.49	88.01
25	42.02	45.84	49.66	53.48	57.30	61.12	64.94	68.76	72.58	76.40	80.22	84.04	87.86	91.68	95.50
26	45.45	49.58	53.71	57.84	61.98	66.11	70.24	74.37	78.50	82.63	86.77	90.90	95.03	99.16	103.29
27	49.01	53.47	57.92	62.38	66.83	71.29	75.75	80.20	84.66	89.11	93.57	98.02	102.48	106.94	111.39
28	52.71	57.50	62.29	67.09	71.88	76.67	81.46	86.25	91.04	95.84	100.63	105.42	110.21	115.00	119.80
29	56.54	61.68	66.82	71.96	77.10	82.24	87.38	92.52	97.66	102.80	107.94	113.08	118.22	123.36	128.50
30	60.51	66.01	71.51	77.01	82.51	88.01	93.51	99.01	104.52	110.02	115.52	121.02	126.52	132.02	137.52

Appendix XXX: Carbon table for *Duabanga grandiflora* (31-50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	90.31	96.33	102.35	108.37	114.39	120.41	126.43	132.45	138.47	144.49	150.51	156.53	162.55	168.57	174.59	180.61
32	96.23	102.64	109.06	115.47	121.89	128.30	134.72	141.13	147.55	153.96	160.38	166.79	173.21	179.62	186.04	192.45
33	102.34	109.16	115.98	122.80	129.62	136.45	143.27	150.09	156.91	163.74	170.56	177.38	184.20	191.03	197.85	204.67
34	108.63	115.87	123.12	130.36	137.60	144.84	152.08	159.33	166.57	173.81	181.05	188.29	195.54	202.78	210.02	217.26
35	115.12	122.79	130.46	138.14	145.81	153.49	161.16	168.84	176.51	184.19	191.86	199.53	207.21	214.88	222.56	230.23
36	121.79	129.91	138.03	146.15	154.26	162.38	170.50	178.62	186.74	194.86	202.98	211.10	219.22	227.34	235.46	243.58
37	128.65	137.22	145.80	154.38	162.95	171.53	180.11	188.68	197.26	205.84	214.41	222.99	231.57	240.14	248.72	257.30
38	135.70	144.74	153.79	162.83	171.88	180.93	189.97	199.02	208.07	217.11	226.16	235.21	244.25	253.30	262.34	271.39
39	142.93	152.46	161.99	171.52	181.05	190.58	200.10	209.63	219.16	228.69	238.22	247.75	257.28	266.81	276.33	285.86
40	150.36	160.38	170.40	180.43	190.45	200.47	210.50	220.52	230.54	240.57	250.59	260.62	270.64	280.66	290.69	300.71
41	157.97	168.50	179.03	189.56	200.09	210.62	221.15	231.68	242.22	252.75	263.28	273.81	284.34	294.87	305.40	315.93
42	165.77	176.82	187.87	198.92	209.97	221.02	232.07	243.12	254.18	265.23	276.28	287.33	298.38	309.43	320.48	331.53
43	173.75	185.34	196.92	208.51	220.09	231.67	243.26	254.84	266.42	278.01	289.59	301.17	312.76	324.34	335.92	347.51
44	181.93	194.06	206.19	218.32	230.44	242.57	254.70	266.83	278.96	291.09	303.22	315.34	327.47	339.60	351.73	363.86
45	190.29	202.98	215.67	228.35	241.04	253.72	266.41	279.10	291.78	304.47	317.16	329.84	342.53	355.21	367.90	380.59
46	198.84	212.10	225.36	238.61	251.87	265.13	278.38	291.64	304.90	318.15	331.41	344.66	357.92	371.18	384.43	397.69
47	207.58	221.42	235.26	249.10	262.94	276.78	290.62	304.46	318.30	332.13	345.97	359.81	373.65	387.49	401.33	415.17
48	216.51	230.95	245.38	259.81	274.25	288.68	303.12	317.55	331.98	346.42	360.85	375.29	389.72	404.15	418.59	433.02
49	225.63	240.67	255.71	270.75	285.79	300.84	315.88	330.92	345.96	361.00	376.04	391.09	406.13	421.17	436.21	451.25
50	234.93	250.59	266.25	281.92	297.58	313.24	328.90	344.56	360.23	375.89	391.55	407.21	422.87	438.54	454.20	469.86

Appendix XXXI: Carbon table for *Duabanga grandiflora* (>50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	213.12	227.33	241.54	255.75	269.96	284.16	298.37	312.58	326.79	341.00	355.21	369.41	383.62	397.83	412.04	426.25	440.45	454.66	468.87	483.08	497.29
52	221.56	236.33	251.10	265.88	280.65	295.42	310.19	324.96	339.73	354.50	369.27	384.04	398.81	413.58	428.36	443.13	457.90	472.67	487.44	502.21	516.98
53	230.17	245.51	260.86	276.20	291.54	306.89	322.23	337.58	352.92	368.27	383.61	398.96	414.30	429.64	444.99	460.33	475.68	491.02	506.37	521.71	537.06
54	238.93	254.86	270.79	286.72	302.65	318.58	334.51	350.44	366.37	382.29	398.22	414.15	430.08	446.01	461.94	477.87	493.80	509.73	525.66	541.58	557.51
55	247.87	264.39	280.91	297.44	313.96	330.49	347.01	363.54	380.06	396.58	413.11	429.63	446.16	462.68	479.21	495.73	512.26	528.78	545.30	561.83	578.35
56	256.96	274.09	291.22	308.35	325.48	342.61	359.74	376.88	394.01	411.14	428.27	445.40	462.53	479.66	496.79	513.92	531.05	548.18	565.31	582.44	599.57
57	266.22	283.97	301.72	319.46	337.21	354.96	372.71	390.46	408.20	425.95	443.70	461.45	479.20	496.94	514.69	532.44	550.19	567.94	585.68	603.43	621.18
58	275.64	294.02	312.40	330.77	349.15	367.52	385.90	404.28	422.65	441.03	459.40	477.78	496.16	514.53	532.91	551.29	569.66	588.04	606.41	624.79	643.17
59	285.23	304.24	323.26	342.28	361.29	380.31	399.32	418.34	437.35	456.37	475.38	494.40	513.41	532.43	551.44	570.46	589.47	608.49	627.51	646.52	665.54
60	294.98	314.65	334.31	353.98	373.64	393.31	412.97	432.64	452.30	471.97	491.63	511.30	530.96	550.63	570.30	589.96	609.63	629.29	648.96	668.62	688.29
61	304.90	325.22	345.55	365.87	386.20	406.53	426.85	447.18	467.51	487.83	508.16	528.48	548.81	569.14	589.46	609.79	630.12	650.44	670.77	691.10	711.42
62	314.97	335.97	356.97	377.97	398.97	419.96	440.96	461.96	482.96	503.96	524.96	545.95	566.95	587.95	608.95	629.95	650.95	671.94	692.94	713.94	734.94
63	325.22	346.90	368.58	390.26	411.94	433.62	455.30	476.98	498.66	520.35	542.03	563.71	585.39	607.07	628.75	650.43	672.11	693.79	715.47	737.16	758.84
64	335.62	358.00	380.37	402.75	425.12	447.50	469.87	492.25	514.62	537.00	559.37	581.75	604.12	626.49	648.87	671.24	693.62	715.99	738.37	760.74	783.12
65	346.19	369.27	392.35	415.43	438.51	461.59	484.67	507.75	530.83	553.91	576.99	600.07	623.15	646.23	669.31	692.38	715.46	738.54	761.62	784.70	807.78
66	356.93	380.72	404.52	428.31	452.11	475.90	499.70	523.49	547.29	571.08	594.88	618.67	642.47	666.26	690.06	713.85	737.65	761.44	785.24	809.03	832.83
67	367.82	392.35	416.87	441.39	465.91	490.43	514.95	539.48	564.00	588.52	613.04	637.56	662.08	686.61	711.13	735.65	760.17	784.69	809.21	833.73	858.26
68	378.89	404.14	429.40	454.66	479.92	505.18	530.44	555.70	580.96	606.22	631.48	656.74	681.99	707.25	732.51	757.77	783.03	808.29	833.55	858.81	884.07
69	390.11	416.12	442.13	468.13	494.14	520.15	546.16	572.16	598.17	624.18	650.19	676.19	702.20	728.21	754.22	780.22	806.23	832.24	858.25	884.25	910.26
70	401.50	428.27	455.03	481.80	508.57	535.33	562.10	588.87	615.64	642.40	669.17	695.94	722.70	749.47	776.24	803.00	829.77	856.54	883.30	910.07	936.84

Appendix XXXII: Carbon table for *Magnolia champaca* (10-30 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	13.71	14.95	16.20	17.45	18.69	19.94	21.19	22.43	23.68	24.92	26.17	27.42	28.66	29.91	31.16
11	16.59	18.09	19.60	21.11	22.62	24.13	25.63	27.14	28.65	30.16	31.67	33.17	34.68	36.19	37.70
12	19.74	21.53	23.33	25.12	26.92	28.71	30.51	32.30	34.10	35.89	37.69	39.48	41.27	43.07	44.86
13	23.17	25.27	27.38	29.49	31.59	33.70	35.80	37.91	40.02	42.12	44.23	46.33	48.44	50.55	52.65
14	26.87	29.31	31.75	34.20	36.64	39.08	41.52	43.97	46.41	48.85	51.29	53.74	56.18	58.62	61.06
15	30.84	33.65	36.45	39.26	42.06	44.86	47.67	50.47	53.28	56.08	58.88	61.69	64.49	67.29	70.10
16	35.09	38.28	41.47	44.66	47.85	51.04	54.23	57.42	60.62	63.81	67.00	70.19	73.38	76.57	79.76
17	39.62	43.22	46.82	50.42	54.02	57.62	61.23	64.83	68.43	72.03	75.63	79.23	82.83	86.44	90.04
18	44.41	48.45	52.49	56.53	60.57	64.60	68.64	72.68	76.72	80.75	84.79	88.83	92.87	96.90	100.94
19	49.49	53.99	58.48	62.98	67.48	71.98	76.48	80.98	85.48	89.98	94.47	98.97	103.47	107.97	112.47
20	54.83	59.82	64.80	69.79	74.77	79.76	84.74	89.73	94.71	99.70	104.68	109.67	114.65	119.64	124.62
21	60.45	65.95	71.44	76.94	82.44	87.93	93.43	98.92	104.42	109.91	115.41	120.91	126.40	131.90	137.39
22	66.35	72.38	78.41	84.44	90.47	96.51	102.54	108.57	114.60	120.63	126.66	132.70	138.73	144.76	150.79
23	72.52	79.11	85.70	92.29	98.89	105.48	112.07	118.66	125.26	131.85	138.44	145.03	151.63	158.22	164.81
24	78.96	86.14	93.32	100.49	107.67	114.85	122.03	129.21	136.38	143.56	150.74	157.92	165.10	172.27	179.45
25	85.68	93.47	101.25	109.04	116.83	124.62	132.41	140.20	147.99	155.78	163.56	171.35	179.14	186.93	194.72
26	92.67	101.09	109.52	117.94	126.36	134.79	143.21	151.64	160.06	168.49	176.91	185.33	193.76	202.18	210.61
27	99.93	109.02	118.10	127.19	136.27	145.36	154.44	163.53	172.61	181.70	190.78	199.87	208.95	218.04	227.12
28	107.47	117.24	127.01	136.78	146.55	156.32	166.09	175.86	185.63	195.40	205.17	214.94	224.71	234.48	244.26
29	115.29	125.77	136.25	146.73	157.21	167.69	178.17	188.65	199.13	209.61	220.09	230.57	241.05	251.53	262.01
30	123.37	134.59	145.81	157.02	168.24	179.45	190.67	201.88	213.10	224.32	235.53	246.75	257.96	269.18	280.40

Appendix XXXIII: Carbon table for *Magnolia champaca* (31-50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	131.35	140.11	148.86	157.62	166.38	175.13	183.89	192.65	201.40	210.16	218.92	227.67	236.43	245.19	253.94	262.70
32	139.96	149.29	158.62	167.95	177.28	186.61	195.94	205.28	214.61	223.94	233.27	242.60	251.93	261.26	270.59	279.92
33	148.84	158.77	168.69	178.61	188.54	198.46	208.38	218.31	228.23	238.15	248.07	258.00	267.92	277.84	287.77	297.69
34	158.00	168.54	179.07	189.60	200.14	210.67	221.20	231.74	242.27	252.80	263.34	273.87	284.40	294.94	305.47	316.00
35	167.43	178.60	189.76	200.92	212.08	223.24	234.41	245.57	256.73	267.89	279.06	290.22	301.38	312.54	323.70	334.87
36	177.14	188.95	200.76	212.56	224.37	236.18	247.99	259.80	271.61	283.42	295.23	307.04	318.85	330.66	342.47	354.27
37	187.11	199.59	212.06	224.54	237.01	249.49	261.96	274.44	286.91	299.38	311.86	324.33	336.81	349.28	361.76	374.23
38	197.37	210.52	223.68	236.84	250.00	263.15	276.31	289.47	302.63	315.79	328.94	342.10	355.26	368.42	381.57	394.73
39	207.89	221.75	235.61	249.47	263.33	277.19	291.05	304.91	318.77	332.62	346.48	360.34	374.20	388.06	401.92	415.78
40	218.69	233.27	247.85	262.43	277.00	291.58	306.16	320.74	335.32	349.90	364.48	379.06	393.64	408.22	422.80	437.38
41	229.76	245.08	260.39	275.71	291.03	306.35	321.66	336.98	352.30	367.61	382.93	398.25	413.57	428.88	444.20	459.52
42	241.10	257.18	273.25	289.32	305.40	321.47	337.54	353.62	369.69	385.77	401.84	417.91	433.99	450.06	466.13	482.21
43	252.72	269.57	286.42	303.27	320.11	336.96	353.81	370.66	387.51	404.35	421.20	438.05	454.90	471.75	488.59	505.44
44	264.61	282.25	299.89	317.53	335.18	352.82	370.46	388.10	405.74	423.38	441.02	458.66	476.30	493.94	511.58	529.22
45	276.78	295.23	313.68	332.13	350.58	369.04	387.49	405.94	424.39	442.84	461.30	479.75	498.20	516.65	535.10	553.55
46	289.21	308.50	327.78	347.06	366.34	385.62	404.90	424.18	443.46	462.74	482.02	501.31	520.59	539.87	559.15	578.43
47	301.93	322.05	342.18	362.31	382.44	402.57	422.70	442.82	462.95	483.08	503.21	523.34	543.47	563.60	583.72	603.85
48	314.91	335.90	356.90	377.89	398.89	419.88	440.88	461.87	482.86	503.86	524.85	545.85	566.84	587.83	608.83	629.82
49	328.17	350.05	371.92	393.80	415.68	437.56	459.44	481.31	503.19	525.07	546.95	568.83	590.70	612.58	634.46	656.34
50	341.70	364.48	387.26	410.04	432.82	455.60	478.38	501.16	523.94	546.72	569.50	592.28	615.06	637.84	660.62	683.40

Appendix XXXIV: Carbon table for *Magnolia champaca* (>50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	346.36	369.45	392.54	415.63	438.72	461.81	484.90	507.99	531.08	554.17	577.26	600.35	623.44	646.53	669.62	692.71	715.80	738.89	761.98	785.07	808.16
52	360.07	384.08	408.08	432.09	456.09	480.10	504.10	528.10	552.11	576.11	600.12	624.12	648.13	672.13	696.14	720.14	744.15	768.15	792.16	816.16	840.17
53	374.05	398.99	423.93	448.86	473.80	498.74	523.67	548.61	573.55	598.49	623.42	648.36	673.30	698.23	723.17	748.11	773.04	797.98	822.92	847.85	872.79
54	388.30	414.19	440.08	465.96	491.85	517.74	543.62	569.51	595.40	621.28	647.17	673.06	698.94	724.83	750.72	776.60	802.49	828.38	854.26	880.15	906.04
55	402.82	429.67	456.53	483.38	510.23	537.09	563.94	590.80	617.65	644.51	671.36	698.22	725.07	751.92	778.78	805.63	832.49	859.34	886.20	913.05	939.91
56	417.60	445.44	473.28	501.12	528.96	556.80	584.64	612.48	640.32	668.16	696.00	723.84	751.68	779.52	807.36	835.20	863.04	890.87	918.71	946.55	974.39
57	432.64	461.49	490.33	519.17	548.02	576.86	605.70	634.55	663.39	692.23	721.07	749.92	778.76	807.60	836.45	865.29	894.13	922.98	951.82	980.66	1009.50
58	447.96	477.82	507.69	537.55	567.41	597.28	627.14	657.01	686.87	716.73	746.60	776.46	806.33	836.19	866.05	895.92	925.78	955.65	985.51	1015.37	1045.24
59	463.54	494.44	525.34	556.25	587.15	618.05	648.95	679.86	710.76	741.66	772.56	803.47	834.37	865.27	896.17	927.08	957.98	988.88	1019.79	1050.69	1081.59
60	479.39	511.34	543.30	575.26	607.22	639.18	671.14	703.10	735.06	767.02	798.98	830.93	862.89	894.85	926.81	958.77	990.73	1022.69	1054.65	1086.61	1118.57
61	495.50	528.53	561.56	594.60	627.63	660.66	693.70	726.73	759.76	792.80	825.83	858.86	891.90	924.93	957.96	991.00	1024.03	1057.06	1090.09	1123.13	1156.16
62	511.88	546.00	580.13	614.25	648.38	682.50	716.63	750.75	784.88	819.00	853.13	887.25	921.38	955.50	989.63	1023.75	1057.88	1092.00	1126.13	1160.25	1194.38
63	528.52	563.76	598.99	634.23	669.46	704.70	739.93	775.17	810.40	845.64	880.87	916.10	951.34	986.57	1021.81	1057.04	1092.28	1127.51	1162.75	1197.98	1233.22
64	545.43	581.80	618.16	654.52	690.88	727.24	763.61	799.97	836.33	872.69	909.06	945.42	981.78	1018.14	1054.50	1090.87	1127.23	1163.59	1199.95	1236.32	1272.68
0.65	562.61	600.12	637.63	675.13	712.64	750.15	787.66	825.16	862.67	900.18	937.69	975.19	1012.70	1050.21	1087.72	1125.22	1162.73	1200.24	1237.75	1275.25	1312.76
66	580.06	618.73	657.40	696.07	734.74	773.41	812.08	850.75	889.42	928.09	966.76	1005.43	1044.10	1082.77	1121.44	1160.11	1198.78	1237.45	1276.12	1314.79	1353.46
67	597.77	637.62	677.47	717.32	757.17	797.02	836.87	876.72	916.58	956.43	996.28	1036.13	1075.98	1115.83	1155.68	1195.53	1235.38	1275.24	1315.09	1354.94	1394.79
68	615.74	656.79	697.84	738.89	779.94	820.99	862.04	903.09	944.14	985.19	1026.24	1067.29	1108.34	1149.39	1190.44	1231.49	1272.54	1313.59	1354.64	1395.69	1436.73
69	633.99	676.25	718.52	760.78	803.05	845.32	887.58	929.85	972.11	1014.38	1056.64	1098.91	1141.18	1183.44	1225.71	1267.97	1310.24	1352.50	1394.77	1437.04	1479.30
70	652.50	696.00	739.50	783.00	826.50	870.00	913.49	956.99	1000.49	1043.99	1087.49	1130.99	1174.49	1217.99	1261.49	1304.99	1348.49	1391.99	1435.49	1478.99	1522.49

Appendix XXXV: Carbon table for *Toona ciliata* (10-30 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)														
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	9.18	10.01	10.85	11.68	12.52	13.35	14.18	15.02	15.85	16.69	17.52	18.36	19.19	20.03	20.86
11	11.11	12.12	13.13	14.13	15.14	16.15	17.16	18.17	19.18	20.19	21.20	22.21	23.22	24.23	25.24
12	13.22	14.42	15.62	16.82	18.02	19.22	20.43	21.63	22.83	24.03	25.23	26.43	27.64	28.84	30.04
13	15.51	16.92	18.33	19.74	21.15	22.56	23.97	25.38	26.79	28.20	29.61	31.02	32.43	33.84	35.25
14	17.99	19.63	21.26	22.90	24.53	26.17	27.80	29.44	31.07	32.71	34.34	35.98	37.61	39.25	40.89
15	20.65	22.53	24.41	26.28	28.16	30.04	31.92	33.79	35.67	37.55	39.43	41.30	43.18	45.06	46.94
16	23.50	25.63	27.77	29.90	32.04	34.18	36.31	38.45	40.59	42.72	44.86	46.99	49.13	51.27	53.40
17	26.53	28.94	31.35	33.76	36.17	38.58	40.99	43.41	45.82	48.23	50.64	53.05	55.46	57.87	60.29
18	29.74	32.44	35.14	37.85	40.55	43.26	45.96	48.66	51.37	54.07	56.77	59.48	62.18	64.88	67.59
19	33.13	36.15	39.16	42.17	45.18	48.19	51.21	54.22	57.23	60.24	63.26	66.27	69.28	72.29	75.30
20	36.71	40.05	43.39	46.73	50.06	53.40	56.74	60.08	63.41	66.75	70.09	73.43	76.76	80.10	83.44
21	40.48	44.16	47.84	51.52	55.20	58.88	62.55	66.23	69.91	73.59	77.27	80.95	84.63	88.31	91.99
22	44.42	48.46	52.50	56.54	60.58	64.62	68.65	72.69	76.73	80.77	84.81	88.85	92.89	96.92	100.96
23	48.55	52.97	57.38	61.80	66.21	70.62	75.04	79.45	83.87	88.28	92.69	97.11	101.52	105.94	110.35
24	52.87	57.67	62.48	67.29	72.09	76.90	81.70	86.51	91.32	96.12	100.93	105.74	110.54	115.35	120.15
25	57.37	62.58	67.80	73.01	78.23	83.44	88.66	93.87	99.09	104.30	109.52	114.73	119.95	125.16	130.38
26	62.05	67.69	73.33	78.97	84.61	90.25	95.89	101.53	107.17	112.81	118.45	124.09	129.73	135.37	141.01
27	66.91	72.99	79.08	85.16	91.24	97.32	103.41	109.49	115.57	121.66	127.74	133.82	139.90	145.99	152.07
28	71.96	78.50	85.04	91.58	98.13	104.67	111.21	117.75	124.29	130.83	137.38	143.92	150.46	157.00	163.54
29	77.19	84.21	91.22	98.24	105.26	112.28	119.29	126.31	133.33	140.35	147.36	154.38	161.40	168.42	175.43
30	82.61	90.12	97.62	105.13	112.64	120.15	127.66	135.17	142.68	150.19	157.70	165.21	172.72	180.23	187.74

Appendix XXXVI: Carbon table for *Toona ciliata* (31-50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)															
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	75.07	80.08	85.08	90.09	95.09	100.10	105.10	110.11	115.11	120.12	125.12	130.13	135.13	140.14	145.14	150.15
32	79.99	85.33	90.66	95.99	101.33	106.66	111.99	117.33	122.66	127.99	133.32	138.66	143.99	149.32	154.66	159.99
33	85.07	90.74	96.42	102.09	107.76	113.43	119.10	124.77	130.44	136.12	141.79	147.46	153.13	158.80	164.47	170.15
34	90.31	96.33	102.35	108.37	114.39	120.41	126.43	132.45	138.47	144.49	150.51	156.53	162.55	168.57	174.59	180.61
35	95.70	102.08	108.46	114.84	121.22	127.60	133.98	140.36	146.74	153.12	159.50	165.87	172.25	178.63	185.01	191.39
36	101.24	107.99	114.74	121.49	128.24	134.99	141.74	148.49	155.24	161.99	168.74	175.49	182.24	188.99	195.74	202.49
37	106.95	114.08	121.21	128.34	135.47	142.60	149.72	156.85	163.98	171.11	178.24	185.37	192.50	199.63	206.76	213.89
38	112.81	120.33	127.85	135.37	142.89	150.41	157.93	165.45	172.97	180.49	188.01	195.53	203.05	210.57	218.09	225.61
39	118.82	126.74	134.66	142.58	150.51	158.43	166.35	174.27	182.19	190.11	198.03	205.96	213.88	221.80	229.72	237.64
40	124.99	133.32	141.66	149.99	158.32	166.66	174.99	183.32	191.65	199.99	208.32	216.65	224.99	233.32	241.65	249.98
41	131.32	140.07	148.83	157.58	166.34	175.09	183.85	192.60	201.36	210.11	218.87	227.62	236.38	245.13	253.88	262.64
42	137.80	146.99	156.18	165.36	174.55	183.74	192.93	202.11	211.30	220.49	229.67	238.86	248.05	257.23	266.42	275.61
43	144.44	154.07	163.70	173.33	182.96	192.59	202.22	211.85	221.48	231.11	240.74	250.37	260.00	269.63	279.26	288.89
44	151.24	161.32	171.41	181.49	191.57	201.65	211.74	221.82	231.90	241.98	252.07	262.15	272.23	282.32	292.40	302.48
45	158.19	168.74	179.29	189.83	200.38	210.92	221.47	232.02	242.56	253.11	263.66	274.20	284.75	295.29	305.84	316.39
46	165.30	176.32	187.34	198.36	209.38	220.40	231.42	242.44	253.46	264.48	275.50	286.52	297.54	308.56	319.58	330.60
47	172.57	184.07	195.58	207.08	218.58	230.09	241.59	253.10	264.60	276.11	287.61	299.12	310.62	322.13	333.63	345.13
48	179.99	191.99	203.99	215.99	227.99	239.98	251.98	263.98	275.98	287.98	299.98	311.98	323.98	335.98	347.98	359.98
49	187.57	200.07	212.57	225.08	237.58	250.09	262.59	275.10	287.60	300.11	312.61	325.11	337.62	350.12	362.63	375.13
50	195.30	208.32	221.34	234.36	247.38	260.40	273.42	286.44	299.46	312.48	325.50	338.52	351.54	364.56	377.58	390.60

Appendix XXXVII: Carbon table for *Toona ciliata* (>50 cm diameter class) in kg/tree

Diameter at breast height (cm)	Height (m)																				
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
51	276.38	294.81	313.23	331.66	350.08	368.51	386.94	405.36	423.79	442.21	460.64	479.06	497.49	515.91	534.34	552.76	571.19	589.62	608.04	626.47	644.89
52	287.33	306.48	325.64	344.79	363.95	383.10	402.26	421.41	440.57	459.72	478.88	498.03	517.19	536.34	555.50	574.65	593.81	612.96	632.12	651.27	670.43
53	298.48	318.38	338.28	358.18	378.08	397.98	417.88	437.78	457.68	477.57	497.47	517.37	537.27	557.17	577.07	596.97	616.87	636.77	656.67	676.56	696.46
54	309.85	330.51	351.17	371.82	392.48	413.14	433.80	454.45	475.11	495.77	516.42	537.08	557.74	578.39	599.05	619.71	640.37	661.02	681.68	702.34	722.99
55	321.44	342.87	364.29	385.72	407.15	428.58	450.01	471.44	492.87	514.30	535.73	557.16	578.59	600.01	621.44	642.87	664.30	685.73	707.16	728.59	750.02
56	333.23	355.45	377.66	399.88	422.09	444.31	466.52	488.74	510.95	533.17	555.39	577.60	599.82	622.03	644.25	666.46	688.68	710.89	733.11	755.32	777.54
57	345.24	368.25	391.27	414.29	437.30	460.32	483.33	506.35	529.37	552.38	575.40	598.41	621.43	644.45	667.46	690.48	713.49	736.51	759.53	782.54	805.56
58	357.46	381.29	405.12	428.95	452.78	476.61	500.44	524.27	548.10	571.93	595.76	619.59	643.43	667.26	691.09	714.92	738.75	762.58	786.41	810.24	834.07
59	369.89	394.55	419.21	443.87	468.53	493.19	517.85	542.51	567.17	591.83	616.49	641.14	665.80	690.46	715.12	739.78	764.44	789.10	813.76	838.42	863.08
60	382.54	408.04	433.54	459.04	484.55	510.05	535.55	561.05	586.56	612.06	637.56	663.06	688.56	714.07	739.57	765.07	790.57	816.08	841.58	867.08	892.58
61	395.39	421.75	448.11	474.47	500.83	527.19	553.55	579.91	606.27	632.63	658.99	685.35	711.71	738.07	764.43	790.79	817.15	843.51	869.87	896.23	922.58
62	408.46	435.69	462.93	490.16	517.39	544.62	571.85	599.08	626.31	653.54	680.77	708.00	735.23	762.47	789.70	816.93	844.16	871.39	898.62	925.85	953.08
63	421.75	449.86	477.98	506.10	534.21	562.33	590.44	618.56	646.68	674.79	702.91	731.03	759.14	787.26	815.38	843.49	871.61	899.72	927.84	955.96	984.07
64	435.24	464.26	493.27	522.29	551.31	580.32	609.34	638.35	667.37	696.39	725.40	754.42	783.43	812.45	841.47	870.48	899.50	928.51	957.53	986.55	1015.56
65	448.95	478.88	508.81	538.74	568.67	598.60	628.53	658.46	688.39	718.32	748.25	778.18	808.11	838.04	867.97	897.90	927.83	957.76	987.69	1017.62	1047.55
66	462.87	493.73	524.58	555.44	586.30	617.16	648.02	678.87	709.73	740.59	771.45	802.31	833.16	864.02	894.88	925.74	956.60	987.45	1018.31	1049.17	1080.03
67	477.00	508.80	540.60	572.40	604.20	636.00	667.80	699.60	731.40	763.20	795.00	826.80	858.60	890.40	922.20	954.00	985.80	1017.60	1049.40	1081.20	1113.00
68	491.35	524.10	556.86	589.62	622.37	655.13	687.88	720.64	753.40	786.15	818.91	851.67	884.42	917.18	949.94	982.69	1015.45	1048.21	1080.96	1113.72	1146.47
69	505.90	539.63	573.36	607.08	640.81	674.54	708.27	741.99	775.72	809.45	843.17	876.90	910.63	944.35	978.08	1011.81	1045.53	1079.26	1112.99	1146.72	1180.44
70	520.67	555.39	590.10	624.81	659.52	694.23	728.94	763.66	798.37	833.08	867.79	902.50	937.21	971.92	1006.64	1041.35	1076.06	1110.77	1145.48	1180.19	1214.91

Appendix: XXXVIII Volume, biomass and carbon table for *Betula alnoides* (DBH 10 -51 cm)

DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)	DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)
10	0.068	39.04	19.52	**31**	0.603	345.37	172.68
11	0.082	47.24	23.62	**32**	0.642	368.01	184.01
12	0.098	56.22	28.11	**33**	0.683	391.37	195.69
13	0.115	65.98	32.99	**34**	0.725	415.45	207.72
14	0.134	76.53	38.26	**35**	0.768	440.25	220.12
15	0.153	87.85	43.92	**36**	0.813	465.76	232.88
16	0.174	99.95	49.98	**37**	0.859	492.00	246.00
17	0.197	112.84	56.42	**38**	0.906	518.95	259.48
18	0.221	126.50	63.25	**39**	0.954	546.63	273.31
19	0.246	140.95	70.47	**40**	1.004	575.02	287.51
20	0.273	156.18	78.09	**41**	1.054	604.13	302.06
21	0.300	172.19	86.09	**42**	1.106	633.96	316.98
22	0.330	188.97	94.49	**43**	1.160	664.50	332.25
23	0.360	206.54	103.27	**44**	1.214	695.77	347.89
24	0.392	224.89	112.45	**45**	1.270	727.76	363.88
25	0.426	244.03	122.01	**46**	1.327	760.46	380.23
26	0.461	263.94	131.97	**47**	1.385	793.88	396.94
27	0.497	284.63	142.32	**48**	1.445	828.02	414.01
28	0.534	306.11	153.05	**49**	1.506	862.88	431.44
29	0.573	328.36	164.18	**50**	1.568	898.46	449.23
30	0.613	351.40	175.70	**51**	1.583	907.04	453.52

Appendix: XXXIX Volume, biomass and carbon table for *Betula alnoides* (DBH 51-100 cm)

DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)	DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)
51	1.583	907.04	453.52	**76**	3.515	2014.25	1007.13
52	1.646	942.96	471.48	**77**	3.608	2067.61	1033.80
53	1.710	979.58	489.79	**78**	3.703	2121.66	1060.83
54	1.775	1016.89	508.45	**79**	3.798	2176.41	1088.21
55	1.841	1054.90	527.45	**80**	3.895	2231.86	1115.93
56	1.909	1093.61	546.81	**81**	3.993	2288.00	1144.00
57	1.977	1133.02	566.51	**82**	4.092	2344.85	1172.42
58	2.047	1173.12	586.56	**83**	4.193	2402.39	1201.19
69	2.119	1213.92	606.96	**84**	4.294	2460.62	1230.31
60	2.191	1255.42	627.71	**85**	4.397	2519.56	1259.78
61	2.265	1297.62	648.81	**86**	4.501	2579.19	1289.60
62	2.339	1340.51	670.25	**87**	4.606	2639.52	1319.76
63	2.416	1384.10	692.05	**88**	4.713	2700.55	1350.27
64	2.493	1428.39	714.19	**89**	4.821	2762.27	1381.14
65	2.571	1473.37	736.69	**90**	4.930	2824.70	1412.35
66	2.651	1519.06	759.53	**91**	5.040	2887.81	1443.91
67	2.732	1565.44	782.72	**92**	5.151	2951.63	1475.82
68	2.814	1612.52	806.26	**93**	5.264	3016.15	1508.07
69	2.898	1660.29	830.15	**94**	5.378	3081.36	1540.68
70	2.982	1708.77	854.38	**95**	5.493	3147.27	1573.63
71	3.068	1757.94	878.97	**96**	5.609	3213.88	1606.94
72	3.155	1807.80	903.90	**97**	5.726	3281.18	1640.59
73	3.243	1858.37	929.19	**98**	5.845	3349.18	1674.59
74	3.333	1909.63	954.82	**99**	5.965	3417.88	1708.94
75	3.423	1961.59	980.80	**100**	6.086	3487.28	1743.64

Appendix: XL Volume, biomass and carbon table for *Duabanga grandiflora* (DBH 10 - 51 cm)

DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)	DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)
10	0.049	18.82	9.41	**31**	0.690	263.47	131.73
11	0.060	22.77	11.38	**32**	0.735	280.74	140.37
12	0.071	27.10	13.55	**33**	0.782	298.56	149.28
13	0.083	31.80	15.90	**34**	0.830	316.93	158.47
14	0.097	36.88	18.44	**35**	0.879	335.85	167.92
15	0.111	42.34	21.17	**36**	0.930	355.31	177.66
16	0.126	48.17	24.09	**37**	0.983	375.33	187.66
17	0.142	54.38	27.19	**38**	1.036	395.89	197.94
18	0.160	60.97	30.48	**39**	1.092	417.00	208.50
19	0.178	67.93	33.97	**40**	1.148	438.66	219.33
20	0.197	75.27	37.63	**41**	1.206	460.87	230.43
21	0.217	82.98	41.49	**42**	1.266	483.62	241.81
22	0.238	91.08	45.54	**43**	1.327	506.92	253.46
23	0.261	99.54	49.77	**44**	1.389	530.78	265.39
24	0.284	108.39	54.19	**45**	1.453	555.18	277.59
25	0.308	117.61	58.80	**46**	1.519	580.13	290.06
26	0.333	127.21	63.60	**47**	1.585	605.62	302.81
27	0.359	137.18	68.59	**48**	1.654	631.67	315.83
28	0.386	147.53	73.76	**49**	1.723	658.26	329.13
29	0.414	158.25	79.13	**50**	1.794	685.40	342.70
30	0.443	169.36	84.68	**51**	2.052	783.84	391.92

Appendix: XLI Volume, biomass and carbon table for *Duabanga grandiflora* (DBH 51-100 cm)

DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)	DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)
51	2.052	783.84	391.92	**76**	4.557	1740.65	870.33
52	2.133	814.88	407.44	**77**	4.677	1786.76	893.38
53	2.216	846.52	423.26	**78**	4.800	1833.47	916.74
54	2.300	878.77	439.38	**79**	4.924	1880.79	940.39
55	2.386	911.61	455.81	**80**	5.049	1928.70	964.35
56	2.474	945.06	472.53	**81**	5.176	1977.22	988.61
57	2.563	979.12	489.56	**82**	5.305	2026.34	1013.17
58	2.654	1013.77	506.89	**83**	5.435	2076.07	1038.03
69	2.746	1049.03	524.52	**84**	5.566	2126.39	1063.20
60	2.840	1084.90	542.45	**85**	5.700	2177.32	1088.66
61	2.935	1121.36	560.68	**86**	5.835	2228.86	1114.43
62	3.033	1158.43	579.21	**87**	5.971	2280.99	1140.50
63	3.131	1196.10	598.05	**88**	6.109	2333.73	1166.87
64	3.231	1234.37	617.18	**89**	6.249	2387.07	1193.54
65	3.333	1273.25	636.62	**90**	6.390	2441.01	1220.51
66	3.436	1312.72	656.36	**91**	6.533	2495.56	1247.78
67	3.541	1352.80	676.40	**92**	6.677	2550.71	1275.35
68	3.648	1393.49	696.74	**93**	6.823	2606.46	1303.23
69	3.756	1434.77	717.39	**94**	6.971	2662.82	1331.41
70	3.866	1476.66	738.33	**95**	7.120	2719.77	1359.89
71	3.977	1519.15	759.58	**96**	7.271	2777.33	1388.67
72	4.090	1562.25	781.12	**97**	7.423	2835.49	1417.75
73	4.204	1605.95	802.97	**98**	7.577	2894.26	1447.13
74	4.320	1650.25	825.12	**99**	7.732	2953.63	1476.81
75	4.438	1695.15	847.57	**100**	7.889	3013.60	1506.80

Appendix: XLII Volume, biomass and carbon table for *Magnolia champca* (DBH 10 -51 cm)

DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)	DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)
10	0.061	41.00	20.50	**31**	0.550	368.74	184.37
11	0.074	49.61	24.81	**32**	0.586	392.92	196.46
12	0.088	59.05	29.52	**33**	0.624	417.86	208.93
13	0.103	69.30	34.65	**34**	0.662	443.57	221.78
14	0.120	80.37	40.18	**35**	0.702	470.04	235.02
15	0.138	92.26	46.13	**36**	0.742	497.29	248.64
16	0.157	104.97	52.49	**37**	0.784	525.30	262.65
17	0.177	118.50	59.25	**38**	0.827	554.08	277.04
18	0.198	132.85	66.43	**39**	0.871	583.62	291.81
19	0.221	148.02	74.01	**40**	0.916	613.93	306.97
20	0.245	164.02	82.01	**41**	0.963	645.01	322.51
21	0.270	180.83	90.41	**42**	1.010	676.86	338.43
22	0.296	198.46	99.23	**43**	1.059	709.48	354.74
23	0.324	216.91	108.46	**44**	1.109	742.86	371.43
24	0.353	236.18	118.09	**45**	1.160	777.01	388.51
25	0.383	256.28	128.14	**46**	1.212	811.93	405.96
26	0.414	277.19	138.59	**47**	1.265	847.61	423.81
27	0.446	298.92	149.46	**48**	1.320	884.07	442.03
28	0.480	321.47	160.74	**49**	1.375	921.29	460.64
29	0.515	344.84	172.42	**50**	1.432	959.27	479.64
30	0.551	369.04	184.52	**51**	1.700	1138.83	569.42

Appendix: XLIII Volume, biomass and carbon table for *Magnolia champca* (DBH 51-100 cm)

DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)	DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)
51	1.700	1138.83	569.42	**76**	3.775	2528.99	1264.50
52	1.767	1183.93	591.97	**77**	3.875	2595.98	1297.99
53	1.836	1229.91	614.95	**78**	3.976	2663.85	1331.92
54	1.906	1276.76	638.38	**79**	4.078	2732.59	1366.30
55	1.977	1324.48	662.24	**80**	4.182	2802.21	1401.10
56	2.049	1373.08	686.54	**81**	4.288	2872.70	1436.35
57	2.123	1422.56	711.28	**82**	4.394	2944.07	1472.03
58	2.198	1472.91	736.46	**83**	4.502	3016.31	1508.16
69	2.275	1524.14	762.07	**84**	4.611	3089.43	1544.72
60	2.353	1576.24	788.12	**85**	4.722	3163.43	1581.72
61	2.432	1629.22	814.61	**86**	4.833	3238.30	1619.15
62	2.512	1683.08	841.54	**87**	4.946	3314.05	1657.02
63	2.594	1737.81	868.90	**88**	5.061	3390.67	1695.34
64	2.677	1793.41	896.71	**89**	5.176	3468.17	1734.09
65	2.761	1849.90	924.95	**90**	5.293	3546.54	1773.27
66	2.847	1907.25	953.63	**91**	5.412	3625.79	1812.90
67	2.934	1965.49	982.74	**92**	5.531	3705.92	1852.96
68	3.022	2024.60	1012.30	**93**	5.652	3786.92	1893.46
69	3.111	2084.58	1042.29	**94**	5.774	3868.80	1934.40
70	3.202	2145.44	1072.72	**95**	5.898	3951.55	1975.78
71	3.294	2207.18	1103.59	**96**	6.023	4035.18	2017.59
72	3.388	2269.79	1134.89	**97**	6.149	4119.68	2059.84
73	3.483	2333.28	1166.64	**98**	6.276	4205.06	2102.53
74	3.579	2397.64	1198.82	**99**	6.405	4291.32	2145.66
75	3.676	2462.88	1231.44	**100**	6.535	4378.45	2189.23

Appendix: XLIV Volume, biomass and carbon table for *Toona ciliata* (DBH 10 -51 cm)

DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)	DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)
10	0.049	27.42	13.71	31	0.409	228.88	114.44
11	0.059	33.18	16.59	32	0.436	243.88	121.94
12	0.071	39.49	19.74	33	0.463	259.36	129.68
13	0.083	46.35	23.17	34	0.492	275.32	137.66
14	0.096	53.75	26.87	35	0.521	291.76	145.88
15	0.110	61.70	30.85	36	0.551	308.67	154.33
16	0.125	70.20	35.10	37	0.582	326.05	163.03
17	0.142	79.25	39.63	38	0.614	343.91	171.96
18	0.159	88.85	44.43	39	0.647	362.25	181.13
19	0.177	99.00	49.50	40	0.680	381.07	190.53
20	0.196	109.69	54.85	41	0.715	400.36	200.18
21	0.216	120.94	60.47	42	0.750	420.13	210.06
22	0.237	132.73	66.36	43	0.786	440.37	220.19
23	0.259	145.07	72.53	44	0.823	461.09	230.55
24	0.282	157.96	78.98	45	0.861	482.29	241.15
25	0.306	171.40	85.70	46	0.900	503.96	251.98
26	0.331	185.38	92.69	47	0.939	526.11	263.06
27	0.357	199.92	99.96	48	0.980	548.74	274.37
28	0.384	215.00	107.50	49	1.021	571.84	285.92
29	0.412	230.63	115.31	50	1.063	595.42	297.71
30	0.441	246.81	123.40	51	1.714	960.019	480.01

Appendix: XLV Volume, biomass and carbon table for *Toona ciliata* (DBH 51-100 cm)

DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)	DBH (cm)	Volume (m^3)	Biomass (kg/tree)	Carbon (kg/tree)
51	1.714	960.019	480.01	**76**	3.807	2131.898	1065.95
52	1.782	998.036	499.02	**77**	3.908	2188.370	1094.19
53	1.851	1036.791	518.40	**78**	4.010	2245.580	1122.79
54	1.922	1076.284	538.14	**79**	4.113	2303.528	1151.76
55	1.994	1116.515	558.26	**80**	4.218	2362.214	1181.11
56	2.067	1157.485	578.74	**81**	4.324	2421.639	1210.82
57	2.141	1199.193	599.60	**82**	4.432	2481.802	1240.90
58	2.217	1241.639	620.82	**83**	4.541	2542.702	1271.35
69	2.294	1284.823	642.41	**84**	4.651	2604.341	1302.17
60	2.373	1328.746	664.37	**85**	4.762	2666.719	1333.36
61	2.453	1373.406	686.70	**86**	4.875	2729.834	1364.92
62	2.534	1418.805	709.40	**87**	4.989	2793.688	1396.84
63	2.616	1464.942	732.47	**88**	5.104	2858.279	1429.14
64	2.700	1511.817	755.91	**89**	5.221	2923.609	1461.80
65	2.785	1559.431	779.72	**90**	5.339	2989.678	1494.84
66	2.871	1607.782	803.89	**91**	5.458	3056.484	1528.24
67	2.959	1656.872	828.44	**92**	5.579	3124.029	1562.01
68	3.048	1706.700	853.35	**93**	5.701	3192.311	1596.16
69	3.138	1757.266	878.63	**94**	5.824	3261.332	1630.67
70	3.230	1808.570	904.29	**95**	5.948	3331.091	1665.55
71	3.323	1860.613	930.31	**96**	6.074	3401.589	1700.79
72	3.417	1913.394	956.70	**97**	6.201	3472.824	1736.41
73	3.512	1966.913	983.46	**98**	6.330	3544.798	1772.40
74	3.609	2021.170	1010.58	**99**	6.460	3617.510	1808.75
75	3.707	2076.165	1038.08	**100**	6.591	3690.960	1845.48