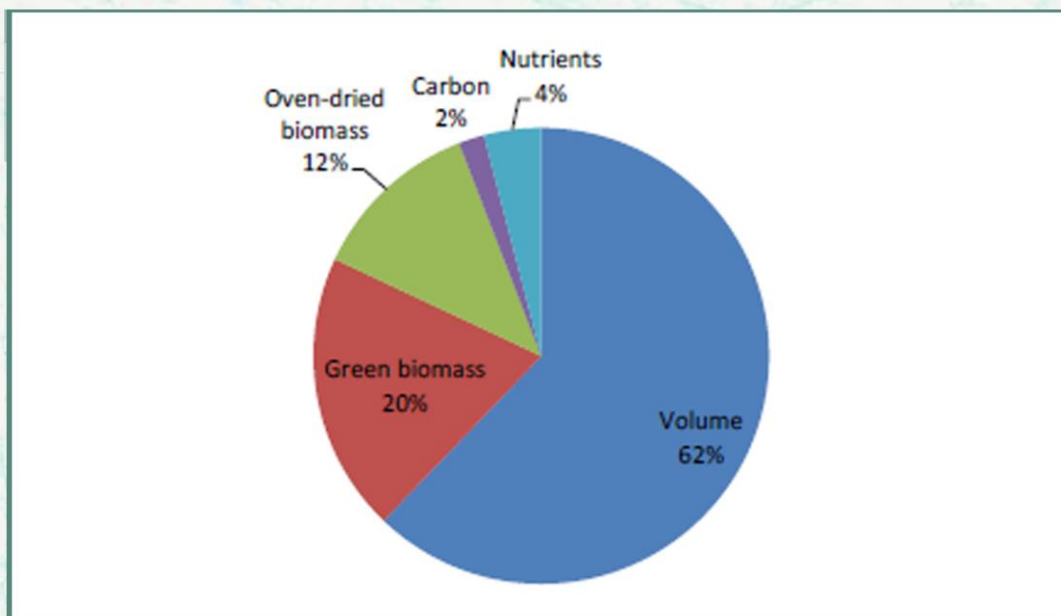




Compilation and validation of existing allometric equation of Bangladesh



Bangladesh Forest Department
February 2017



The Forest Department of Bangladesh leads actions to improve forest management and conservation, adopting forward thinking, innovative approaches in its management of approximately 1.55 million hectares of land across the country.

In 2015, the Forest Department began a process to establish a National Forest Inventory and Satellite Land Monitoring System for improved forest and natural resource management. The process supports national objectives related to climate change mitigation and provides information in support of the UN-REDD programme aimed at Reducing Emissions from Deforestation and Forest Degradation (REDD+). The process also addresses domestic information needs and supports national policy processes related to forests and the multitude of interconnected human and environmental systems that forests support.

The activities implemented under the Bangladesh Forest Inventory process are collaboration between several national and international institutions and stakeholders. National partners from multiple government departments and agencies assist in providing a nationally coordinated approach to land management. International partners, including the United States Agency for International Development (USAID) and the Food and Agriculture Organization of the United Nations (FAO) are supporting the development of technical and financial resources that will assist in institutionalizing the process.

The results will allow the Forest Department to provide regular, updated information about the status of trees and forests for a multitude of purposes including for assessment of role of trees for firewood, medicines, timber, and climate change mitigation.

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Disclaimer

This report is designed to reflect the activities and progress related to the project GCP/GD/058/USAID “Strengthening National Forest Inventory and Satellite Forest Monitoring System in support of REDD+ in Bangladesh”. This report is not authoritative information sources – it does not reflect the official position of the supporting international agencies including USAID or FAO and should not be used for official purposes. Should readers find any errors in the document or would like to provide comments for improving its quality they are encouraged to contact one of above contacts.

Executive Summary

Estimations of biomass, volume and carbon stock are important in the decision making process for the sustainable management of a forest. These estimations can be conducted by using available allometric equations of biomass and volume. Present study aims to: i. develop a compilation with verified allometric equations of biomass, volume, and carbon for trees and shrubs of Bangladesh, ii. find out the gaps and scope for further development of allometric equations for different trees and shrubs of Bangladesh. Key stakeholders (government departments, research organizations, academic institutions, and potential individual researchers) were identified considering their involvement in use and development of allometric equations. A list of documents containing allometric equations was prepared from secondary sources. The documents were collected, examined, and sorted to avoid repetition, yielding 50 documents. These equations were tested through a quality control scheme involving operational verification, conceptual verification, applicability, and statistical credibility. A total of 517 allometric equations for 80 species of trees, shrubs, palm, and bamboo were recorded. In addition, 222 allometric equations for 39 species were validated through the quality control scheme. Among the verified equations, 20%, 12% and 62% of equations were for green-biomass, oven-dried biomass, and volume respectively and 4 tree species contributed 37% of the total verified equations. Five gaps have been pinpointed for the existing allometric equations of Bangladesh: a. little work on allometric equation of common tree and shrub species, b. most of the works were concentrated on certain species, c. very little proportion of allometric equations for biomass estimation, d. no allometric equation for below-ground biomass and carbon estimation, and d. lower proportion of valid allometric equations. It is recommended that site and species specific allometric equations should be developed and consistency in field sampling, sample processing, data recording and selection of allometric equations should be maintained to ensure accuracy in estimation of biomass, volume, and carbon stock in different forest types of Bangladesh.

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1. INTRODUCTION

Bangladesh is one of the most densely populated countries in the world with only 0.06% of the world's forest [1] and 0.017 ha of per capita forest land [2]. The huge population (166.3 million) exerts immense pressure on her forest resources for the demand of timber, fuel wood, and other forest products. Measurement of forest biomass and volume are important for estimating forest productivity. Appropriate estimation of forest stocking, productivity, nutrient cycling, nutrient budget, amount of carbon stock, and prediction of future status are important considerations for the sustainable management of forest resources [3, 4]. Tree biomass and volume can be measured from both destructive (clear-cut) and non-destructive (allometric equation) methods [3, 5]. Allometric method is frequently used for estimating the biomass and volume of forest plant species, which is the most powerful tool of measurement [6, 7, 8, 9]. The use of appropriate equations for estimating biomass and volume will contribute in improving the accuracy of forest resource assessment, and also guide the forest policies and management interventions [10, 11]. Considering this importance, different research and academic institutions and individual researchers have developed biomass and volume allometric equations for estimating biomass and volume stock of a particular forest of Bangladesh.

Choice of allometric equations is one of the key sources of uncertainty in forest biomass estimation. About one-fourth of the published equations contain blunders, oversights, or forecast unrealistic values [12]. Therefore, verification and validation of allometric equation is imperative, before its application in estimation of biomass and volume [13]. Validating and verifying an allometric equation is vast in extent, and diverse in regards to methods, assumptions and conclusions. Recently, [13] proposed a systematic transparent quality control method to quantify the degree of confidence for the allometric equations without involving equation development. Quantitative reviews of available allometric equations have been implemented at a regional scale, but few countries have developed a national database for biomass and volume allometric equations [12]. In South Asia, the first regional database was developed in 2014 [14], while [15] have developed the first database for Bangladesh in 2013. However, these databases were not comprehensive and quality controlled. Repetition of some allometric equations was also observed. The use and development of allometric equations should be specific to the conditions of the country, which is crucial for three reasons. The first is that the assessment of tree and forest resources of a country should be accurate. The second is that country specific models are more efficient, and the third reason is the amount of uncertainty of the models used. However, the overall objective is to improve the quality of estimates for a multitude of purposes including timber

volume, wood energy biomass, carbon stocks, etc. in trees and forest resources of Bangladesh. To achieve this overall objective, we have to have the status of the existing tree allometric equations, forest resource estimation methods, and a verified database of tree allometric equations. Therefore, a quality controlled comprehensive database of allometric equations is needed to assess the gaps and scope for the development of new allometric equations with important tree species of different forest types of Bangladesh. The specific objectives of the present study were to: i. develop a compilation with valid allometric equations of biomass, volume and carbon for trees and shrubs of Bangladesh, ii. find out the gaps and scope for further development of allometric equations with different trees and shrubs.

1.1 OBJECTIVES

The specific objectives of the present study were to:

- i. Develop a compilation with valid allometric equations of biomass, volume and carbon for trees and shrubs of Bangladesh
- ii. Find out the gaps and scope for further development of allometric equations with different trees and shrubs.

2. MATERIAL AND METHODS

2.1 COLLECTION OF INFORMATION

Key stakeholders (government departments, research organizations, academic institutions, and potential individual researchers) were identified considering their involvement and experiences in the use and development of allometric equations. A draft list of documents containing allometric equations was prepared through consultation with key stakeholders and online search (Google Scholar) results. This list was updated by taking time and identifying unlisted documents. The listed documents were collected from bibliographic databases such as: Science Direct, Springer Link, CABI, AGRIS, AGRICOLA, JSTOR, ResearchGate. Sometimes personal and official communications were established with identified key stakeholders to obtain their research articles, reports, theses, bulletins, monographs, inventory reports and proceedings papers. Hard and soft copies of the collected documents were maintained for references.

2.2 COMPILATION OF INFORMATION

The collected documents were sorted considering relevance and repetition. The information of the allometric equations in the sorted documents was grouped and recorded into 8 different categories. The categories were plant ecology (Population), geographical location, ecoregions (FAO, Udvardy, Bailey, WWF, Holridge and IUCN Bioecological zones-Bangladesh), equation parameters (coefficients, constants, variables and ranges), plant components (leaves, Branches, Stump, Stems, Bark, Root, etc.), taxonomical description (Family, Genus, Species), fit statistical information (R², adjusted R², RMSE, sample number, bias correction, Akaike information criterion, furnival index) and Bibliography.

2.3 QUALITY CONTROL OF THE ALLOMETRIC EQUATIONS

All the allometric equations were tested through a quality control scheme following four types of verification (operational verification, conceptual verification, applicability, statistical credibility) according to [13]. The detail process of verification has been given below:

- Operational verification: Too large or too small predicted biomass or volume values
- Conceptual verification: Predicted biomass or volume are lower than “0” or have negative values
- Applicability: Under which condition the model can be applied (Population ecology, environmental condition of the site where the equation was developed, tree component measured, Taxonomic reference, Range of applicability)
- Statistical credibility: Sample size should be at least 30 trees and the coefficient of determination should be higher than 0.85

3. RESULTS

3.1 DOCUMENTS OF ALLOMETRIC EQUATIONS

A total of 53 documents were identified that contained the allometric equations for plants of Bangladesh. The collected documents were sorted, considering relevance and repetition, and 50 documents were found (i.e. 96% of the total document of allometric equations). Most of the documents were Journals (52%) followed by reports (24%), bulletins and theses (Figure 1). The list of documents containing allometric equations of Bangladesh has been presented as Appendix 1.

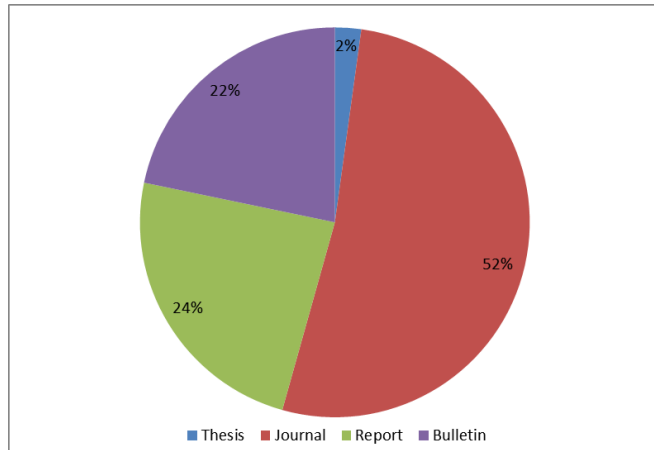


FIGURE 1: DOCUMENT TYPE OF AVAILABLE LITERATURE IN PERCENTAGE

Most of the documents were prepared during the last decade of the twentieth century (1991-2000). However, the number of studies on the development of allometric equations has increased rapidly during 2011 to 2016, which contributed 26% of the total allometric documents of Bangladesh (Figure 2).

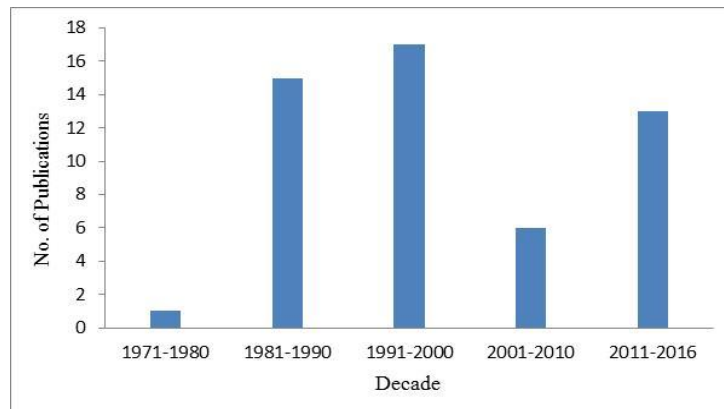


FIGURE 2: YEAR-WISE PUBLICATION OF THE DOCUMENTS

3.2 TOTAL NUMBER OF ALLOMETRIC EQUATIONS

This study recorded a total of 517 allometric equations on volume, biomass, carbon and nutrients for 80 species of tree, shrub, palm and bamboo. Higher preference, about 92% of the total allometric equations, was recorded for trees and 6% for shrubs. Among these equations, 70% equations were for volume estimation and only 6% equations were for oven-dry biomass

estimation. Unfortunately, there is not a single equation for below-ground biomass estimation (Table 1).

TABLE 1: TOTAL NUMBER OF ALLOMETRIC EQUATIONS ACCORDING TO PLANT AND EQUATION TYPES IN BANGLADESH

Category	Volume	Green biomass	Oven-dried biomass	Air-dried biomass	Carbon	Nutrients	Length of split leaf	Total
Tree	360	78	11	0	25	3	0	477
Shrub	1	1	20	0	3	6	0	31
Palm	0	2	0	0	0	0	1	3
Bamboo	0	3	0	3	0	0	0	6
Total	361	84	31	3	28	9	1	517

3.3 VERIFIED ALLOMETRIC EQUATIONS

Considering operational and conceptual verification, applicability and statistical credibility, the total number of allometric equations was reduced to 222, which was 43% of the total allometric equations. Most of the equations (45%) failed to meet the requirements of statistical credibility and conceptual verification (24%) (table 2). About 97% of the valid allometric equations were for individual species, while only 3% equations for mixed species. Irrespectively, about 77% of allometric equations were for plantation followed by natural forest (15%) and home garden (7%).

TABLE 2: NUMBER OF ALLOMETRIC EQUATIONS IN EACH CATEGORY OF VERIFICATION

Category	Operational verification	Conceptual verification	Applicability	Statistical credibility	Final validation
Valid	473	394	517	285	222
Not valid	44	123	0	232	295
Total equation	517	517	517	517	517

Trees contained 196 verified equations which were 41% of the total allometric equations under the tree category. Shrubs contained 26 verified equations which were 84% of the total allometric equations of the shrub category (Table 1 and 3). Surprisingly, not a single verified allometric equation was found for palm and bamboo. Under valid allometric equations, about 62% and 12% of the equations were observed for volume and oven-dry biomass respectively (Figure 3).

TABLE 3: NUMBER OF VERIFIED ALLOMETRIC EQUATIONS ACCORDING TO PLANT AND EQUATION TYPES IN BANGLADESH.

Category	Volume	Green biomass	Oven-dried biomass	Carbon	Nutrients	Total
Tree	138	44	10	1	3	196
Shrub	0	0	17	3	6	26
Palm	0	0	0	0	0	0
Bamboo	0	0	0	0	0	0
Grand total	138	44	27	4	9	222

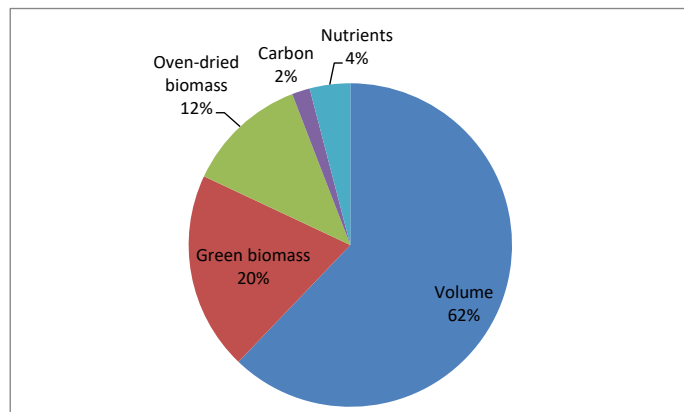


FIGURE 3: PERCENTAGE OF VALID ALLOMETRIC EQUATIONS IN DIFFERENT CATEGORIES

Thirty-nine species of 18 families and 31 genera have a total of 222 verified allometric equations. But, *Sonneratia apetala*, *Acacia mangium* and *Acacia auriculiformis* have each of 12 volume equations. *Senna siamea* has 23 allometric equations for green biomass, but other species have few equations under each category. These four species contributed 37% of the total verified allometric equations (Table 4). Species wide valid allometric equations in Bangladesh have been prepared and presented in Appendix 2.

TABLE 4: LIST OF SPECIES WITH VERIFIED ALLOMETRIC EQUATIONS IN BANGLADESH

Genus	Species	Local name	Volume	Green biomass	Oven-dried biomass	Carbon	Nutrients	Remark
<i>Acacia</i>	<i>mangium</i>	Mangium	12	12				
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	12	5	1			
<i>Acacia</i>	<i>nilotica</i>	Babla	2					
<i>Aegialitis</i>	<i>rotundifolia</i>	Nuniya			2			
<i>Aegiceras</i>	<i>corniculatum</i>	Khulshi			4	1	3	
<i>Albizia</i>	<i>procera</i>	Koroi	2					
<i>Albizia</i>	<i>spp</i>	Koroi	6					Mixed species
<i>Albizia</i>	<i>saman</i>	Rain tree	6					
<i>Albizia</i>	<i>richardiana</i>	Rajkoroi	2					
<i>Aphanamixis</i>	<i>polystachya</i>	Pitraj	2					
<i>Artocarpus</i>	<i>chaplasha</i>	Chapalish	2		2			
<i>Artocarpus</i>	<i>heterophyllus</i>	Kathal	2					
<i>Avicennia</i>	<i>officinalis</i>	Baen	2					
<i>Azadirachta</i>	<i>indica</i>	Neem	2					
<i>Breonia</i>	<i>chinensis</i>	Kadam	1					
<i>Ceriops</i>	<i>decandra</i>	Goran			5			
<i>Dalbergia</i>	<i>sissoo</i>	Sissoo	5					
<i>Dipterocarpus</i>	<i>turbinatus</i>	Telya	3					
		garjan						
<i>Eucalyptus</i>	<i>camaldulensis</i>	Eucalyptus	7					
<i>Eucalyptus</i>	<i>tereticornis</i>	Eucalyptus	1					
<i>Eucalyptus</i>	<i>brassiana</i>	Eucalyptus	1					
<i>Excoecaria</i>	<i>agallocha</i>	Gewa			5	1	3	
<i>Falcataria</i>	<i>moluccana</i>	Moluccna	2					
<i>Gmelina</i>	<i>arborea</i>	Gamar	2					
<i>Hevea</i>	<i>brasiliensis</i>	Rubber	10					
<i>Kandelia</i>	<i>candel</i>	Goria			5	1	3	
<i>Lagerstroemia</i>	<i>speciosa</i>	Jarul	1		1			
<i>Lannea</i>	<i>coromandelica</i>	Badi	1					
<i>Mangifera</i>	<i>indica</i>	Am	2					
<i>Melia</i>	<i>azadarach</i>	Bokain	2					
Mixed			1	4	1	1		
<i>Pinus</i>	<i>caribaea</i>	Pine	8					
<i>Senna</i>	<i>siamea</i>	Minjiri	8	23				
<i>Shorea</i>	<i>robusta</i>	Sal	7					
<i>Sonneratia</i>	<i>apetala</i>	Keora	12					
<i>Swietenia</i>	<i>macrophylla</i>	Mahogany	6					
<i>Syzygium</i>	<i>cumini</i>	Kalojam	1					
<i>Tectona</i>	<i>grandis</i>	Teak	2		1			
<i>Terminalia</i>	<i>arjuna</i>	Arjun	2					
<i>Xylia</i>	<i>xylocarpa</i>	Pyinkado	1					

A total of 58 verified allometric equations were observed for all over Bangladesh for different species. These allometric equations were developed from sample trees that were collected from different locations of Bangladesh. Therefore, these equations overlap different ecoregions of Bangladesh. Conversely, the other 164 verified allometric equations were found under all categories of ecoregions in Bangladesh as described by FAO, Udvardy, WWF and Bailey (Table 5).

TABLE 5: NUMBERS OF ALLOMETRIC EQUATIONS AND SPECIES IN DIFFERENT ECOREGIONS OF BANGLADESH.

Ecoregion	Zones	Equation number	Species number
FAO	Tropical moist Deciduous Forest	38	12
	Tropical rain forest	26	12
Udvardy	Tropical humid forests	76	14
	Tropical dry forests / Woodlands	12	9
WWF	Tropical humid forest	12	6
	Tropical and subtropical moist broadleaf forests	10	1
	Tropical and subtropical dry broadleaf forests	77	20
	Mangrove	33	5
Bailey	Rainforest Division	101	21
	Rainforest Regime Mountain	12	9
Holdridge	Subtropical moist	13	4
	Subtropical wet	13	10
	Tropical moist	10	2
Bangladesh IUCN	Brahmaputra-Jamuna flood plain	4	2
	Chittagong Hills and the CHTs	6	2
	Ganges flood plain	2	1
	Offshore island	14	2
	Sundarbans	33	5
	Surma-Kushiara flood plain	1	1
	Sylhet hills	11	8

* Overlapped ecoregions have not considered in this table

4. DISCUSSION

Allometric equations for trees and shrubs are fundamental to assess standing volume, biomass or carbon stock, bioenergy, nutrient cycling, payment for environmental services etc. [7, 10, 11]. Inappropriate use and development of allometric equations may give an inaccurate estimate of forest resources that may lead to inappropriate decisions on forest management issues and initiatives [16]. In Bangladesh, 5% species of trees and shrubs have allometric equations for

estimating biomass and volume. However, this percentage was reduced to 2.5% considering only the verified equations. Four tree species contributed about 37% of the total valid allometric equations, and 12% verified equations were for oven-dried biomass of 10 species. This scenario pinpointed five gaps in the existing allometric equations of Bangladesh. This situation indicates: a. little work on allometric equations of common tree and shrub species, b. most of the works were concentrated on certain species, c. very little proportion of allometric equations for biomass estimation, d. no allometric equation for below-ground biomass and carbon estimation, and d. lower proportion of valid allometric equations.

Bangladesh Forest Research Institute (BFRI) was usually responsible for the development of allometric equations for estimating volume and biomass since 1971. Forest Department also developed some volume allometric equations in cooperation with BFRI under specific forest inventory from 1971 to 2000. The contribution of individual researchers in developing allometric equations was quite low during that period. Recently (2001-2016), the contribution from the individual researchers has increased. Previously, almost all efforts were given to derived volume equations for different tree species in the natural forest and plantation, to estimate the commercial volume stock of timber in particular forest and species as well. This could be the reason a very small number of biomass allometric equations were found in Bangladesh during 1971 to 2000. Few fuel wood species (*Acacia mangium*, *Acacia auriculiformis*, *Senna siamea* and *Sonneratia apetala*) have gotten more emphasis to derive allometric equations.

Development of biomass and volume allometric equations requires extensive planning, field works, sample analysis in the laboratory, and data analysis. These activities are mostly destructive, difficult, and expensive to repeat. Therefore, these activities require consistency in field work and equation selection process. Most of the allometric equations, 45% and 24% of the total allometric equations, failed to meet the requirements of statistical credibility and conceptual verification respectively under quality control scheme. This large proportion of invalid equations (57%) may be from lack of awareness on the quality control scheme of the derived allometric equations. So, it is suggested to include interval of calibration, residual standard deviation, coefficient of regression value, number of sample trees and location of sample tree or data collection in the document to meet the requirements of quality control scheme.

During the last National Forest Assessment in Bangladesh (2005-07), globally available equations and factors were used to calculate the above-ground biomass of forest. The Sundarban Carbon inventory in 2009-10 used the globally available equations for the mangrove species to calculate

the carbon stock in the Sundarban Reserved Forest [17]. However, the accuracy can be questionable as they were using some general allometric equations [16, 18]. Therefore, development of allometric equations for local species, considering various factors for different forest types, is essential to ensure accuracy in volume, biomass and carbon estimation [12]. Major species of bamboo natural/ homestead, coastal afforestation, fresh water swamp forest, inland chars, mango plantation, associate species of Sal forest, major species of the Sundarbans and tree species outside the forest (Table 6) should be given more emphasis during the development of biomass and volume allometric equations in Bangladesh.

TABLE 6: LIST OF RECOMMENDED SPECIES FOR FURTHER DEVELOPMENT OF ALLOMETRIC EQUATIONS IN BANGLADESH

<i>Acacia catechu</i>	<i>Bombax ceiba</i>	<i>Dendrocalamus longispatus</i>
<i>Adina cordifolia</i>	<i>Borassus flabellifer</i>	<i>Dillenia indica</i>
<i>Albizia lebeck</i>	<i>Bruguiera gymnorrhiza</i>	<i>Dillinia pentagyna</i>
<i>Albizia odoratissimus</i>	<i>Bruguiera sexangula</i>	<i>Diospyros peregrina</i>
<i>Anacardium occidentale</i>	<i>Butea monosperma</i>	<i>Disopyros philippensis</i>
<i>Areca catechu</i>	<i>Calophyllum inophyllum</i>	<i>Duabanga grandiflora</i>
<i>Avicennia alba</i>	<i>Cassia fistula</i>	<i>Dysoxylum binectariferum</i>
<i>Avicennia marina</i>	<i>Cerbera manghas</i>	<i>Erythrina orientalis</i>
<i>Avicennia officinalis</i>	<i>Chickrassia tabularis</i>	<i>Excoecaria indica</i>
<i>Bambusa arundinacea</i>	<i>Clerodendrum inerme</i>	<i>Feronia limonia</i>
<i>Bambusa balcooa</i>	<i>Cocos nucifera</i>	<i>Ficus bengalensis</i>
<i>Bambusa longispiculata</i>	<i>Cynometra ramiflora</i>	<i>Ficus hispida</i>
<i>Bambusa polymorpha</i>	<i>Dalbergia sisoo</i>	<i>Ficus religiosa</i>
<i>Bambusa tulda</i>	<i>Dalbergia spinosa</i>	<i>Heritiera fomes</i>
<i>Bambusa vulgaris</i>	<i>Dellinia pentagyna</i>	<i>Hibiscus tiliaceus</i>
<i>Barringtonia acutangula</i>	<i>Delonix regia</i>	<i>Khaya anthotheca</i>
<i>Leucaena leucocephala</i>	<i>Pongamia pinnata</i>	<i>Pithecellobium dulce</i>
<i>Litchi chinensis</i>	<i>Psidium guajava</i>	<i>Tamarix indica</i>
<i>Lumnitzera racemosa</i>	<i>Rhizophora apiculata</i>	<i>Terminalia belerica</i>
<i>Melocanna baccifera</i>	<i>Rhizophora mucronata</i>	<i>Terminalia catappa</i>
<i>Michelia champca</i>	<i>Schima wallichii</i>	<i>Toona ciliata</i>
<i>Mimosops elengi</i>	<i>Sonneratia apetala</i>	<i>Trema orientalis</i>
<i>Moringa oleifera</i>	<i>Sonneratia caseolaris</i>	<i>Xylocarpus granatum</i>
<i>Nypa fruticans</i>	<i>Spondias dulce</i>	<i>Xylocarpus mekongensis</i>
<i>Phoenix paludosa</i>	<i>Syzygium grandis</i>	<i>Zizyphus mauritiana</i>
<i>Phoenix sylvestris</i>	<i>Tamarindus indica</i>	

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APPENDIX

APPENDIX 1: SOURCES OF ALLOMETRIC EQUATIONS

Sl no	Source
1	Alamgir, M., Al-Amin, M. 2008. Allometric models to estimate biomass organic carbon stock in forest vegetation. <i>Journal of Forestry Research</i> 19 (2): 101-106
2	Chaffey, D.R., Miller, F.R., Sandom, J.H. 1985. A forest inventory of the Sundarbans, Bangladesh. Project report 140, Overseas Development Administration, Land Resources Development Centre, England
3	Cox, F.Z. 1984. Volume functions for plantation species and elements for growth models for Teak. Field Document no 2, Assistance to the Forestry Sector of Bangladesh, Food and Agricultural Organization of the United Nations, FAO/UNDP Project BGD/79/017
4	Das, N. 2014. Modeling Develops to Estimate Leaf Area and Leaf Biomass of <i>Lagerstroemia speciosa</i> in West Vanugach Reserve Forest of Bangladesh. <i>ISRN Forestry</i> , doi.org/10.1155/2014/486478
5	Das, S., Davidson, J., Latif, M.A., Rahman, F., Das, S. 1985. Tree volume tables for <i>Moluccana</i> (<i>Paraserianthes falcataria</i> syn. <i>Albizia falcataria</i> syn. <i>A. moluccana</i>) in Bangladesh. Bulletin no 4, Inventory Division, Bangladesh Forest Research Institute, Chittagong.
6	Das, S., Rahman, M.F., Reza, N.A., Latif, M.A. 1992. Tree volume tables for Sal (<i>Shorea robusta</i> Gaertn. f.) in the plantations of Bangladesh. Bulletin 7, Forest Inventory Series, Bangladesh Forest Research Institute, Chittagong, 1-11 pp.
7	Davidson, J., Das, S., Khan, S.A., Latif, M.A., Zashimuddin, M. 1985. Tree volume tables for small Eucalypt round wood in Bangladesh. Bulletin no 4, Silviculturer Research Division, Bangladesh Forest research Institute, Chittagong
8	Deb, J.C., Halim, M.A., Ahmed, E. 2012. An allometric equation for estimating stem biomass of <i>Acacia auriculiformis</i> in the north-eastern region of Bangladesh. <i>Southern Forests</i> 74(2): 103–113
9	Drigo, R., Latif, M.A., Chowdhury, J.A., Shaheduzzaman, M. 1987. The maturing mangrove plantations of the coastal afforestation project. Food and Agricultural Organization of the United Nations, FAO/UNDP Project BDG/85/085, Assistant to the Forestry Sector.

Sl no	Source
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11	Hossain, S.M.Y., Martin, A.R. 2013. Merchantable timber production in Dalbergia sissoo plantations across Bangladesh: regional patterns, management practices and edaphic factors. Journal of Tropical Forest Science 25(3): 299-309
12	Islam, S.M.Z., Ahmed, K.U., Khan, M.I. 2014. Mathematical models for estimating stem volume and volume tables of Rubber tree. Bulletin 10, Forest Inventory Series, Bangladesh Forest Research Institute, Chittagong.
13	Islam, S.M.Z., Khan, M.I. Ahmed, K.U. 2012. Volume equations and tables for Rajkoroi (<i>Albizia richardiana</i> King and Prain) planted in the southern part of Bangladesh. Bangladesh Journal of Forest Science 32 (1): 28-39
14	Islam, S.S., 1988. Commercial volume table for teak (<i>Tectona grandis</i>) in Bangladesh by regression technique. Bano Biggyan Patrika 17 (1&2): 55-67
15	Islam, S.S., Kabir, J., Masum, A.K.M. 2012. Volume Table of Raintree (<i>Samanea saman</i>) in Bangladesh by Regression Technique. Open Journal of Statistics 2: 115-119
16	Islam, S.S., Reza, N.A., Hasnin, M., Khan, M.A.S., Islam, M.R., Siddiqi, N.A. 1992. Volume table of young Keora (<i>Sonneratia apetala</i>) trees for the western coastal belt of Bangladesh. Bulletin 1, Plantation Trial Unit Series, Bangladesh Forest Research Institute, Chittagong, 1-23 pp.
17	Khan, M.N.I., Faruque, O. 2010. Allometric relationships for predicting the stem volume in a <i>Dalbergia sissoo</i> Roxb. plantation in Bangladesh. iForest 3: 153-158
18	Kingston, B. 1979. A collation of tree and bamboo volume tables of Bangladesh. Field Document no 15, Food and Agricultural Organization of the United Nations, UNDP/FAO Project BGD/72/005, Forest Research Institute, Chittagong
19	Latif M.A., Habib, M.A. 1994. Biomass tables for <i>Acacia mangium</i> grown in the plantations in Bangladesh. Journal of Tropical Forest Science 7(2): 296- 302
20	Latif, M.A., 1988. Biomass tables for young <i>Eucalyptus</i> grown in Bangladesh. Bano Biggyan Patrika 17 (1 & 2): 46-54

Sl no	Source
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22	Latif, M.A., Habib, M.A. 1993. Biomass table for <i>Acacia auriculiformis</i> grown in the plantation in Bangladesh. <i>Indian Journal of Forestry</i> 16 (4): 323-327
23	Latif, M.A., Habib, M.A. 1994. Biomass tables for minjiri (<i>Cassia Siamea</i> Lam.) grown in the plantations in Bangladesh. <i>Bangladesh Journal of Forest Science</i> 23 (1): 59-64
24	Latif, M.A., Habib, M.A., Das, S., 1993. Tree volume tables for <i>Acacia mangium</i> in the plantations of Bangladesh. <i>Bangladesh Journal of Forest Science</i> 22 (1 & 2): 23-29
25	Latif, M.A., Islam, M.N. 1984a. Tree volume volume tables for <i>Syzygium grande</i> (Wt.) Wald (Dhakijam). In: Choudhury, J.H., and Davidson, J. (eds.), Tree volume tables for four species grown in plantation in Bangladesh. Bulletin 2, Inventory Division, Bangladesh Forest Research institute. Chittagong, Bangladesh, pp. 25-57.
26	Latif, M.A., Islam, M.N. 1984b. Tree volume tables for <i>Artocarpus chaplasha</i> Roxb. (Chapalish). In: Choudhury, J.H., and Davidson, J. (eds.), Tree volume tables for four species grown in plantation in Bangladesh. Bulletin 2, Inventory Division, Bangladesh Forest Research institute. Chittagong, Bangladesh, pp. 58-92.
27	Latif, M.A., Islam, M.N. 1984c. Tree volume tables for <i>Dipterocarpus turbinatus</i> Gaertn. F. (Tali Garjan). In: Choudhury, J.H., and Davidson, J. (eds.), Tree volume tables for four species grown in plantation in Bangladesh. Bulletin 2, Inventory Division, Bangladesh Forest Research institute. Chittagong, Bangladesh, pp. 122-128.
28	Latif, M.A., Islam, M.N. Choudhury, J.H. 1984. Tree volume tables for <i>Gmelina arborea</i> Roxb. (Gamar). In: Choudhury, J.H., and Davidson, J. (eds.), Tree volume tables for four species grown in plantation in Bangladesh. Bulletin 2, Inventory Division, Bangladesh Forest Research institute. Chittagong, Bangladesh, pp. 93-121.
29	Latif, M.A., Islam, M.N., Islam, S.S. 1985. Tree volume tables for Teak (<i>Tectona grandis</i>) in Bangladesh. Bulletin no 5, Inventory Division, Bangladesh Forest Research Institute, Chittagong.

Sl no	Source
30	Latif, M.A., Islam, M.S., Islam, S.M.Z. 1999. Volume tables for sissoo, koroi, mahogany, eucalyptus and bokain planted on croplands in the western part of Bangladesh. Bangladesh Forest Research Institute, Chittagong.
31	Latif, M.A., Islam, M.S., Islam, S.M.Z., 2000. Volume tables for Sissoo, Koroi, Akashmoni, Babla, Mahogany, and Rain tree planted on embankments and road sides in the coastal areas of Bangladesh. Bulletin 9, Forest Inventory Series, Bangladesh Forest Research Institute, Chittagong.
32	Latif, M.A., Islam, S.M.Z. 2000. Volume tables for 11 important tree species grown in the home gardens of Bangladesh. Forest Inventory Division, Bangladesh Forest Research Institute, Chittagong.
33	Latif, M.A., Islam, S.M.Z. 2004. Timber and fuelwood volume tables for <i>Acacia auriculiformis</i> , <i>A. mangium</i> , <i>Eucalyptus camaldulensis</i> and <i>Dalbergia sissoo</i> in plantations in Bangladesh. Forestry Sector Project, Bangladesh Forest Department and Bangladesh Forest Research Institute, Chittagong.
34	Latif, M.A., Islam, S.S., Davidson, J. 1986. Metric volume tables for some tree species found in the natural forests of Bangladesh. Bulletin 6, Inventory Division, Bangladesh Forest Resarch Institute, Chittagong.
35	Latif, M.A., Khan, A.F.M.K., Hossain, M.M. 1998. Stump diameter -DBH - volume relationships for Teli Garjan (<i>Dipterocarpus turbinatus</i>), Dhakijam (<i>Syzygium grande</i>) and Teak (<i>Tectona grandis</i>) in Bangladesh. Bangladesh Journal of Forest Science 27 (1): 16-24
36	Latif, M.A., Rahman, M.F., Das, S. 1995. Volume table for <i>Acacia auriculiformis</i> , <i>Cassia siamea</i> and <i>Pinus caribaea</i> in Bangladesh. Bangladesh Journal of Forest Science 24 (2): 22-30
37	Mahmood, H., Saha, C., Abdullah, S.M.R., Saha, S., Siddique, M.R.H. 2015b. Allometric biomass, nutrient and carbon stock models for <i>Kandelia candel</i> of the Sundarbans, Bangladesh. Trees DOI: 10.1007/s00468-015-1314-0
38	Mahmood, H., Shaikh, M.A.A., Saha, C., Abdullah, S.M.R., Saha, S., Siddique, M.R.H. 2016. Above-ground biomass, nutrients and carbon in <i>Aegiceras corniculatum</i> of the Sundarbans. <i>Open Journal of Forestry</i> 6 (2): 72-89
39	Mahmood, H., Siddique, M.R.H., Bose, A., Limon, S.H., Chowdhury, M.R.K. Saha, S. 2012. Allometry, above-ground biomass and nutrient distribution in <i>Ceriops decandra</i> (Griffith) Ding Hou dominated forest types of the Sundarbans mangrove forest, Bangladesh. <i>Wetlands Ecology and Management</i> 20: 539-548

Sl no	Source
40	Mahmood, H., Siddique, M.R.H., Saha, S., Abdullah, S.M.R. 2015a. Allometric models for biomass, nutrients and carbon stock in <i>Excoecaria agallocha</i> of the Sundarbans, Bangladesh. <i>Wetlands Ecology and Management</i> 23 (4): 765-774
41	Rahman, M.F., Das, S., Latif, M.A. 2001. Volume table for Koroi (<i>albizia procera</i>) and Arjun (<i>Terminalia arjuna</i>) trees planted in the central part of Bangladesh. <i>Bangladesh Journal of Forest Science</i> 30 (1): 39-46.
42	Rahman, M.F., Das, S., Reza, N.A., Chowdhury, J.A., Latif, M.A. 1994. Tree volume table for Keora (<i>Sonneratia apetala</i> Buch.-Ham) in the coastal plantation of Bangladesh. In: Latif, M.A. (ed.), <i>Tree volume table for keora (Sonneratia apetala) and Baen (Avicennia officinalis) in the coastal plantation of Banglaesh</i> . Bulletin 8, Forest Inventory Division, Bangladesh Forest Research Institute, Chittagong, 1-20 pp.
43	Rahman, M.M., Kamaluddin, M. 1996. Volume table for natural hybrid trees of <i>Acacia mangium</i> X <i>Acacia auriculiformis</i> in plantations of Bangladesh. <i>Chittagong University Studies</i> , 20 (1): 89-94
44	Revilla, J.A.V., Ahmed, I.U., Hossain, A. 1998a. Forest Inventory of the Sundarbans Reserved Forest, Final Report, Volume 1. Mandala Agricultural Development Corporation and Forest Department, Ministry of Environment and Forests, Dhaka, Bangladesh
45	Revilla, J.A.V., Ahmed, I.U., Saha, U.K. 1998b. Forest Inventory of the Natural Forest and Forest Plantations (Sylhet Forest Division), Final Report. Gob/Wb, Forest Resources Management Project, Technical Assistance Component. (Mandala Agricultural Development Corporation and Forest Department, Ministry of Environment and Forests, Dhaka, Bangladesh).
46	Roy, B. 2012. Species-specific allometric models for estimation of aboveground stem biomass of three dominant tree species at Satchari National park. Unpublished MS thesis. Department of Forestry and Environmental Science, ShahJalal University of Science and Technology, Sylhet, Bangladesh
47	Sarker, S.K., Das, N., Chowdhury, M.Q., Haque, M.M. 2013. Developing allometric equations for estimating leaf area and leaf biomass of <i>Artocarpus chaplasha</i> in Raghunandan Hill Reserve, Bangladesh. <i>Southern Forests</i> 75(1): 51-57
48	Siddique, M.R.H., Mahmood, H., Chowdhury, M.R.K. 2012. Allometric relationship for estimating above-ground biomass of <i>Aegialitis rotundifolia</i> Roxb. of Sundarbans mangrove forest, in Bangladesh. <i>Journal of Forestry Research</i> 23 (1): 23-28.
49	Sylvander, R., Latif, M.A., Karlsson, A. 2001. Forest inventory of the Sal forest of Bangladesh, Volume 1, Technical Report, Forestry Sector Project, Forest Department, Ministry of Environment and Forest, Dhaka
50	Ullah, M.R., Banik, G.R., RajibBanik. 2014. Developing Allometric Models for Carbon Stock Estimation in Eighteen-Year-Old Plantation Forests of Bangladesh. <i>Jacobs Journal of Microbiology and Pathology</i> 1(1): 006

APPENDIX 2: LIST OF VALIDED ALLOMETRIC EQUATIONS

Genus	Species	Local name	Family	Unite of Y	Vegetation Component	Equation	Sample size	R2	MSE	Ref. No
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Total above-ground biomass	green Log (Green biomass) = -1.5851 + 2.4855 * Log (DBH)	120	0.9728	0.0232	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Total above-ground biomass	green Log (Green biomass) = -4.4303 + 2.4855 * Log (GBH)	120	0.9728	0.0232	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Total above-ground biomass	green Log (Green biomass) = -2.0847 + 2.1723 * Log (DBH) + 0.5141 * Log (Height)	120	0.9777	0.0189	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Total above-ground biomass	green Log (Green biomass) = -4.5714 + 2.1723 * Log (GBH) + 0.5141 * Log (Height)	120	0.9777	0.0189	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Stem green biomass	Log (Green biomass) = -2.1442 + 2.5917 * Log (DBH)	120	0.9665	0.0313	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Stem green biomass	Log (Green biomass) = -5.1110 + 2.5917 * Log (GBH)	120	0.9665	0.0313	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Stem green biomass	Log (Green biomass) = -2.7095 + 2.2372 * Log (DBH) + 0.5817 * Log (Height)	120	0.9722	0.0257	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Stem green biomass	Log (Green biomass) = -5.2705 + 2.2372 * Log (GBH) + 0.5817 * Log (Height)	120	0.9722	0.0257	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Branch green Biomass	Log (Green biomass) = -2.2732 + 1.9752 * Log (DBH)	120	0.5707	0.3528	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Branch green Biomass	Log (Green biomass) = -4.5343 + 1.9752 * Log (GBH)	120	0.5707	0.3528	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Branch green Biomass	Log (Green biomass) = -3.2955 + 1.3142 * Log (DBH) + 1.0521 * Log (Height)	120	0.5855	0.3355	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Branch green Biomass	Log (Green biomass) = -4.7999 + 1.3142 * Log (GBH) + 1.0521 * Log (Height)	120	0.5855	0.3355	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Leaves and twigs biomass	green Log (Green biomass) = -2.1219 + 1.9299 * Log (DBH)	120	0.7614	0.1568	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Leaves and twigs biomass	green Log (Green biomass) = -4.3311 + 1.9299 * Log (GBH)	120	0.7614	0.1568	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Leaves and twigs biomass	green Log (Green biomass) = -0.6183 + 2.8726 * Log (DBH) - 1.5471 * Log (Height)	120	0.8209	0.098	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Leaves and twigs biomass	green Log (Green biomass) = -3.9067 + 2.8726 * Log (GBH) - 1.5471 * Log (Height)	120	0.8209	0.098	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Stem and branch biomass	green Log (Green biomass) = -2.0512 + 2.6006 * Log (DBH)	120	0.9641	0.0339	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Stem and branch biomass	green Log (Green biomass) = -5.0282 + 2.6006 * Log (GBH)	120	0.9641	0.0339	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Stem and branch biomass	green Log (Green biomass) = -2.9256 + 2.0525 * Log (DBH) + 0.8996 * Log (Height)	120	0.9785	0.0201	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Stem and branch biomass	green Log (Green biomass) = -5.2752 + 2.0525 * Log (GBH) + 0.8996 * Log (Height)	120	0.9785	0.0201	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Branch, leaves and twigs biomass	green Log (Green biomass) = -2.5173 + 2.281 * Log (DBH)	120	0.8098	0.1641	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Branch, leaves and twigs biomass	green Log (Green biomass) = -2.9974 + 1.98 * Log (DBH) + 0.494 * Log (Height)	120	0.8115	0.1613	23
<i>Senna</i>	<i>siamea</i>	Minjiri	Leguminosae	kg	Branch, leaves and twigs biomass	green Log (Green biomass) = -5.264 + 1.98 * Log (GBH) + 0.494 * Log (Height)	120	0.8115	0.1613	23

Genus	Species	Local name	Family	Unit of Y	Vegetation Component	Equation	Sample size	R2	MSE	FI	Ref. No
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Total volume over bark	Volume = $0.0117 + 0.0000280056 * DBH^{(2)} * Height$	713	0.912			42
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Total volume over bark	Volume = $0.0117 + 0.00000283756 * GBH^{(2)} * Height$	713	0.912			42
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Volume under bark	Volume = $0.0041 + 0.0000246325 * DBH^{(2)} * Height$	713	0.937			42
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Volume under bark	Volume = $0.0041 + 0.00000249579 * GBH^{(2)} * Height$	713	0.937			42
<i>Avicennia</i>	<i>officinalis</i>	Baen	Aviceniaceae	m3	Total volume over bark	Volume = $0.0089 + 0.0000264 * DBH^{(2)} * Height$	308	0.859	0.00026		21
<i>Avicennia</i>	<i>officinalis</i>	Baen	Aviceniaceae	m3	Total volume over bark	Volume = $0.0089 + 0.00000267 * GBH^{(2)} * Height$	308	0.859	0.00026		21
<i>Albizia</i>	<i>procera</i>	Koroi	Mimosaceae	m3	Total volume over bark	Log (Volume) = $-12.0901 + 2.502194 * Log (GBH)$	221	0.983			41
<i>Albizia</i>	<i>procera</i>	Koroi	Mimosaceae	m3	Total volume over bark	Log (Volume) = $-11.6632 + 1.941989 * Log (GBH) + 0.754839 * Log (Height)$	221	0.991			41
<i>Terminalia</i>	<i>arjuna</i>	Arjun	Combretaceae	m3	Total volume over bark	Log (Volume) = $-11.1885 + 2.222144 * Log (GBH)$	177	0.986			41
<i>Terminalia</i>	<i>arjuna</i>	Arjun	Combretaceae	m3	Total volume over bark	Log (Volume) = $-11.3794 + 1.896423 * Log (GBH) + 0.653558 * Log (Height)$	177	0.997			41
<i>Shorea</i>	<i>robusta</i>	Sal	Dipterocarpaceae	m3	Total volume over bark	Log (Volume) = $-9.1727759 + 2.5178944 * DBH$	499	0.9666	0.03856	0.0575	38
<i>Shorea</i>	<i>robusta</i>	Sal	Dipterocarpaceae	m3	Total volume over bark	Log (Volume) = $-12.0554 + 2.5178944 * Log (GBH)$	499	0.9666	0.03856	0.0575	38
<i>Shorea</i>	<i>robusta</i>	Sal	Dipterocarpaceae	m3	Total volume over bark	Log (Volume) = $-9.615639 + 2.033071 * Log (DBH) + 0.7361229 * Log (Height)$	499	0.9551	0.00776	0.0881	38
<i>Shorea</i>	<i>robusta</i>	Sal	Dipterocarpaceae	m3	Total volume over bark	Log (Volume) = $-11.938881 + 2.033071 * Log (GBH) + 0.7361229 * Log (Height)$	499	0.9551	0.00776	0.0881	38
<i>Shorea</i>	<i>robusta</i>	Sal	Dipterocarpaceae	m3	Total volume under bark	Volume = $0.0032556 + 0.0000269 * DBH^{(2)} * Height$	499	0.9622	0.00652	0.0808	38
<i>Shorea</i>	<i>robusta</i>	Sal	Dipterocarpaceae	m3	Total volume under bark	Volume = $0.003255 + 0.0000027255 * GBH^{(2)} * Height$	499	0.9622	0.00652	0.0808	38
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Total volume over bark	Volume = $0.0052 - 0.0022 * X + 0.0005 * DBH^{(2)}$	461	0.86	0.00008	0.009	16
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Total volume over bark	Log (Volume) = $-9.1937 + 1.7683 * Log (DBH) + 0.7358 * Log (Height)$	461	0.95	0.0547	0.003	16
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Total volume over bark	Volume = $0.0042 - 0.0017 * DBH + 0.0005 * DBH^{(2)}$	464	0.85	0.0001	0.0109	16
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Total volume over bark	Log (Volume) = $-9.2587 + 1.6463 * Log (DBH) + 0.9138 * Log (Height)$	464	0.94	0.0744	0.0051	16
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Total volume over bark	Log (Volume) = $-8.209 + 2.2178 * Log (DBH)$	132	0.98	0.0152	0.0062	24
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Total volume over bark	Log (Volume) = $-10.7488 + 2.2178 * Log (GBH)$	132	0.98	0.0152	0.0062	24

Genus	Species	Local name	Family	Unite of Y	Vegetation Component	Equation	Sample size	R2	MSE	FI	Ref. No
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Total volume over bark	$\text{Log (Volume)} = -9.1426 + 1.7612 * \text{Log (DBH)} + 0.83335 * \text{Log (Height)}$	132	0.989	0.0091	0.0048	24
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Total volume over bark	$\text{Log (Volume)} = -11.1587 + 1.7612 * \text{Log (GBH)} + 0.83335 * \text{Log (Height)}$	132	0.989	0.0091	0.0048	24
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Total volume under bark	$\text{Log (Volume)} = -9.00226 + 2.3246 * \text{Log (DBH)}$	132	0.969	0.0299	0.0056	24
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Total volume under bark	$\text{Log (Volume)} = -11.6633 + 2.3246 * \text{Log (GBH)}$	132	0.969	0.0299	0.0056	24
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Total volume under bark	$\text{Log (Volume)} = -10.2221 + 1.74054 * \text{Log (DBH)} + 1.07596 * \text{Log (Height)}$	132	0.977	0.0219	0.0048	24
Mixed				kg	Total above-ground green biomass	$\text{Log (Green biomass)} = -1.3933 + 2.39602 * \text{Log (DBH)}$	294	0.948			20
Mixed				kg	Total above-ground green biomass	$\text{Log (Green biomass)} = -4.136 + 2.39602 * \text{Log (GBH)}$	294	0.948			20
Mixed				kg	Total above-ground green biomass	$\text{Log (Green biomass)} = -2.228 + 1.81492 * \text{Log (DBH)} + 0.85007 * \text{Log (Height)}$	294	0.9575			20
Mixed				kg	Total above-ground green biomass	$\text{Log (Green biomass)} = -4.306 + 1.81492 * \text{Log (GBH)} + 0.85007 * \text{Log (Height)}$	294	0.9575			20
<i>Tectona</i>	<i>grandis</i>	Teak	Lamiaceae	cft	Total volume over bark	$\text{Volume} = 0.084 * \text{DBH}^{(2.263)}$	635	0.88	0.23	40.79	17
<i>Tectona</i>	<i>grandis</i>	Teak	Lamiaceae	cft	Total volume over bark	$\text{Volume} = 0.000465 * \text{DBH}^{(1.58)} * \text{Height}^{(1.603)}$	645	0.92	0.16	33.36	17
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	kg	Total above-ground green biomass	$\text{Log (Green biomass)} = -1.3577 + 2.4177 * \text{Log (DBH)}$	139	0.9674			22
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	kg	Total above-ground green biomass	$\text{Log (Green biomass)} = -2.2782 + 1.9736 * \text{Log (DBH)} + 0.8113 * \text{Log (Height)}$	139	0.986	0.0084		22
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	kg	Stem green biomass	$\text{Log (Green biomass)} = -2.3176 + 2.6075 * \text{Log (DBH)}$	139	0.9698	0.0218		22
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	kg	Stem green biomass	$\text{Log (Green biomass)} = -3.1661 + 2.1982 * \text{Log (DBH)} + 0.7477 * \text{Log (Height)}$	139	0.983	0.0119		22
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -8.208 + 2.2389 * \text{Log (DBH)}$	139	0.959		0.0061	36
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -10.7709 + 2.2389 * \text{Log (GBH)}$	139	0.959		0.0061	36
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -9.125 + 1.918 * \text{Log (DBH)} + 0.67988 * \text{Log (Height)}$	139	0.988		0.0648	36
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -11.3205 + 1.918 * \text{Log (GBH)} + 0.67988 * \text{Log (Height)}$	139	0.988		0.0648	36
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	m3	Total volume under bark	$\text{Log (Volume)} = -9.187 + 2.468 * \text{Log (DBH)}$	139	0.9688		0.0059	36
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	m3	Total volume under bark	$\text{Log (Volume)} = -12.0121 + 2.468 * \text{Log (GBH)}$	139	0.9688		0.0059	36
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	m3	Total volume under bark	$\text{Log (Volume)} = -10.2398 + 2.100244 * \text{Log (DBH)} + 0.780214 * \text{Log (Height)}$	139	0.9773		0.0048	36

Genus	Species	Local name	Family	Unit of Y	Vegetation Component	Equation	Sample size	R2	MSE	FI	Ref. No
Acacia	auriculiformis	Akashmoni	Leguminosae	m3	Total volume under bark	$\text{Log (Volume)} = -12.6440 + 2.100244 * \text{Log (GBH)} + 0.780214 * \text{Log (Height)}$	139	0.9773		0.0048	36
Senna	siamea	Minjiri	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -8.602 + 2.4038 * \text{Log (DBH)}$	120	0.9796		0.0098	36
Senna	siamea	Minjiri	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -11.3536 + 2.4038 * \text{Log (GBH)}$	120	0.9796		0.0098	36
Senna	siamea	Minjiri	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -9.514 + 1.871 * \text{Log (DBH)} + 0.897 * \text{Log (Height)}$	120	0.9898		0.0054	36
Senna	siamea	Minjiri	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -11.6557 + 1.871 * \text{Log (GBH)} + 0.897 * \text{Log (Height)}$	120	0.9898		0.0054	36
Senna	siamea	Minjiri	Leguminosae	m3	Total volume under bark	$\text{Log (Volume)} = -9.334 + 2.55686 * \text{Log (DBH)}$	120	0.976		0.0081	36
Senna	siamea	Minjiri	Leguminosae	m3	Total volume under bark	$\text{Log (Volume)} = -12.2632 + 2.55686 * \text{Log (GBH)}$	120	0.976		0.0081	36
Senna	siamea	Minjiri	Leguminosae	m3	Total volume under bark	$\text{Log (Volume)} = -10.1766698 + 2.0641847 * \text{Log (DBH)} + 0.8290937 * \text{Log (Height)}$	120	0.986		0.0049	36
Senna	siamea	Minjiri	Leguminosae	m3	Total volume under bark	$\text{Log (Volume)} = -12.5396 + 2.064187 * \text{Log (GBH)} + 0.8290937 * \text{Log (Height)}$	120	0.986		0.0049	36
Pinus	caribaea	Pine	Pinaceae	m3	Total volume over bark	$\text{Log (Volume)} = -8.7854 + 2.410755 * \text{Log (DBH)}$	122	0.986		0.002	36
Pinus	caribaea	Pine	Pinaceae	m3	Total volume over bark	$\text{Log (Volume)} = -11.545 + 2.410755 * \text{Log (GBH)}$	122	0.986		0.002	36
Pinus	caribaea	Pine	Pinaceae	m3	Total volume over bark	$\text{Log (Volume)} = -9.39412 + 1.867386 * \text{Log (DBH)} + 0.839034 * \text{Log (Height)}$	122	0.9945		0.0052	36
Pinus	caribaea	Pine	Pinaceae	m3	Total volume over bark	$\text{Log (Volume)} = -11.5317 + 1.867386 * \text{Log (GBH)} + 0.839034 * \text{Log (Height)}$	122	0.9945		0.0052	36
Pinus	caribaea	Pine	Pinaceae	m3	Total volume under bark	$\text{Log (Volume)} = -9.11552 + 2.483187 * \text{Log (DBH)}$	122	0.9858		0.0084	36
Pinus	caribaea	Pine	Pinaceae	m3	Total volume under bark	$\text{Log (Volume)} = -11.9580 + 2.483187 * \text{Log (GBH)}$	122	0.9858		0.0084	36
Pinus	caribaea	Pine	Pinaceae	m3	Total volume under bark	$\text{Log (Volume)} = -9.7505 + 1.935397 * \text{Log (DBH)} + 0.851715 * \text{Log (Height)}$	122	0.9933		0.0058	36
Pinus	caribaea	Pine	Pinaceae	m3	Total volume under bark	$\text{Log (Volume)} = -11.9660 + 1.935397 * \text{Log (GBH)} + 0.851715 * \text{Log (Height)}$	122	0.9933		0.0058	36
Acacia	auriculiformis	Akashmoni	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -11.839665 + 2.404568 * \text{Log (GBH)}$	124	0.973			31
Acacia	auriculiformis	Akashmoni	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -11.506528 + 1.973377 * \text{Log (GBH)} + 0.623823 * \text{Log (Height)}$	124	0.979			31
Swietenia	macrophylla	Mahogany	Meliaceae	m3	Total volume over bark	$\text{Log (Volume)} = -12.52620808 + 2.5653795 * \text{Log (GBH)}$	245	0.942			31
Swietenia	macrophylla	Mahogany	Meliaceae	m3	Total volume over bark	$\text{Log (Volume)} = -12.4361459 + 1.8661846 * \text{Log (GBH)} + 1.2282822 * \text{Log (Height)}$	245	0.96			31
Albizia	spp	Koroi	Mimosaceae	m3	Total volume over bark	$\text{Log (Volume)} = -12.8715358 + 2.6994968 * \text{Log (GBH)}$	178	0.929			31

Genus	Species	Local name	Family	Unit of Y	Vegetation Component	Equation	Sample size	R2	MSE	FI	Ref. No
<i>Albizia</i>	spp	Koroi	Mimosaceae	m3	Total volume over bark	$\text{Log (Volume)} = -12.4 + 1.7131 * \text{Log (GBH)} + 1.58245 * \text{Log (Height)}$	178	0.967			31
<i>Dalbergia</i>	<i>sissoo</i>	Sissoo	Fabaceae	m3	Total volume over bark	$\text{Log (Volume)} = -12.427775 + 2.6056676 * \text{Log (GBH)}$	202	0.902			31
<i>Dalbergia</i>	<i>sissoo</i>	Sissoo	Fabaceae	m3	Total volume over bark	$\text{Log (Volume)} = -12.5189939 + 1.9800535 * \text{Log (GBH)} + 1.0775148 * \text{Log (Height)}$	202	0.934			31
<i>Acacia</i>	<i>nilotica</i>	Babla	Mimosaceae	m3	Total volume over bark	$\text{Log (Volume)} = -11.2782859 + 2.34743 * \text{Log (GBH)}$	128	0.91			31
<i>Acacia</i>	<i>nilotica</i>	Babla	Mimosaceae	m3	Total volume over bark	$\text{Log (Volume)} = -11.875835 + 1.8823999 * \text{Log (GBH)} + 1.0819988 * \text{Log (Height)}$	128	0.91			31
<i>Albizia</i>	<i>saman</i>	Rain tree	Mimosaceae	m3	Total volume over bark	$\text{Log (Volume)} = -12.287524 + 2.5086408 * \text{Log (GBH)}$	190	0.952			31
<i>Albizia</i>	<i>saman</i>	Rain tree	Mimosaceae	m3	Total volume over bark	$\text{Log (Volume)} = -12.3213818 + 1.8912934 * \text{Log (GBH)} + 1.183443 * \text{Log (Height)}$	190	0.974			31
<i>Ceriops</i>	<i>decandra</i>	Goran	Rhizophoraceae	g	Leaf	Oven-dried biomass = $2.99 * (\text{Collar girth})^{1.95}$	48	0.89	0.02		39
<i>Ceriops</i>	<i>decandra</i>	Goran	Rhizophoraceae	g	Branch	Oven-dried biomass = $0.23 * (\text{Collar girth})^{3.09}$	48	0.94	0.03		39
<i>Ceriops</i>	<i>decandra</i>	Goran	Rhizophoraceae	g	Bark	Oven-dried biomass = $0.77 * (\text{Collar girth})^{2.23}$	48	0.97	0.01		39
<i>Ceriops</i>	<i>decandra</i>	Goran	Rhizophoraceae	g	Stem with bark	Oven-dried biomass = $3.22 * (\text{Collar girth})^{2.27}$	48	0.97	0.01		39
<i>Ceriops</i>	<i>decandra</i>	Goran	Rhizophoraceae	g	Total above-ground	Oven-dried biomass = $4.70 * (\text{Collar girth})^{2.41}$	48	0.97	0.01		39

Genus	Species	Local name	Family	Unit of Y	Vegetation Component	Equation	Sample size	R2	MSE	RMSE	AIC	Bias correction	Ref. No
<i>Aegialitis</i>	<i>rotundifolia</i>	Nuniya	Plumbaginaceae	g	Leaf	Oven-dried biomass = 13.96 * (Collar girth) - 12.38 * (Height) ² - 0.01 * (Height at girth measurement point) ² + 0.08 * (Collar girth) * (Height) * (Height at girth measurement point)	50	0.88	1392.78	37.32			48
<i>Aegialitis</i>	<i>rotundifolia</i>	Nuniya	Plumbaginaceae	g	Branch	Oven-dried biomass = 3.09 * (Collar girth) ² - 22.887 * (Height) ² + 0.13 * (Collar girth) * (Height) * (Height at girth measurement point)	50	0.92	8626.98	92.882			48
<i>Excoecaria</i>	<i>agallocha</i>	Gewa	Euphorbiaceae	kg	Leaf	Log ₁₀ (Oven-dried biomass) = 0.9256 * Log ₁₀ (DBH ²) - 2.133	30	0.8499	0.051	0.226	-86.652	1.146	40
<i>Excoecaria</i>	<i>agallocha</i>	Gewa	Euphorbiaceae	kg	Branch	Log ₁₀ (Oven-dried biomass) = 1.1656 * Log ₁₀ (DBH ²) - 1.7047	30	0.9669	0.016	0.126	-122.159	1.043	40
<i>Excoecaria</i>	<i>agallocha</i>	Gewa	Euphorbiaceae	kg	Bark	Log ₁₀ (Oven-dried biomass) = 1.0824 * Log ₁₀ (DBH ²) - 1.7568	30	0.9933	0.003	0.052	-175.484	1.007	40
<i>Excoecaria</i>	<i>agallocha</i>	Gewa	Euphorbiaceae	kg	Stem without bark	Log ₁₀ (Oven-dried biomass) = 1.0927 * Log ₁₀ (DBH ²) - 1.0275	30	0.9937	0.003	0.051	-176.616	1.007	40
<i>Excoecaria</i>	<i>agallocha</i>	Gewa	Euphorbiaceae	kg	Total above-ground	Log ₁₀ (Oven-dried biomass) = 1.0996 * Log ₁₀ (DBH ²) - 0.8572	30	0.9953	0.002	0.044	-185.005	1.005	40
<i>Excoecaria</i>	<i>agallocha</i>	Gewa	Euphorbiaceae	kg	Total above-ground	Log ₁₀ (Nitrogen) = 1.0972 * Log ₁₀ (DBH ²) - 3.0845	30	0.9922	0.0032	0.05677		1.008583	40
<i>Excoecaria</i>	<i>agallocha</i>	Gewa	Euphorbiaceae	kg	Total above-ground	Log ₁₀ (Phosphorus) = 1.0947 * Log ₁₀ (DBH ²) - 5.6790	30	0.9905	0.0039	0.0623		1.010333	40
<i>Excoecaria</i>	<i>agallocha</i>	Gewa	Euphorbiaceae	kg	Total above-ground	Log ₁₀ (Potassium) = 1.0990 * Log ₁₀ (DBH ²) - 3.0370	30	0.9929	0.0029	0.054		1.007774	40

Genus	Species	Local name	Family	Unit of Y	Vegetation Component	Equation	Sample size	R2	MSE	RMSE	AIC	FI	Bias correction	Ref. No
<i>Excoecaria</i>	<i>agallocha</i>	Gewa	Euphorbiaceae	kg	Total above-ground	$\text{Log}_{10}(\text{Carbon}) = 1.1 * \text{Log}_{10}(\text{DBH}^2) - 1.1937$	30	0.9953	0.0019	0.044			1.005136	40
<i>Kandelia</i>	<i>candel</i>	Goria	Rhizophoraceae	kg	Leaf	$\text{Oven-dried biomass} = 0.014 * (\text{DBH})^2 + 0.03$	25	0.89	0.004	0.06	-133.53	0.063		37
<i>Kandelia</i>	<i>candel</i>	Goria	Rhizophoraceae	kg	Branch	$\text{Sqrt}(\text{Oven-dried biomass}) = 0.29 * (\text{DBH}) - 0.21$	25	0.87	0.03	0.16	-86.947	0.23		37
<i>Kandelia</i>	<i>candel</i>	Goria	Rhizophoraceae	kg	Bark	$\text{Sqrt}(\text{Oven-dried biomass}) = 0.66 * \text{sqrt}(\text{DBH}) - 0.57$	25	0.86	0.01	0.1	-110.07	0.111		37
<i>Kandelia</i>	<i>candel</i>	Goria	Rhizophoraceae	kg	Stem without bark	$\text{Sqrt}(\text{Oven-dried biomass}) = 1.19 * \text{Sqrt}(\text{DBH}) - 1.02$	25	0.86	0.03	0.18	-80.521	0.345		37
<i>Kandelia</i>	<i>candel</i>	Goria	Rhizophoraceae	kg	Total above-ground	$\text{Oven-dried biomass} = 0.21 * (\text{DBH})^2 + 0.12$	25	0.94	0.38	0.62	-18.875	0.616		37
<i>Kandelia</i>	<i>candel</i>	Goria	Rhizophoraceae	kg	Total above-ground	$\text{Nitrogen} = 0.39 * (\text{DBH})^2 + 0.49$	25	0.95						37
<i>Kandelia</i>	<i>candel</i>	Goria	Rhizophoraceae	kg	Total above-ground	$\text{Phosphorus} = 0.77 * (\text{DBH})^2 + 0.14$	25	0.95						37
<i>Kandelia</i>	<i>candel</i>	Goria	Rhizophoraceae	kg	Total above-ground	$\text{Potassium} = 0.87 * (\text{DBH})^2 + 0.07$	25	0.95						37
<i>Kandelia</i>	<i>candel</i>	Goria	Rhizophoraceae	kg	Total above-ground	$\text{Carbon} = 0.09 * (\text{DBH})^2 + 0.05$	25	0.96						37
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	kg	Stem biomass	$\text{Oven-dried biomass} = 0.092486 * ((\text{DBH}) * (\text{Height}))^{1.4765}$	600	0.9674			-600.02		1.01066	8
<i>Albizia</i>	<i>saman</i>	Rain tree	Mimosaceae	m3	Stem volume	$\text{Log}(\text{Volume}) = -8.3013 + 2.1746 * \text{Log}(\text{DBH})$	205	0.86	0.07			0.21		15
<i>Albizia</i>	<i>saman</i>	Rain tree	Mimosaceae	m3	Stem volume	$\text{Log}(\text{Volume}) = -9.1864 + 1.8502 * \text{Log}(\text{DBH}) + 0.8234 * \text{Log}(\text{Height})$	205	0.9	0.05			0.18		15
Mixed Shrub				g	Above-ground biomass	$\text{Oven-dried biomass} = 0.696735 + 0.536662 * (\text{Biomass})$		0.8720						1
Mixed Shrub				g	Above-ground biomass	$\text{Carbon} = -0.379625 + 0.500132 * (\text{Biomass})$		0.8970						1

Genus	Species	Local name	Family	Unit of Y	Vegetation Component	Equation	Sample size	R2	MSE	AIC	FI	Bias correction	Ref. No
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Total above-ground green biomass	$\text{Log (Green biomass)} = -1.4659 + 2.3256 * \text{Log (DBH)}$	132	0.9795	0.0193				19
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Total above-ground green biomass	$\text{Log (Green biomass)} = -4.1281 + 2.3256 * \text{Log (GBH)}$	132	0.9795	0.0193				19
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Total above-ground green biomass	$\text{Log (Green biomass)} = -1.7073 + 2.1922 * \text{Log (DBH)} + 0.2331 * \text{Log (Height)}$	132	0.9772	0.0185				19
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Total above-ground green biomass	$\text{Log (Green biomass)} = -4.2168 + 2.1922 * \text{Log (GBH)} + 0.2331 * \text{Log (Height)}$	132	0.9772	0.0185				19
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Stem green biomass	$\text{Log (Green biomass)} = -2.2782 + 2.5213 * \text{Log (DBH)}$	132	0.9553	0.0431				19
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Stem green biomass	$\text{Log (Green biomass)} = -5.1644 + 2.5213 * \text{Log (GBH)}$	132	0.9553	0.0431				19
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Stem green biomass	$\text{Log (Green biomass)} = -2.7344 + 2.2692 * \text{Log (DBH)} + 0.4406 * \text{Log (Height)}$	132	0.9584	0.0397				19
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Stem green biomass	$\text{Log (Green biomass)} = -5.3320 + 2.2692 * \text{Log (GBH)} + 0.4406 * \text{Log (Height)}$	132	0.9584	0.0397				19
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Stem and branch green biomass	$\text{Log (Green biomass)} = -1.8493 + 2.3906 * \text{Log (DBH)}$	132	0.9751	0.0211				19
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Stem and branch green biomass	$\text{Log (Green biomass)} = -4.5859 + 2.3906 * \text{Log (GBH)}$	132	0.9751	0.0211				19
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Stem and branch green biomass	$\text{Log (Green biomass)} = -2.4276 + 2.0709 * \text{Log (DBH)} + 0.5586 * \text{Log (Height)}$	132	0.9818	0.0153				19
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	kg	Stem and branch green biomass	$\text{Log (Green biomass)} = -4.7982 + 2.0709 * \text{Log (GBH)} + 0.5586 * \text{Log (Height)}$	132	0.9818	0.0153				19
<i>Artocarpus</i>	<i>chaplasha</i>	Chapalish	Moraceae	kg	Leaf	$\text{Log (Oven-dried biomass)} = -4.44814 + 2.0483 * \text{Log (DBH)}$	200			-58.298		1.019	47
<i>Lagerstroemia</i>	<i>speciosa</i>	Jarul	Lythraceae	kg	Leaf	$\text{Log (Oven-dried biomass)} = -1.34008 + 0.83123 * \text{Log (DBH)} + 0.47969 * \text{Log (Height)}$	312	0.9638		-309.79	0.47	1.0066	4
<i>Artocarpus</i>	<i>chaplasha</i>	Chapalish	Moraceae	kg	Stem biomass	$\text{Log (Oven-dried biomass)} = -0.53361 + 0.988759 * \text{Log ((DBH)}^2 * \text{Height)} * \text{(Wood density)}$	101	0.99		-427.62			46

Genus	Species	Local name	Family	Unit of Y	Vegetation Component	Equation	Sample size	R2	RMSE	AIC	FI	Ref. No
<i>Tectona</i>	<i>grandis</i>	Teak	Lamiaceae	kg	Stem biomass	$\text{Log (Oven-dried biomass)} = 0.07908 + 0.89315 * \text{Log} ((\text{DBH})^2 * (\text{Height}) * (\text{Wood density}))$	101	0.94		-76.89		46
<i>Albizia</i>	<i>richardiana</i>	Rajkoro	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -10.996396 + 2.247808 * \text{Log (GBH)}$	511	0.98				13
<i>Albizia</i>	<i>richardiana</i>	Rajkoro	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -10.831293 + 1.699319 * \text{Log (GBH)} + 0.813706 * \text{Log (Height)}$	511	0.98				13
<i>Mixed</i>				m3	Total volume over bark	$\text{Log (Volume)} = -9.4209 + 1.7480 * \text{Log (DBH)} + 0.9310 * \text{Log (Height)}$	954	0.984				7
<i>Eucalyptus</i>	<i>brassiana</i>	Eucalyptus	Myrtaceae	m3	Total volume over bark	$\text{Log (Volume)} = -9.5783 + 1.6783 * \text{Log (DBH)} + 1.0483 * \text{Log (Height)}$	164	0.985				7
<i>Eucalyptus</i>	<i>tereticornis</i>	Eucalyptus	Myrtaceae	m3	Total volume over bark	$\text{Log (Volume)} = -9.4264 + 1.6850 * \text{Log (DBH)} + 0.9840 * \text{Log (Height)}$	279	0.981				7
<i>Eucalyptus</i>	<i>camaldulensis</i>	Eucalyptus	Myrtaceae	m3	Total volume over bark	$\text{Log (Volume)} = -9.3520 + 1.8055 * \text{Log (DBH)} + 0.8590 * \text{Log (height)}$	511	0.986				7
<i>Artocarpus</i>	<i>chaplasha</i>	Chapalish	Moraceae	m3	Total volume over bark	$\text{Log (Volume)} = -8.179774 + 2.24074 * \text{Log (DBH)}$	427	0.976	0.03		3.27	26
<i>Artocarpus</i>	<i>chaplasha</i>	Chapalish	Moraceae	m3	Total volume over bark	$\text{Log (Volume)} = -8.9449526 + 1.82851 * \text{Log (DBH)} + 0.735381 * \text{Log (Height)}$	427	0.984	0.02		2.67	26
<i>Gmelina</i>	<i>arborea</i>	Gamar	Lamiaceae	m3	Total volume over bark	$\text{Log (Volume)} = -7.9022697 + 2.1472 * \text{Log (DBH)}$	486	0.933	0.08		3.68	28
<i>Gmelina</i>	<i>arborea</i>	Gamar	Lamiaceae	m3	Total volume over bark	$\text{Log (Volume)} = -8.4687076 + 1.63502 * \text{Log (DBH)} + 0.784847 * \text{Log (Height)}$	486	0.966	0.04		2.65	28
<i>Dipterocarpus</i>	<i>turbinatus</i>	Telya garjan	Dipterocarpaceae	m3	Total volume over bark	$\text{Log (Volume)} = -8.5116354 + 2.35556 * \text{Log (DBH)}$	436	0.979	0.034		1.82	27
<i>Dipterocarpus</i>	<i>turbinatus</i>	Telya garjan	Dipterocarpaceae	m3	Total volume over bark	$\text{Volume} = 0.000390878 + 0.00064549776 * (\text{DBH})^2 + 0.0001478277 * (\text{DBH}) * (\text{Height}) + 0.00002407 * (\text{DBH})^2 * (\text{Height})$	436	0.69			1.47	27
<i>Falcataria</i>	<i>moluccana</i>	Moluccna	Leguminosae	m3	Stem Volume over bark	$\text{Log (Volume)} = -8.9942 + 1.4963 * \text{Log (DBH)} + 1.1461 * \text{Log (Height)}$	343	0.932			0.0141	5
<i>Falcataria</i>	<i>moluccana</i>	Moluccna	Leguminosae	m3	Stem Volume over bark	$\text{Log (Volume)} = -10.707106 + 1.4963 * \text{Log (GBH)} + 1.1461 * \text{Log (Height)}$	343	0.932				5
<i>Hevea</i>	<i>brasiliensis</i>	Rubber	Euphorbiaceae	m3	Total volume over bark	$\text{Log (Volume)} = -10.5628 + 2.1502 * \text{Log (GBH)}$	583	0.95				12
<i>Hevea</i>	<i>brasiliensis</i>	Rubber	Euphorbiaceae	m3	Total volume over bark	$\text{Log (Volume)} = -11.2768 + 1.8795 * \text{Log (GBH)} + 0.6928 * \text{Log (Height)}$	583	0.97				12
<i>Hevea</i>	<i>brasiliensis</i>	Rubber	Euphorbiaceae	m3	Total volume under bark	$\text{Log (Volume)} = -10.6451 + 2.1607 * \text{Log (GBH)}$	583	0.95				12
<i>Hevea</i>	<i>brasiliensis</i>	Rubber	Euphorbiaceae	m3	Total volume under bark	$\text{Log (Volume)} = -11.3509 + 1.8930 * \text{Log (GBH)} + 0.6848 * \text{Log (Height)}$	583	0.97				12
<i>Hevea</i>	<i>brasiliensis</i>	Rubber	Euphorbiaceae	m3	Total volume over bark	$\text{Log (Volume)} = -10.4946 + 2.1365 * \text{Log (GBH)}$	388	0.93				12

Genus	Species	Local name	Family	Unit of Y	Vegetation Component	Equation	Sample size	R2	Ref. No
<i>Hevea</i>	<i>brasiliensis</i>	Rubber	Euphorbiaceae	m3	Total volume over bark	$\text{Log (Volume)} = -11.355075 + 1.90505 * \text{Log (GBH)} + 0.67956 * \text{Log (Height)}$	388	0.96	12
<i>Hevea</i>	<i>brasiliensis</i>	Rubber	Euphorbiaceae	m3	Total volume under bark	$\text{Log (Volume)} = -10.58495 + 2.14861 * \text{Log (GBH)}$	388	0.93	12
<i>Hevea</i>	<i>brasiliensis</i>	Rubber	Euphorbiaceae	m3	Total volume under bark	$\text{Log (Volume)} = -11.43443 + 1.92013 * \text{Log (GBH)} + 0.670876 * \text{Log (Height)}$	388	0.96	12
<i>Hevea</i>	<i>brasiliensis</i>	Rubber	Euphorbiaceae	m3	Total volume over bark	$\text{Volume} = 0.01097 - 0.00064 * (\text{GBH}) + 0.000055 * (\text{GDB})^2$	195	0.96	12
<i>Hevea</i>	<i>brasiliensis</i>	Rubber	Euphorbiaceae	m3	Total volume under bark	$\text{Volume} = 0.016931 - 0.00085 * (\text{GBH}) + 0.000055 * (\text{GBH})^2$	195	0.96	12
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	m3	Timber volume over bark	$\text{Volume} = 0.027119694 + 0.00000240953 * (\text{GBH})^2 * (\text{Height})$	141	0.942	33
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	m3	Timber volume over bark	$\text{Volume} = 0.02059085 + 0.00000257258 * (\text{GBH})^2 * (\text{Height})$	68	0.929	33
<i>Acacia</i>	<i>auriculiformis</i>	Akashmoni	Leguminosae	kg	Branch and stem less than 30 cm girth to 10 cm girth green biomass	$\text{Green biomass} = 17.17526 + 0.011026 * (\text{GBH})^2$	68	0.857	33
<i>Eucalyptus</i>	<i>camaldulensis</i>	Eucalyptus	Myrtaceae	m3	Timber volume over bark	$\text{Volume} = 0.003083594 + 0.00000291538 * (\text{GBH})^2 * (\text{Height})$	117	0.974	33
<i>Eucalyptus</i>	<i>camaldulensis</i>	Eucalyptus	Myrtaceae	m3	Timber volume over bark	$\text{Volume} = 0.005034521 + 0.00000269095 * (\text{GBH})^2 * (\text{Height})$	60	0.96	33
<i>Eucalyptus</i>	<i>camaldulensis</i>	Eucalyptus	Myrtaceae	m3	Total volume over bark	$\text{Volume} = 0.076339 - 0.00058066 * (\text{Height}) + 0.000016216 * (\text{GBH})^2 + 0.0000032565 * (\text{GBH})^2 * (\text{Height})$	94	0.978	33
<i>Eucalyptus</i>	<i>camaldulensis</i>	Eucalyptus	Myrtaceae	m3	Timber volume over bark	$\text{Volume} = 0.00444242 + 0.00000274348 * (\text{GBH})^2 * (\text{Height})$	94	0.975	33
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Total volume over bark	$\text{Volume} = 0.0379401 - 0.0027469 * (\text{GBH}) + 0.000099945 * (\text{GBH})^2$	44	0.935	33
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Total volume over bark	$\text{Volume} = 0.01368013 - 0.00018226 * (\text{Height}) + 0.000005503 * (\text{GBH})^2 + 0.00000352188 * (\text{GBH})^2 * (\text{Height})$	44	0.971	33
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Timber volume over bark	$\text{Volume} = 0.047423 - 0.00387 * (\text{GBH}) + 0.000109 * (\text{GBH})^2$	37	0.908	33
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Total volume over bark	$\text{Volume} = -0.04085 + 0.00437656 * (\text{Height}) + 0.0000627199 * (\text{GBH})^2 + 0.00000248335 * (\text{GBH})^2 * (\text{Height})$	159	0.965	33
<i>Acacia</i>	<i>mangium</i>	Mangium	Fabaceae	m3	Timber volume over bark	$\text{Volume} = 0.010632025 + 0.00000289124 * (\text{GBH})^2 * (\text{Height})$	133	0.95	33
<i>Dalbergia</i>	<i>sissoo</i>	Sissoo	Fabaceae	m3	Total volume over bark	$\text{Volume} = 0.012282107 + 0.00168945 * (\text{Height}) - 0.000019455 * (\text{GBH})^2 + 0.00000392037 * (\text{GBH})^2 * (\text{Height})$	80	0.972	33

Genus	Species	Local name	Family	Unite of Y	Vegetation Component	Equation	Sample size	R2	Ref. No
<i>Dalbergia</i>	<i>sissoo</i>	Sissoo	Fabaceae	m3	Total volume under bark	$\text{Log (Volume)} = -12.14678171 + 2.49978991 * \text{Log (GBH)}$	181	0.973	30
<i>Dalbergia</i>	<i>sissoo</i>	Sissoo	Fabaceae	m3	Total volume under bark	$\text{Log (Volume)} = -11.8405276 + 2.07000287 * \text{Log (GBH)} + 0.6152993 * \text{Log (Height)}$	181	0.982	30
<i>Swietenia</i>	<i>macrophylla</i>	Mahogany	Meliaceae	m3	Total volume under bark	$\text{Log (Volume)} = -12.045383 + 2.460647 * \text{Log (GBH)}$	120	0.979	30
<i>Swietenia</i>	<i>macrophylla</i>	Mahogany	Meliaceae	m3	Total volume under bark	$\text{Log (Volume)} = -11.716535 + 2.084968 * \text{Log (GBH)} + 0.534389 * \text{Log (Height)}$	120	0.99	30
<i>Albizia</i>	spp	Koroi	Mimosaceae	m3	Total volume under bark	$\text{Log (Volume)} = -12.093533 + 2.463398 * \text{Log (GBH)}$	103	0.931	30
<i>Albizia</i>	spp	Koroi	Mimosaceae	m3	Total volume under bark	$\text{Log (Volume)} = -11.961135 + 1.967741 * \text{Log (GBH)} + 0.907724 * \text{Log (Height)}$	103	0.947	30
<i>Eucalyptus</i>	<i>camaldulensis</i>	Eucalyptus	Myrtaceae	m3	Total volume under bark	$\text{Log (Volume)} = -11.177929 + 2.297689 * \text{Log (GBH)}$	151	0.94	30
<i>Eucalyptus</i>	<i>camaldulensis</i>	Eucalyptus	Myrtaceae	m3	Total volume under bark	$\text{Log (Volume)} = -11.523307 + 1.911628 * \text{Log (GBH)} + 0.738982 * \text{Log (Height)}$	151	0.955	30
<i>Melia</i>	<i>azadarach</i>	Bokain	Meliaceae	m3	Total volume under bark	$\text{Log (Volume)} = -11.041653 + 2.1705 * \text{Log (GBH)}$	143	0.935	30
<i>Melia</i>	<i>azadarach</i>	Bokain	Meliaceae	m3	Total volume under bark	$\text{Log (Volume)} = -10.962743 + 1.888957 * \text{Log (GBH)} + 0.505435 * \text{Log (Height)}$	143	0.951	30
<i>Mangifera</i>	<i>indica</i>	Am	Anacardiaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.27269 + 2.24506 * \text{Log (GBH)}$	343	0.975	32
<i>Mangifera</i>	<i>indica</i>	Am	Anacardiaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.25377 + 1.96697 * \text{Log (GBH)} + 0.52237 * \text{Log (Height)}$	343	0.981	32
<i>Lannea</i>	<i>coromandelica</i>	Badi	Anacardiaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.519102 + 2.01724 * \text{Log (GBH)} + 0.56356 * \text{Log (Height)}$	87	0.971	32
<i>Syzygium</i>	<i>cumini</i>	Kalojam	Myrtaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.24854 + 2.24804 * \text{Log (GBH)}$	99	0.966	32
<i>Artocarpus</i>	<i>heterophyllus</i>	Kathal	Moraceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.06320 + 2.18203 * \text{Log (GBH)}$	119	0.97	32
<i>Artocarpus</i>	<i>heterophyllus</i>	Kathal	Moraceae	m3	Total over bark volume	$\text{Log (Volume)} = -10.99533 + 1.80823 * \text{Log (GBH)} + 0.68951 * \text{Log (Height)}$	119	0.983	32
<i>Albizia</i>	spp	Koroi	Mimosaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.50692 + 2.31757 * \text{Log (GBH)}$	140	0.968	32
<i>Albizia</i>	spp	Koroi	Mimosaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.19651 + 1.85690 * \text{Log (GBH)} + 0.67878 * \text{Log (Height)}$	140	0.979	32
<i>Swietenia</i>	<i>macrophylla</i>	Mahogany	Meliaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.46122 + 2.29592 * \text{Log (GBH)}$	105	0.981	32
<i>Swietenia</i>	<i>macrophylla</i>	Mahogany	Meliaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.27102 + 1.88064 * \text{Log (GBH)} + 0.64629 * \text{Log (Height)}$	105	0.99	32
<i>Azadirachta</i>	<i>indica</i>	Neem	Meliaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.33340 + 2.25814 * \text{Log (GBH)}$	36	0.974	32
<i>Azadirachta</i>	<i>indica</i>	Neem	Meliaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.42823 + 1.89235 * \text{Log (GBH)} + 0.71493 * \text{Log (Height)}$	36	0.985	32
<i>Aphanamixis</i>	<i>polystachya</i>	Pitraj	Meliaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.25645 + 2.25821 * \text{Log (GBH)}$	105	0.973	32
<i>Aphanamixis</i>	<i>polystachya</i>	Pitraj	Meliaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.25528 + 1.98544 * \text{Log (GBH)} + 0.47163 * \text{Log (Height)}$	105	0.987	32
<i>Albizia</i>	<i>saman</i>	Rain tree	Mimosaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.37623 + 2.26924 * \text{Log (GBH)}$	153	0.981	32

Genus	Species	Local name	Family	Unit of Y	Vegetation Component	Equation	Sample size	R2	MSE	RMSE	AIC	FI	Ref. No
<i>Albizia</i>	<i>saman</i>	Rain tree	Mimosaceae	m3	Total over bark volume	$\text{Log (Volume)} = -11.31983 + 1.91118 * \text{Log (GBH)} + 0.63606 * \text{Log (Height)}$	153	0.99					32
<i>Breonia</i>	<i>chinensis</i>	Kadam	Rubiaceae	m3	Total volume over bark	$\text{Log (Volume)} = -10.4647 + 2.3911 * \text{Log (DBH)} + 0.6373 * \text{Log (Height)}$	51	0.99065					10
<i>Dipterocarpus</i>	<i>turbinatus</i>	Telya garjan	Dipterocarpaceae	m3	Total volume over bark	$\text{Log (Volume)} = -9.5258 + 2.1229 * \text{Log (DBH)} + 0.5993 * \text{Log (Height)}$	49	0.96667					10
<i>Lagerstroemia</i>	<i>speciosa</i>	Jarul	Lythraceae	m3	Total volume over bark	$\text{Log (Volume)} = -9.6744 + 2.1065 * \text{Log (DBH)} + 0.6675 * \text{Log (Height)}$	74	0.98628					10
<i>Xylia</i>	<i>xylocarpa</i>	Lohakat	Leguminosae	m3	Total volume over bark	$\text{Log (Volume)} = -9.4303 + 2.0988 * \text{Log (DBH)} + 0.6042 * \text{Log (Height)}$	94	0.98723					10
<i>Shorea</i>	<i>robusta</i>	Sal	Dipterocarpaceae	m3	Total volume over bark	$\text{Log (Volume)} = -10.0253 + 2.1163 * \text{Log (DBH)} + 0.7588 * \text{Log (Height)}$	79	0.98787					10
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Total volume over bark	$\text{Log (Volume)} = -8.66152 + 1.5856 * \text{Log (DBH)} + 0.77152 * \text{Log (Height)}$	91	0.98					9
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Total volume over bark	$\text{Log (Volume)} = -9.29715 + 1.70514 * \text{Log (DBH)} + 0.95088 * \text{Log (Height)}$	236	0.98					9
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Total volume over bark	$\text{Log (Volume)} = -9.23507 + 1.69673 * \text{Log (DBH)} + 0.92309 * \text{Log (Height)}$	133	0.98					9
<i>Sonneratia</i>	<i>apetala</i>	Keora	Lythraceae	m3	Total volume over bark	$\text{Log (Volume)} = -8.75215 + 1.75034 * \text{Log (DBH)} + 0.64233 * \text{Log (Height)}$	214	0.92					9
<i>Aegiceras</i>	<i>corniculatum</i>	Khulshi	Myrsinaceae	kg	Leaf	$\text{Log}_{10} (\text{Oven-dried biomass}) = 0.76 * \text{Log}_{10} ((\text{DBH}^2) - 1.39)$	29	0.93	0.02	0.12	-119.05	0.05	38
<i>Aegiceras</i>	<i>corniculatum</i>	Khulshi	Myrsinaceae	kg	Bark	$\text{Log}_{10} (\text{Oven-dried biomass}) = 1.04 * \text{Log}_{10} ((\text{DBH}^2) - 1.80)$	29	0.99	0.004	0.07	-154.68	0.02	38
<i>Aegiceras</i>	<i>corniculatum</i>	Khulshi	Myrsinaceae	kg	Stem without bark	$\text{Log}_{10} (\text{Oven-dried biomass}) = 1.04 * \text{Log}_{10} ((\text{DBH}^2) - 0.99)$	29	0.99	0.004	0.07	-154.68	0.14	38
<i>Aegiceras</i>	<i>corniculatum</i>	Khulshi	Myrsinaceae	kg	Total above-ground	$\text{Sqrt} (\text{Oven-dried biomass}) = 0.48 * \text{DBH} - 0.13$	29	0.99	0.03	0.18	-96.57	0.68	38
<i>Aegiceras</i>	<i>corniculatum</i>	Khulshi	Myrsinaceae	g	Total above-ground	$\text{Sqrt} (\text{Nitrogen}) = 0.67 * \text{DBH} + 0.11$	29	0.99	0.09	0.31	-66.27	1.85	38
<i>Aegiceras</i>	<i>corniculatum</i>	Khulshi	Myrsinaceae	g	Total above-ground	$\text{Sqrt} (\text{Phosphorus}) = 0.94 * \text{DBH} + 0.08$	29	0.98	0.19	0.43	-45.94	3.69	38
<i>Aegiceras</i>	<i>corniculatum</i>	Khulshi	Myrsinaceae	g	Total above-ground	$\text{Sqrt} (\text{Potassium}) = 1.06 * \text{DBH} - 0.18$	29	0.99	0.17	0.41	-49.25	3.66	38
<i>Aegiceras</i>	<i>corniculatum</i>	Khulshi	Myrsinaceae	kg	Total above-ground	$\text{Sqrt} (\text{Carbon}) = 0.33 * \text{DBH} - 0.09$	29	0.99	0.02	0.13	-177.67	0.39	38