UN-REDD
PROGRAMME

Inventory of volume and biomass tree allometric equations for South Asia

UN-REDD PROGRAMME

January 7, 2014

Peechi, India

KFRI

UN-REDD Programme
MRV report 15
2014

The UN-REDD Programme, implemented by FAO, UNDP and UNEP, has two components: (i) assisting developing countries prepare and implement national REDD strategies and mechanisms; (ii) supporting the development of normative solutions and standardized approaches based on sound science for a REDD instrument linked with the UNFCCC. The programme helps empower countries to manage their REDD processes and will facilitate access to financial and technical assistance tailored to the specific needs of the countries.

The application of UNDP, UNEP and FAO rights-based and participatory approaches will also help ensure the rights of indigenous and forest-dwelling people are protected and the active involvement of local communities and relevant stakeholders and institutions in the design and implementation of REDD plans.

The programme is implemented through the UN Joint Programmes modalities, enabling rapid initiation of programme implementation and channeling of funds for REDD efforts, building on the in-country presence of UN agencies as a crucial support structure for countries. The UN-REDD Programme encourage coordinated and collaborative UN support to countries, thus maximizing efficiencies and effectiveness of the organizations' collective input, consistent with the "One UN" approach advocated by UN members.

Contacts:
S. Sandeep
Kerala Forest research Institute (KFRI)
Peechi, India
Email: sandeepagri@gmail.com
Matieu Henry
UN-REDD Programme
Food and Agriculture Organization of the United Nations (FAO)
Email: Matieu.Henry@fao.org

Recommended citation: Sandeep, S., Sivaram, M., Henry, M., Birigazzi, L. 2014. Inventory of volume and biomass tree allometric equations for South Asia. KFRI, Peechi, India, Food & Agriculture Organization of the United Nations, Rome, Italy.

Photo credit
Muralidharan, E.M. Tallest teak tree recorded in India (Yepra, Western Ghats, India)

Contents

List of Figures

List of Tables

List of Appendices

1. Introduction

Estimation of volume, biomass and carbon stocks support several applications from the commercial exploitation of timber to global carbon cycle. Especially in the latter context the estimation of tree biomass with sufficient accuracy is essential to determine annual changes of carbon stored in particular ecosystems. Such estimations are the core of carbon sequestration projects (sink projects) that deals with the accumulation and long-term storage of atmospheric carbon in vegetation and soil organic matter. These projects give a better understanding of nature's carbon sinks, and the valuable information and evidence generated therein will help addressing the physical, natural, social and economic aspects of climate change in a more factual way.

Forest ecosystems act as both source and sink of carbon and thus play a crucial role in global carbon cycles. Forests form an important aspect of active carbon pool as they account for 60 percent of terrestrial carbon storage (Wilson and Daff, 2003). Tropical forests, which constitute 60 percent of world forests and 43 percent of terrestrial net primary productivity (Dixon *et al*. 1994), dominate the role of forests in the global carbon flux and stocks, and hence demands great attention with respect to carbon policies and estimations. In spite of their importance to the carbon cycle, there is little information on the carbon budgets of tropical forest systems in South Asia. Efficient and accurate national systems for Measurement, Reporting and Verification (MRV) systems are required in the region to properly assess carbon stocks and support international climate change efforts**.** The use of suitable allometric equations is a crucial step in such endeavours, making precise and non destructive estimation of above and belowground biomass and carbon storage in the region.

Allometry, generally relates some non-easy to measure tree characteristics from easily collected data such as dbh (diameter at breast height), total height, or tree age and provides relatively accurate estimates. Models for volume, biomass or nutrient content within the trees belong to the same class as methodologies for sampling trees and fitting and using the equations are similar (Picard *et al*, 2012). Despite their apparent simplicity, these models have to be built carefully, using the latest regression techniques. Tree growth parameters varies considerably with species, site quality, location, climatic regimes, altitude etc. and therefore becomes necessary to obtain accurate and precise tree allometric estimates in order to improve understanding of the role of these carbon sinks in global carbon cycle. An unsuitable application of allometric equation may lead to considerable bias in carbon stocks estimations (Henry, 2013).

In the recent past carbon sequestration has received particular attention in South Asia due to global initiatives on climate change and realization of potentials of tropical forests to attract financial resources under Clean Development Mechanisms (CDM) of Kyoto Protocol. Though the market for CDM sinks were limited in the first commitment period of Kyoto, 2008 -12, a huge potential is envisaged for afforestation and reforestation activities in developing countries beyond 2012 (De Koning *et al*., 2005). South Asia with a sizable proportion of tropical forests can harness a good proportion of these global initiatives. However, the pre requisite to actual commercialization of these carbon sinks depends very much on efficient and accurate methods of estimating biomass stocks and carbon sequestration rates. Though large numbers of tree allometric models have been developed for volume, biomass and carbon stocks estimations in South Asia, their accessibility is very limited as they are mainly confined to scientific articles, reports from private companies and hard copies in institutional or national libraries. The development of new allometric equations is time consuming, laborious and involves destructive harvesting of trees. In order to provide accessibility and facilitate identification of gaps of existing tree allometric models to the national institutions and other stakeholders, it is important to inventory all existing volume and biomass allometric equations. Hence the project was envisaged with the objective of collating published tree allometric equations of six South Asian countries (Bangladesh, Bhutan, India, Nepal, Maldives, Pakistan and Sri Lanka) into a database that can be made available internationally.

2. Objectives of the report

The objective of this report is to provide a regional overview on the status of tree allometric equation in South Asia to support national forest monitoring system and improve assessment of the necessary parameters to support policies and measures. Tree allometric equations are time consuming and costly to develop and such a database is necessary to support cost-efficient actions to improve robustness of estimates.

3. Data compilation

3.1 Review of available literature

The database was developed by collecting data from several secondary sources and by communicating with various agencies. The first stage of the database development was extensive literature survey and identification of key stakeholders who could make significant contributions to the database. An online search using Google Scholar with the selected keywords helped to identify individual researchers and Institutes in the region with good experience in tree allometry. Contacts were established with these Institutes and researchers and the reports, mostly archived as hard copy reports in libraries, were scanned and data added to the database (Appendix – 1). Visits to research and educational Institutions in the region yielded hard copies of dissertation thesis and old research papers which contained large volumes of recent works on allometry in the region. Publications/ documents of the Food and Agriculture Organization (FAO) also served as good source for many allometric equations in the database. Further soft copies of tree, stand and sprout allometry of South Asia published in peer reviewed journals were collected from bibliographic databases such as Science Direct – biological Sciences, Springer Link, CABI, AGRIS, AGRICOLA, JSTOR and Indian Forestry Abstracts (http://www. indianforestry.org). In spite of our earnest attempts the database is not exhaustive and may have several omissions of published literature in the region. However, it is a first such attempt to create a regional database for South Asia that can be progressively completed.

3.2 Data organization

The extensive literature survey produced thousands of documents, which were filtered to give 550 documents containing relevant information. These documents were deciphered and entered into an Excel database. The database provides information on the type of population, ecosystem, bioclimatic zones, equation parameters, fit statistics and geographic location where the equations were developed or applied. Detailed information on the database structure and methodology for entering the data in the database was provided by Baldasso *et al.*, 2012, a tutorial developed for this purpose.

Each row entry in the database contains 74 fields (columns) describing various aspects of the allometric equation. A Unique Identification Number (ID) was given for each allometric equation in the database. Each equation has its own ID reference and two different equations cannot have the same ID. The population (lianas, mangroves, sprout, stand and tree) and ecosystem in which the allometric equations were developed/ applied were defined in the next few fields. Location identity of the particular work was explained by fields: continent – country –latitude and longitude. The geographical coordinates provided in the source documents along with information from publically available spatially explicit datasets were used to extract biome classification. A few fields are devoted for describing the dependent and independent variables and their corresponding units used in the equation. Maximum and minimum values of these variables have also been provided whenever it was available in the source literature.

The equations covered in the database were found to contain many vaguely defined vegetative components (big and small roots, trunk, small and large branches, above ground biomass etc.). For standardizing the data and its easy usage, the vegetative components were divided into 11 different compartments and defined (Figure 1). The equations in the original sources were thoroughly checked and carefully converted to our newly defined system.

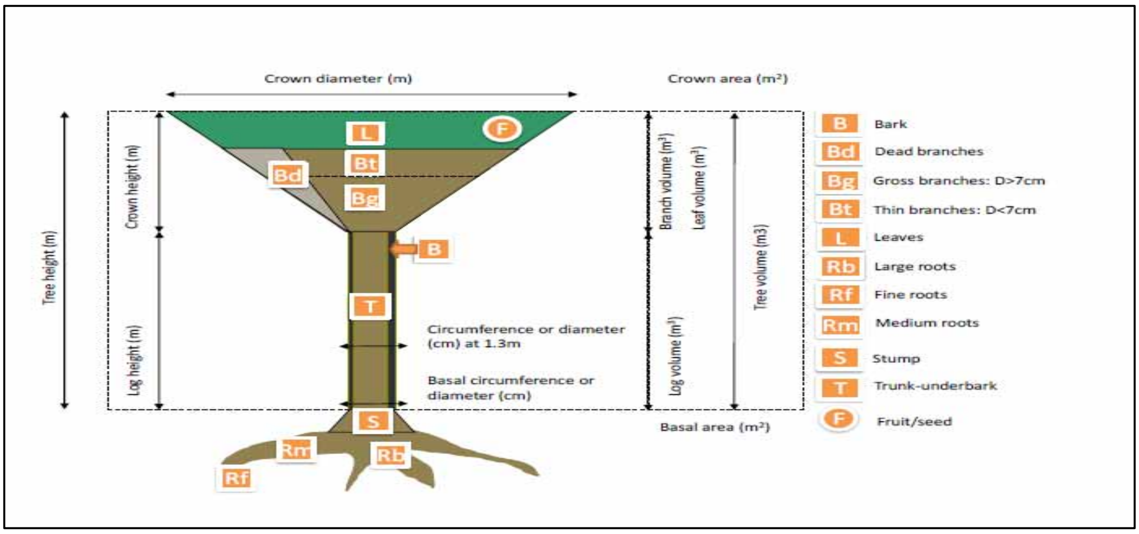


Figure 1. Tree components classification used in the present work (Henry *et al*., 2011)

Taxonomical hierarchy of the plant/ tree for which the equations were developed was explained upto family level (species, genus and family) in three different fields. It should be noted that no attempts were made to update the nomenclature to the present status, but we have used the species and common names as given in the original source. Individual species can be identified using Unique Species Identification Numbers. When an allometric equation refers to a group of species Group Species IDs were provided to describe them. Fit statistics for the entered equations were described in terms of R^2, adjusted R^2, bias correction, root mean sqauer error (RMSE) and standard error of mean.

4. Data description and structure

The database consists of 74 variables grouped into 7 different categories

1. Plant ecology (Population and Ecosystem)
2. Geographical location where the equation was developed or applied (Continent, Country, Biomes)
3. Equation parameters (variable characters and ranges)
4. Tree vegetation components (Bark, Root, Stump etc.)
5. Taxonomical description (Family – Genus- Species)
6. Statistical Information (R^2, adjusted R^2, bias correction, RMSE and standard error of mean)
7. Bibliography

4.1. Document status in the database

Of the thousands of materials collected from the region, 550 documents were found to be in line with the objectives of the project. Further refinement yielded 466 reports/ articles/ other documents which were considered in the present database. 15% of the documents (i.e., 84 nos.) either didn't contain any equations or couldn't technically fit into the defined parameters of the database and hence not included (Table 1). 67.81% of the total articles covered in the database were collected from India. India's vast geographical extend along with its large network of research institutes has enabled generation of large volumes of tree allometric equations compared to other nations included in the study.

Table 1. Country wise literature coverage in South Asia

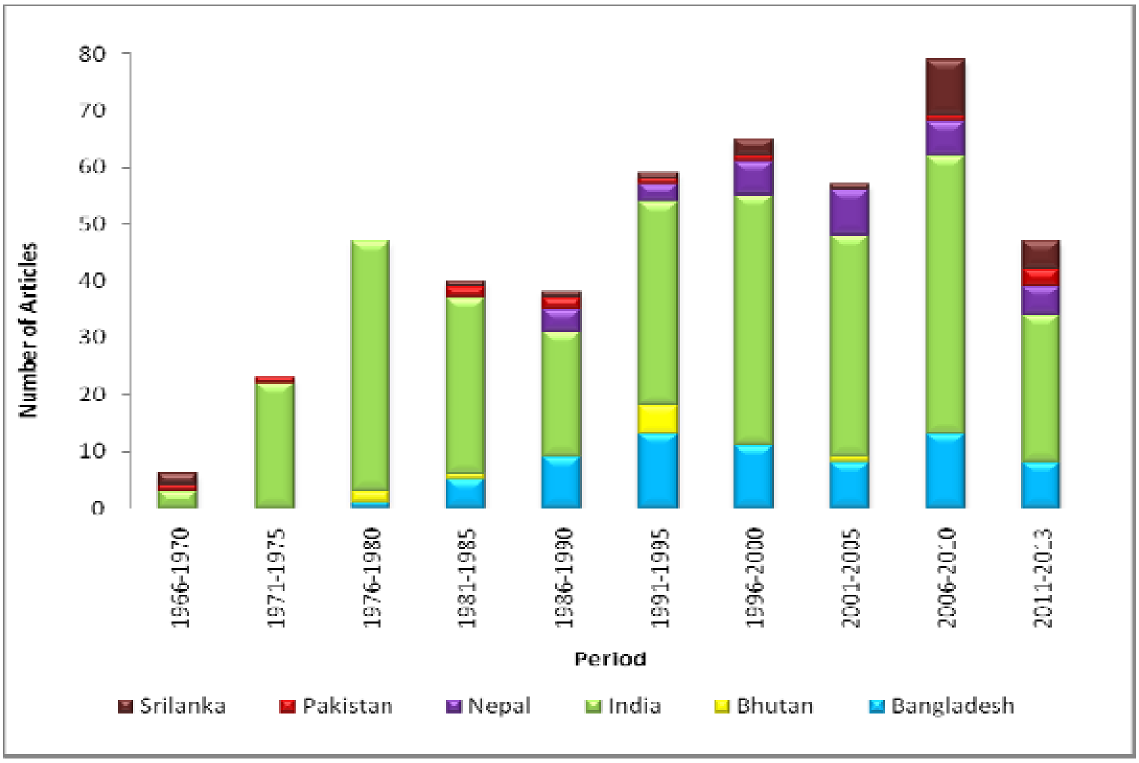
Country	**Total documents collected**		**Documents covered in the database**		**Documents not covered for technical reasons**	
	Number	**%**	**Number**	**%**	**Number**	**%**
Bangladesh	80	14.55	72	15.45	8	9.52
Bhutan	13	2.36	10	2.15	3	3.57
India	371	67.45	316	67.81	55	65.48
Nepal	40	7.27	32	6.87	8	9.52
Maldives	--	--	--	--	--	--
Pakistan	13	2.36	12	2.58	1	1.19
Sri Lanka	29	5.27	24	5.15	5	5.95
Others	4	0.73	0	0	4	4.76
Total	**550**	**100**	**466**	**100**	**84**	**100**

The proportion of equations contributed to the database by individual nations in South Asia varied as India > Bangladesh> Nepal > Sri Lanka> Pakistan> Bhutan. We couldn't find any tree allometric equation reports from Maldives. It should be noted that the database is a compilation of available literature and the proportional contributions may not have a bearing on the actual volume of work on tree allometry in these nations.

4.2. Year wise publication status of tree allometric equations

Year wise classification of the data shows that there were few works in allometric equations in South Asia prior to 1950 (Figure 2). By 1960, works in this field began to take effect in the region especially in India, Pakistan and Sri Lanka. In 1980s, tree inventory and volume table preparation at regional and national scales were taken up by all nations in South Asia and large volumes of output were generated each year. With the advent of new century, modern techniques of inventorying were utilized on a large scale and publications in peer reviewed journals were also found to increase substantially. Since 2000, documents containing allometric equations are being published in the region at a rate of 14 per year, slightly over the 12.5 per year in the previous decade.

Figure 2. Number of published literature per year in South Asia.



4.3. Population status in the database

Population is a major field in the database which explains whether the equations have been developed for trees or stands or mangroves or shrubs or seedlings (Table 2). 70 - 80% of the equations developed and literature derived from the region were for tree populations (except Pakistan). Tree populations were followed by stand and shrubs in the number of equations developed in each country. Equations for mangroves, shrubs and seedlings are the least in the database with only 8% of the records corresponding to these growth forms in the database. As most of the equation in the database is with respect to trees, further discussions in the report are made with respect to this partticular population.

Table 2. Status of population in the literature covered

Population	**Bangladesh**		**Bhutan**		**India**		**Nepal**		**Sri Lanka**		**Pakistan**	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Tree	54	71.05	9	69.23	264	80.98	27	79.41	19	76.00	8	57.14
Stand	15	19.74	1	7.69	36	11.04	7	20.59	5	20.00	4	28.57
Mangroves	2	2.63	0	0.00	2	0.61	0	0.00	1	4.00	0	0.00
Shrubs	4	5.26	3	23.08	12	3.68	0	0.00	0	0.00	1	7.14
Seedlings	1	1.32	0	0.00	12	3.68	0	0.00	0	0.00	1	7.14
Total	76	100.00	13	100.00	326	100.00	34	100.00	25	100.00	14	100.00

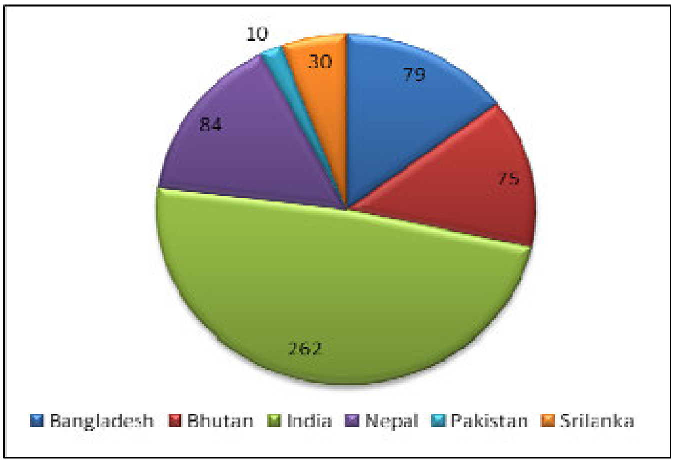
4.4 Tree species status in the database

The database contains allometric equations for 375 species belonging to 96 families and 275 genera and their countrywise coverage in the region is given in Table 3 and Figure 3. Maximum number of allometric models in the database is for *Tectona grandis* covering 5.03% (*n* =224) of the total equations in the database. 4.76% (*n* = 212) equations in the database is with respect to *Populus deltoides*, which ranks second after *Tectona grandis.* 3rd, 4th and 5th positions with respect to the number of equations in the database is occupied by *Dalbergia sissoo* (*n* = 158), *Shorea robusta* (*n* = 142*)* and *Acacia auriculiformis* (*n* = 133). These results show the importance attached to scientific management of plantation species in the region. The number of different types of allometric equations available in the database for each species is given in Appendix – 2.

Table 3. Country wise coverage of genera, family and equations in the database

Country	Number			Percent		
	Family	Genus	Equations	Family	Genus	Equations
Bangladesh	33	72	874	34.38	26.18	19.61
Bhutan	32	64	291	33.33	23.27	6.53
India	72	204	2813	75.00	74.18	63.13
Nepal	39	64	373	40.63	23.27	8.37
Pakistan	5	10	44	5.21	3.64	0.99
Sri Lanka	18	29	65	18.75	10.55	1.46

Figure3. Country wise coverage of tree species in the database



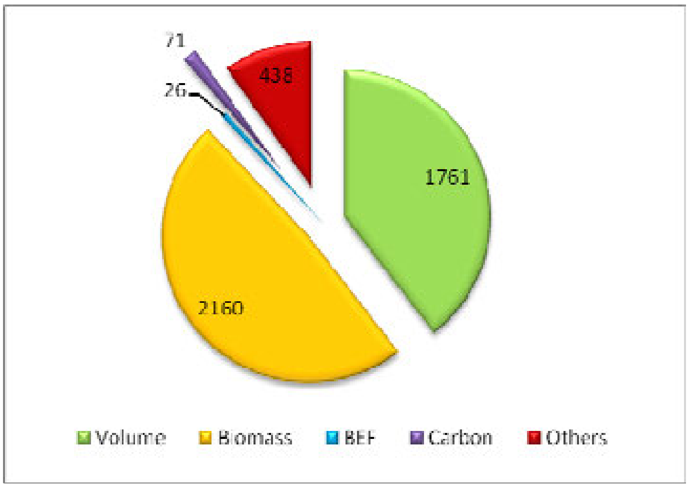
4.5. Status of allometric equations in the database

A total of 4456 tree allometric equations are covered in the database (Figure 4). Out of these 48% are biomass equations, 40% are volume equations, 1.5% equations describes carbon stocks, 0.5% describes biomass expansion factors (BEF) and miscellaneous forms cover 10% of the equations. Among the total volume and biomass equations 53 and 77 percent respectively were developed in India (Table 4).

Table 4. Country wise status of the volume, biomass and BEF tree allometric equations in database

Country	Volume		Biomass		BEF	
	Number	%	Number	%	Number	%
Bangladesh	592	33.62	116	5.37	0	0.00
Bhutan	140	7.95	100	4.63	0	0.00
India	939	53.32	1671	77.36	26	100.00
Nepal	47	2.67	250	11.57	0	0.00
Pakistan	12	0.68	15	0.69	0	0.00
Sri Lanka	31	1.76	8	0.37	0	0.00
Total	1761	100.00	2160	100.00	26	100.00

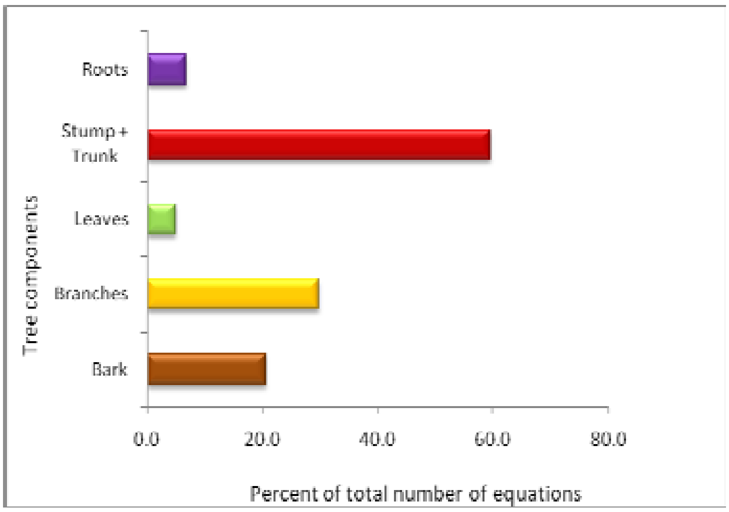
Figure 4. Distribution of volume, biomass, BEF, carbon and other allometric equations (by number) in database



4.6. Status of tree components in the database

Tree components are considered in the equations either singly or in combination (Eg. Branch, Branch + stump + Trunk etc.). So the same equation can contain more than one tree component. 60% of the total tree allometric equations developed in the region are for stump and trunk (Figure 5). Trunk and stump variables are easy to measure and researchers often try to relate easily measurable characters to difficult to measure ones in allometric equations. Foliage, branches, bark etc are often loosely defined and difficult to quantify, hence left out in most instances of allometric equations. Though roots form an important component of plant biomass it was found to be neglected in most documents included in the database.

Figure 5. Percentage of allometric equations per tree component



4.7. Geographical distribution of the equations in South Asia

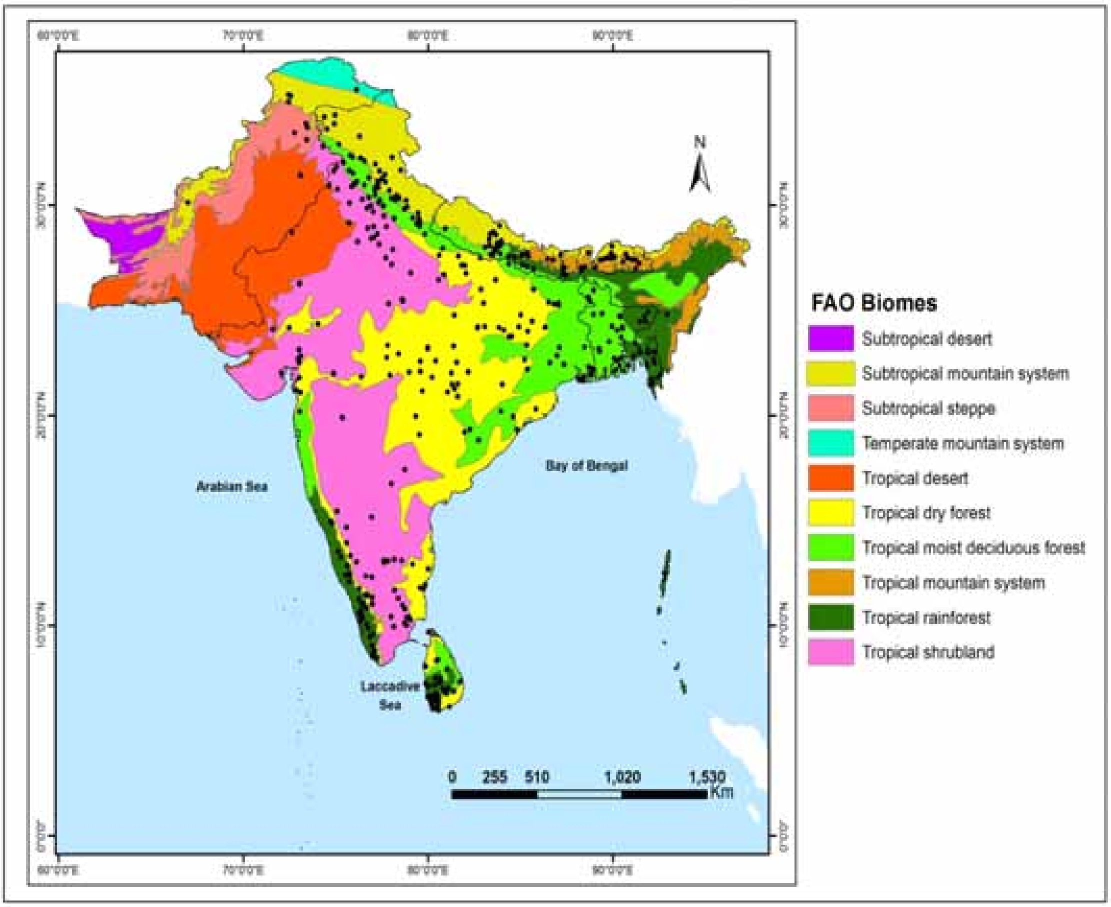
There is high unevenness in the geographical distribution of equations developed across different biomes in South Asia (Figure 6). The amount of allometric works in different life zones had a good correlation with diversity of the system. 21% of the allometric equations in the database were developed for 155 species in tropical rainforests followed by tropical shrubland which covers 95 species and 13% of the equations (Table 5). Among all forest types on earth, the greatest diversity of plants is found in tropical rainforest. Rainforests of tropical Asia are second in extent only to the range of Amazonian rainforests and are found in a great belt centred on the Malay Archipelago, but with tracts found as far west as parts of India and Sri Lanka all the way to the east in Papua New Guinea and northern Queensland in Australia and Pacific islands. We could locate only few allometric works in subtropical steppe.Tropical regimes like tropical moist deciduous forest, tropical dry forest and tropical mountain system were also found to have good number of allometric equations. High diversity in the tropical systems compared to other life zones in South Asia can be cited as the main reason for concentration of most allometry works in these sites. Consequently, tropical desert and subtropical steppe with low species diversity have less number of allometric equations. Coordinates were not available for 2379 allometric equations covered in the database.

Table 5. Coverage of tree allometric equations across different FAO biomes in South Asia

FAO Biomes	Species		Allometric equations	
	Number	%	Number	%
Subtropical mountain system	85	22.67	231	5.18
Subtropical steppe	3	0.80	19	0.43
Tropical desert	7	1.87	25	0.56
Tropical dry forest	52	13.87	422	9.47
Tropical moist deciduous forest	75	20.00	547	12.28
Tropical mountain system	68	18.13	167	3.75
Tropical rainforest	155	41.33	945	21.21
Tropical shrubland	95	25.33	581	13.04
Coordinates not available	260	69.33	2380	53.41
Total*	375		4456	

* Total doesn't represent sum of a particular column as the same species/ allometric equation is repeated in more than one biome. Total refers to the actual number of species/ allometric equation after excluding repetitions.

Figure 6. Geographical distribution of sample plots in FAO Biome systems of South Asia. The black dots represent the sites where equations were developed. (Sample plot distributions of ecosystems in FAO, UDVARDY and Holdridge Biome systems are given in Appendix 3)



5. Country wise analysis in South Asia

5.1 Bangladesh

Seventy two articles from Bangladesh are covered in the database. 75% of this literature is related to tree population and 21% to stand population. A total of 874 equations were derived from these documents covering 33 families, 72 genera and 79 species. 70% of these species are distributed in forest systems (*n*= 56) and plantations (*n*=54). Though majority of the species indicated in the database is common to both forest systems and plantations, most of the allometric equations (85%) were developed with respect to plantation systems. The high percentage of allometric works in plantation sector indicates the importance attached to scientific management of these systems in the country. Though mangroves form a major population type in Bangladesh, we could collect only < 3% allometric equations for this particular system. The geographical distribution of the sample sites of allometric equations developed in Bangladesh was found to be mostly concentrated in Tropical rainforest (FAO Biome classification)/ Tropical humid forests (UDVARDY Biome classification)/ Lower gangetic plain moist deciduous forests (WWF Biome classification)/ Subtropical wet forest (Holridge Biome classification) (Tables 6 to 9). Fit statistics status of the equations from Bangladesh are indicated in table 10.

Table 6. Coverage of species and tree allometric equations across different FAO Biomes in Bangladesh

FAO Biomes	Species		Allometric equations	
	Number	%	Number	%
Tropical moist deciduous forest	27	34.18	216	24.71
Tropical rainforest	65	82.28	470	53.78
Coordinates not available	50	63.29	383	43.82
Total*	79	100.00	874	100.00

Table 7. Coverage of species and tree allometric equations across different UDVARDY Biomes in Bangladesh

UDVARDY Biomes	Species		Allometric equations	
	Number	%	Number	%
Bengalian rainforest	14	17.72	22	2.52
Burman monsoon forest	33	41.77	187	21.40
Burman rainforest	23	29.11	125	14.30
Tropical dry forests/Woodlands	3	3.80	3	0.34
Tropical humid forests	58	73.42	409	46.80
Coordinates not available	50	63.29	383	43.82
Total*	79	100.00	874	100.00

Table 8. Coverage of species and tree allometric equations across different WWF Biomes in Bangladesh

WWF Biomes	Species		Allometric equations	
	Number	%	Number	%
Lower gangetic plain moist deciduous forests	70	88.61	512	58.58
Mizoram-Manipur- Kachin moist evergreen forest	4	5.06	15	1.72
Sunderbans freshwater swamp forest	11	13.92	76	8.70
Sunderbans mangrove	1	1.27	2	0.23
Coordinates not available	50	63.29	383	43.82
Total*	79	100.00	874	100.00

Table 9. Coverage of species and tree allometric equations across different Holdridge Biomes in Bangladesh

HOLDRIDGE Biomes	Species		Allometric equations	
	Number	%	Number	%
Subtropical moist forest	21	26.58	168	19.22
Subtropical wet forest	49	62.03	402	46.00
Tropical moist forest	60	75.95	386	44.16
Total*	79	100.00	874	100.00

* Total doesn't represent sum of a particular column as the same species/ allometric equation is repeated in more than one biome. Total refers to the actual number of species/ allometric equation after excluding repetitions in Tables 5 - 8.

Table 10. Availability of fit statistics for tree allometric equations in Bangladesh

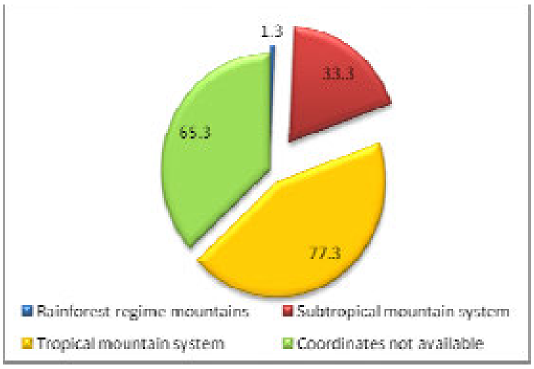
Fit statistics	Number	%
R^2	281	32.15
Adjusted R^2	14	1.60
RMSE	46	5.26
SSE	69	7.89
Bias correction	--	--

5.2 Bhutan

Majority of Bhutan falls under tropical and subtropical mountain systems (FAO Biome Classification). 291 allometric equations related to 32 family, 64 genera and 75 species are covered in the database. 48% of these equations explains tree volume. All the allometric equations from Bhutan covered in the database are for species distributed in forest systems. Majority of the tree allometric works in Bhutan were found to be distributed in Tropical mountain system (FAO Biome classification)/ Himalayan highlands (UDVARDY Biome classification)/ Eastern himalaya broadleaf forest (WWF Biome classification)/ Cool temperate moist forest (Holdridge Biome classification) (Figures 7 - 10). Correlation coefficients were available for 34 % of the equations and remaining 66% of equations covered in the database for Bhutan lack any fit statistical values.

Figure 7 a & b. Percent coverage of species and tree allometric equations across different FAO Biomes in Bhutan

a. Species coverage



b. Allometric equation coverage

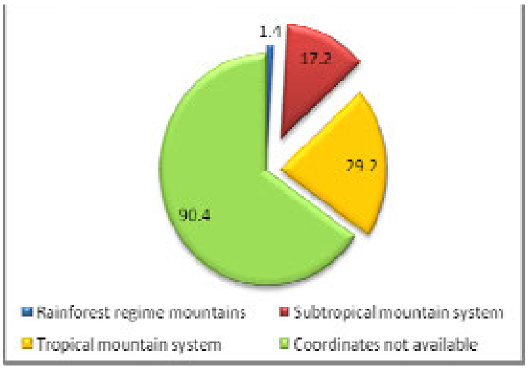
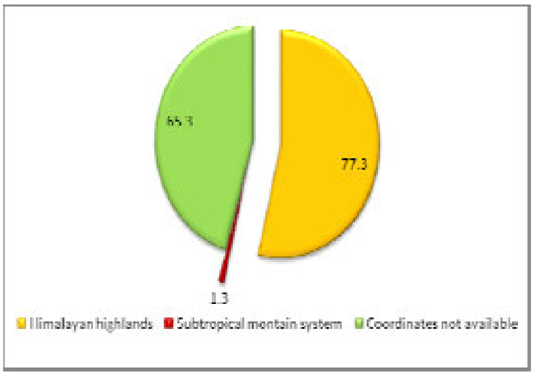


Figure 8 a & b. Percent coverage `of species and tree allometric equations across different UDVARDY Biomes in Bhutan

a. Species coverage



b. Allometric equation coverage

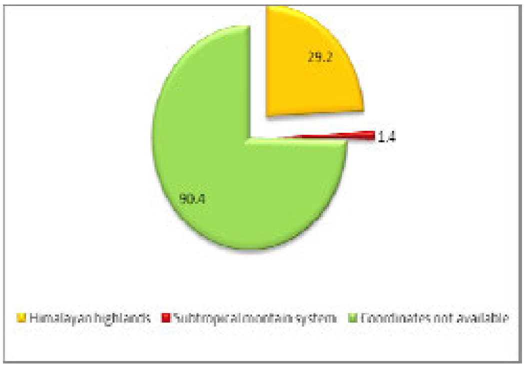
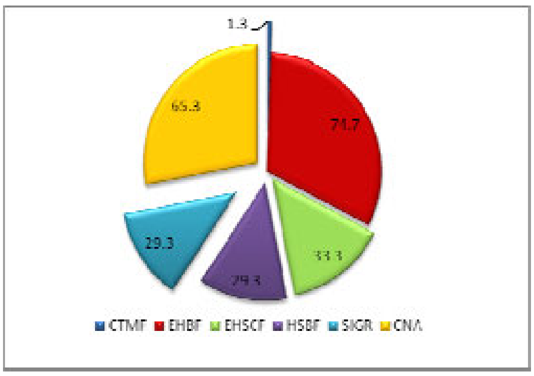
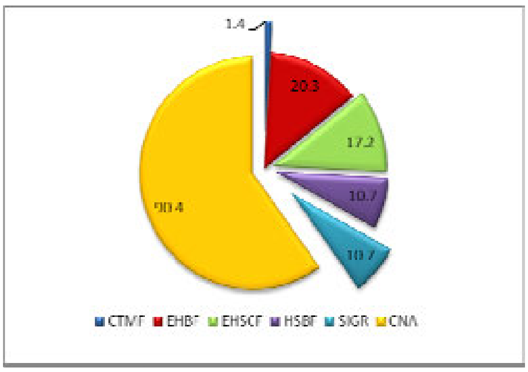


Figure 9 a & b. Percent coverage of species and tree allometric equations across different WWF Biomes in Bhutan

a. Species coverage



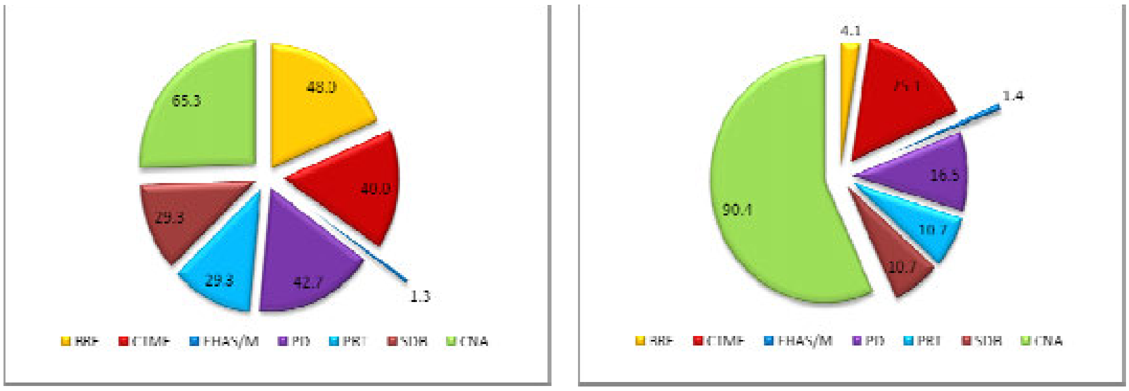
b. Allometric equation coverage



CTMF - Cool temperate moist forest; EHBF - Eastern Himalayan broadleaf forest; EHSCF - Eastern Himalayan subalpine conifer forests; HSBF - Himalayan subtropical broadleaf forest; SIGR - Snow, ice, glaciers and rock; CNA - Coordinates not available

Figure 10 a & b. Percent coverage of species and tree allometric equations across different Holridge Biomes in Bhutan

a. Species coverage b. Allometric equation coverage



BRF - Boreal rain forest; CTMF - Cool temperate moist forest; EHAS/M - Eastern Himalayan alpine shrub/meadow; PD - Polar desert; PRT - Polar rain tundra; SDB - Subtropical desert bush; CNA – Coordinates not available

5.3 India

India contributed 316 articles (68%) to the database. Of these 271 articles (86 %) are related to tree populations and 25 articles (8 %) to stand populations. The database contains 2813 allometric equations of 262 tree species in India. Theses species falls under 204 genera and 72 different families. 60% of these are biomass and 33 % tree volume equations. Majority of the allometric equations (69 %) has been developed for forest systems. Followed by forests, plantations were the major contributors to allometric equations from India (28 %). Plantations have a long history in the country and volume equations were developed long before 1950s to estimate their timber potential. Maximum number of allometric equations in India were developed for *Populus deltoids* (*n*=211) followed by *Tectona grandis* (*n*= 181), *Dalbergia sissoo* (*n* =108) and *Shorea robusta* (*n*=90).

Among the FAO Biomes maximum number of species and allometric equations (94 species, 578 equations) were found to be in Tropical shrublands (Table10). There were only 129 equations for 61 species in subtropical mountain system whereas the documents provided 415 equations for 48 species in the tropical dry forests. Thus there is larger number of equations per species in the Tropical dry forest system compared to Subtropical mountain system. This indicates larger growth differences for the same species in the tropical biomes which make a single allometric equation unable to explain the same character with accuracy at different sites, hence necessitating large number of equations per species across different sampling locations. The literature on allometry was at a minimum for trees of tropical desert and tropical mountain system. The distribution of species and allometric equations across different biomes as classified by UDVARDY, WWF and Holdridge are given in tables 11 to 14. Correlation coefficients were available for 57% and SSE (sum of square error) for 11% of the works done on tree allometry in the country (Figure 11).

Table 11. Coverage of species and tree allometric equations across different FAO Biomes in India

FAO Biomes	Species		Allometric equations	
	Number	%	Number	%
Tropical shrubland	94	35.88	578	20.55
Subtropical mountain system	61	23.28	129	4.59
Tropical desert	3	1.15	11	0.39
Tropical dry forest	48	18.32	415	14.75
Tropical moist deciduous forest	32	12.21	259	9.21
Tropical mountain system	6	2.29	20	0.71
Tropical rainforest	87	33.21	322	11.45
Coordinates not available	183	69.85	1509	53.64
Total*	262		2813	

Table 12. Coverage of species and tree allometric equations across different UDVARDY Biomes in India

UDVARDY Biomes	Species		Allometric equations	
	Number	%	Number	%
Bengalian rainforest	1	0.38	14	0.50
Coromandel	2	0.76	6	0.21
Deccan thorn forest	5	1.91	31	1.10
Himalayan highlands	48	18.32	127	4.51
Indus-Ganges monsoon forest	63	24.05	416	14.79
Mahanadian	3	1.15	7	0.25
Malabar rain forest	60	22.90	159	5.65
Mixed island systems	1	0.38	3	0.11
Mixed mountain systems	39	14.89	308	10.95
Tropical dry forests/Woodlands	40	15.27	271	9.63
Tropical humid forests	80	30.53	283	10.06
Warm deserts/semi-deserts	5	1.91	25	0.89
Coordinates not available	182	69.47	1509	53.64
Total*	262		2813	

Table 13. Coverage of species and tree allometric equations across different WWF Biomes in India

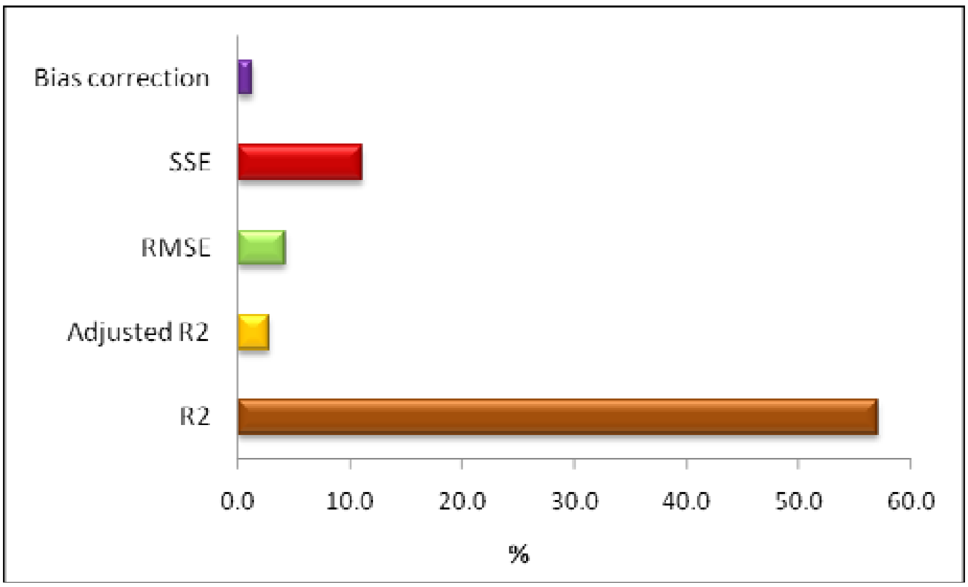
WWF Biomes	Species		Allometric equations	
	Number	%	Number	%
Andaman islands moist forests	1	0.38	3	0.11
Central deccan plateau dry deciduous forest	6	2.29	14	0.50
Chhota-Nagpur dry deciduous forest	23	8.78	27	0.96
Deccan thorn scrub forest	8	3.05	10	0.36
Deccan thorn shrub forest	53	20.23	113	4.02
East deccan semi-evergreen moist forests	3	1.15	26	0.92
Eastern ghats moist deciduous forest	20	7.63	171	6.08
Eastern Himalayan broadleaf forest	2	0.76	4	0.14
Eastern Himalayan subalpine conifer forests	6	2.29	9	0.32
Himalayan subtropical broadleaf forest	9	3.44	64	2.28
Himalayan subtropical pine forest	55	20.99	110	3.91
Khathiar-Gir dry deciduous forest	10	3.82	74	2.63
Lower Gangetic plain moist deciduous forest	24	9.16	52	1.85
Malabar coast moist deciduous forest	5	1.91	40	1.42
Narmada valley dry deciduous forest	24	9.16	148	5.26
North Western ghats moist deciduous forests	50	19.08	59	2.10
North Western ghats montane forests	32	12.21	124	4.41
North Western thorn scrub forest	27	10.31	128	4.55
Orissa semi evergreen moist forests	2	0.76	4	0.14
South Western ghats moist decidous forests	77	29.39	244	8.67
South Western Ghats montane forests	19	7.25	96	3.41
Terai-duar savanna and grassland	6	2.29	69	2.45
Thar desert	1	0.38	4	0.14
Upper gangetic plains deciduous forest	31	11.83	329	11.70
West Pakistan shrub and steppe	1	0.38	13	0.46
Western Himalayan alpine shrub/meadow	1	0.38	12	0.43
Western Himalayan broadleaf forest	10	3.82	73	2.60
Western Himalayan subalpine conifer forests	2	0.76	10	0.36
Coordinates not available	182	69.47	1509	53.64
Total*	262		2813	

Table 14. Coverage of species and tree allometric equations across different Holdridge Biomes in India.

HOLDRIDGE Biomes	Species		Allometric equations	
	Number	%	Number	%
Boreal wet forest	2	0.76	10	0.36
Cool temperate moist forest	2	0.76	10	0.36
Cool temperate rain forest	3	1.15	5	0.18
Cool temperate wet forest	4	1.53	10	0.36
Polar desert	7	2.67	21	0.75
Subtropical desert bush	2	0.76	29	1.03
Subtropical dry forest	30	11.45	274	9.74
Subtropical moist forest	114	43.51	557	19.80
Subtropical thorn steppe	8	3.05	48	1.71
Subtropical wet forest	72	27.48	149	5.30
Tropical dry forest	46	17.56	320	11.38
Tropical moist forest	43	16.41	234	8.32
Tropical thorn steppe	1	0.38	4	0.14
Tropical very dry forest	77	29.39	332	11.80
Warm temperate moist forest	8	3.05	14	0.50
Coordinates not available	182	69.47	1509	53.64
Total*	262		2813	

* Total doesn't represent sum of a particular column as the same species/ allometric equation is repeated in more than one biome. Total refers to the actual number of species/ allometric equation after excluding repetitions in Tables 5 - 8.

Figure 11. Percent availability of fit statistics for tree allometric equations in India



5.4 Nepal

373 allometric equations from Nepal are included in the database from 32 documents. 67% (*n*= 250) of these are biomass related and 13% (*n* = 47) are volume based allometric equations. These equations cover 39 families, 64 genera and 84 species in the country. 67% of the total species reported in the database from Nepal belongs to forest systems and only 16% were from plantation forestry sector. However, maximum number of allometric equations were developed for *Cupressus macrocarpa* (*n*=31) followed by *Acacia auriculiformis* (*n*= 24), two important plantation species in Nepal. 25% of the total allometric equations in Nepal were for 31 species in Tropical rainforest system (FAO Biome classification). The distribution of species and allometric equations in different Biome classification systems (UDVARDY, WWF and Holdridge) in Nepal is given in Figures 12 -15. All the documents collected from Nepal had fit statistics values (Table 15).

Figure 12 a & b. Percent coverage of species and tree allometric equations across different FAO Biomes in Nepal

a. Species coverage b. Allometric equation coverage

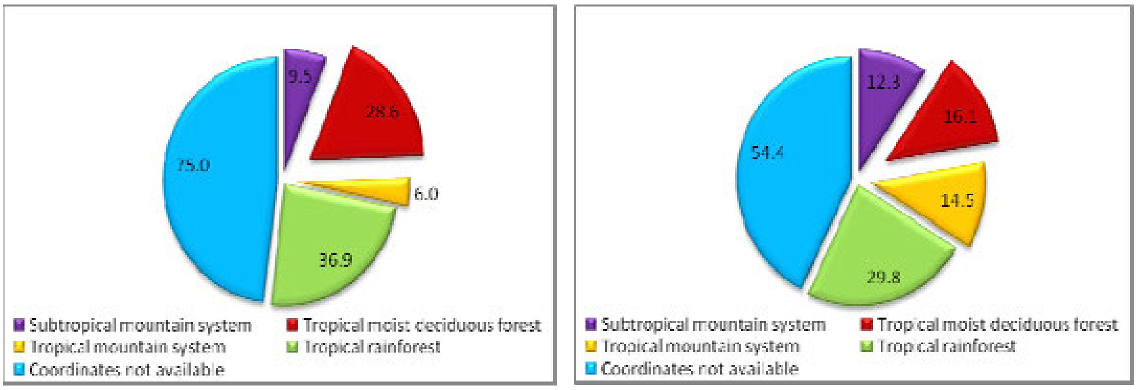
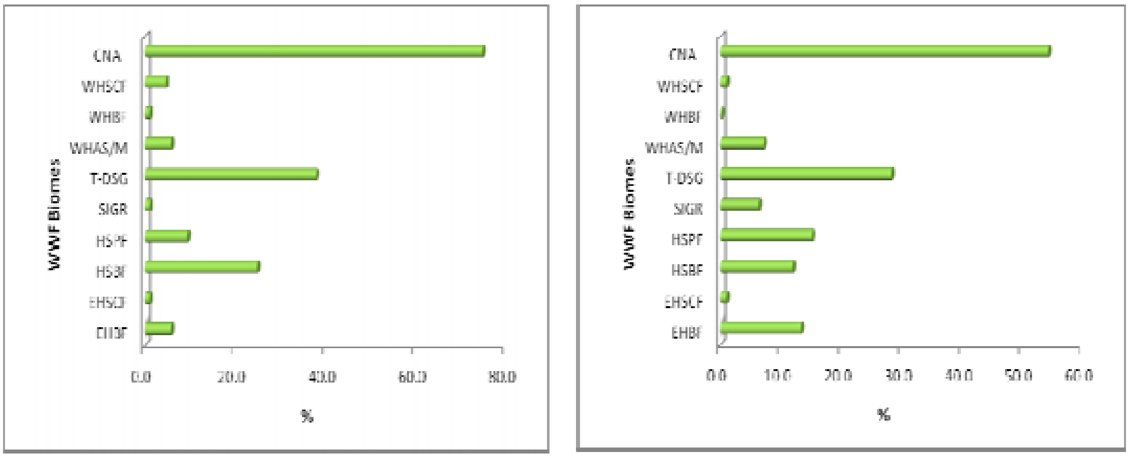


Figure 13 a & b. Percent coverage of species and tree allometric equations across different UDVARDY Biomes in Nepal

a. Species coverage b. Allometric equation coverage

Figure 14 a & b. Percent coverage of species and tree allometric equations across different WWF Biomes in Nepal

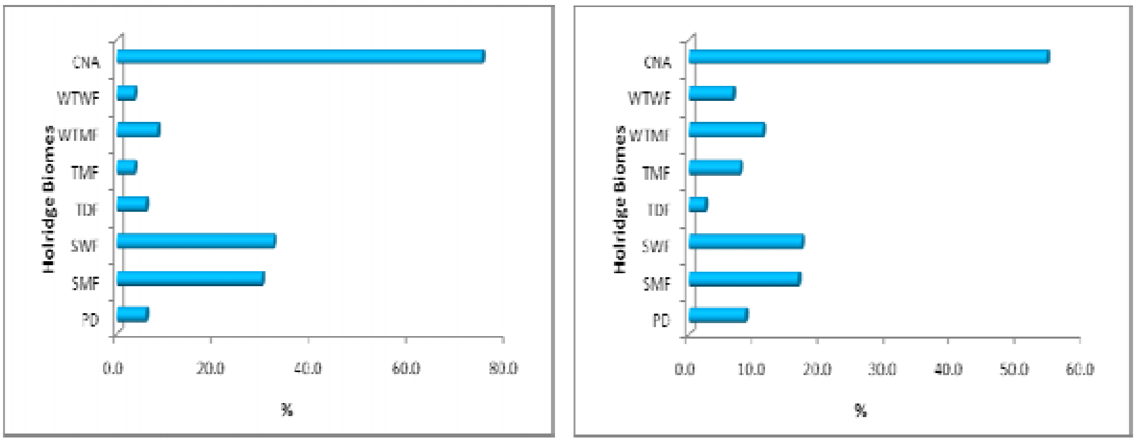
a. Species coverage | b. Allometric equation coverage



EHBF - Eastern Himalayan broadleaf forest; EHSCF - Eastern Himalayan subalpine conifer forests; HSBF - Himalayan subtropical broadleaf forest; HSPF - Himalayan subtropical pine forest; SIGR - Snow, ice, glaciers and rock; T - DSG - Terai-Duar savanna and grassland; WHAS/M - Western Himalayan alpine shrub/meadow; WHBF - Western himalayan broadleaf forest; WHSCF - Western Himalayan subalpine conifer forests; CNA – Coordinates not available

Figure 15 a & b. Percent coverage of species and tree allometric equations across different Holdridge Biomes in Nepal

a. Species coverage | b. Allometric equation coverage



PD - Polar desert; SMF - Subtropical moist forest; SWF - Subtropical wet forest; TDF - Tropical dry forest; TMF - Tropical moist forest; WTMF - Warm temperate moist forest; WTWF - Warm temperate wet forest; CNA – Coordinates not available.

Table 15. Availability of fit statistics for tree allometric equations in Nepal

Fit statistics	Number	%
R^2	281	75.34
Adjusted R^2	55	14.75
RMSE	33	8.85
SSE	40	10.72
Bias correction	30	8.04

5.5 Pakistan

12 articles covering 5 family and 10 genera from Pakistan are included in the database. Most of the 44 allometric equations from Pakistan included in the database represent tree biomass (34%) and volume (27%). Maximum number of equations are for *Olea ferruginea* (n= 11) and *Pinus roxburghii* (n = 7). 80% of the species from Pakistan included in the database belong to forest systems mainly spread over subtropical steppe and tropical desert systems (FAO Biome Classification) (Figure 15). The distribution of species and allometric equations across different biomes as classified by UDVARDY, WWF and Holridge are given in Figures 16 to 19. More than 50% of the allometric works from Pakistan had some sort of fit statistical values (Table 16).

Figure 16 a & b. Percent coverage of species and tree allometric equations across different FAO Biomes in Pakistan

a. Species coverage

b. Allometric equation coverage

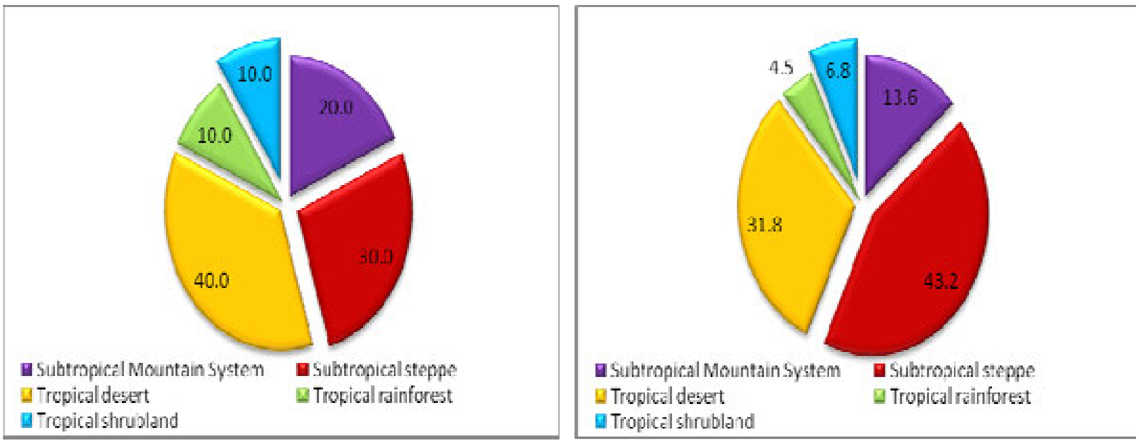
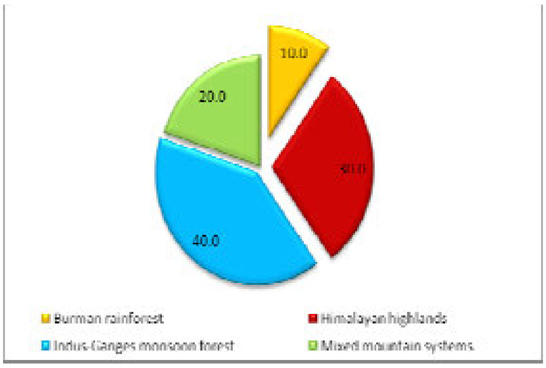


Figure 17 a & b. Percent coverage of species and tree allometric equations across different UDVARDY Biomes in Pakistan

a. Species coverage



b. Allometric equation coverage

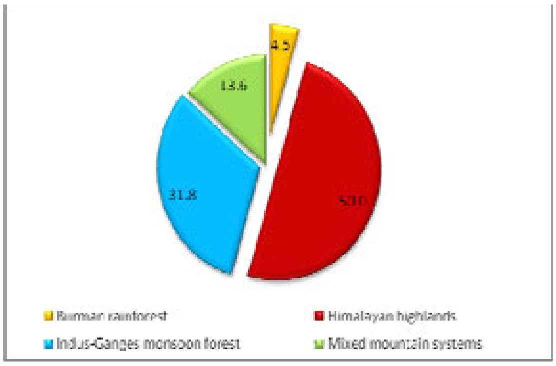
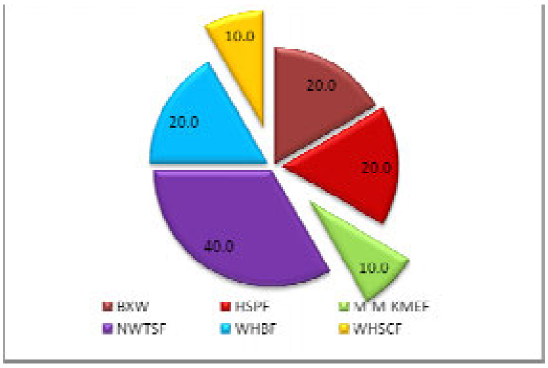
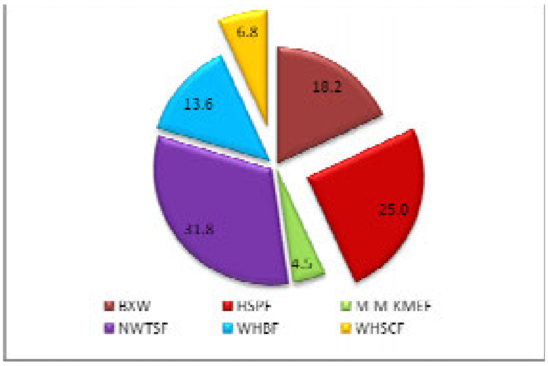


Figure 18 a & b. Percent coverage of species and tree allometric equations across different WWF Biomes in Pakistan

a. Species coverage



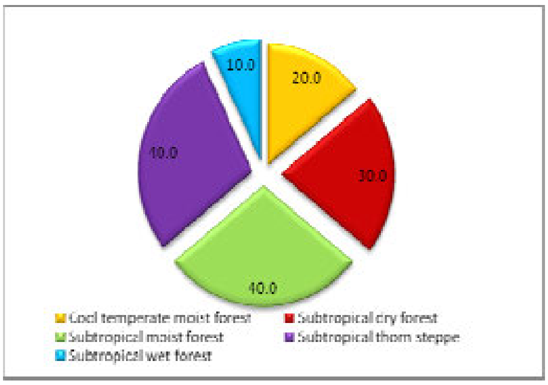
b. Allometric equation coverage



BXW - Baluchistan xeric woodland; HSPF - Himalayan subtropical pine forest; M-M-KMEF - Mizoram-Manipur- Kachin moist evergreen forest; NWTSF - North Western thorn scrub forest; WHBF - Western Himalayan broadleaf forest; WHSCF - Western Himalayan subalpine conifer forests

Figure 19 a & b. Percent coverage of species and tree allometric equations across different Holdridge Biomes in Pakistan

a. Species coverage



b. Allometric equation coverage

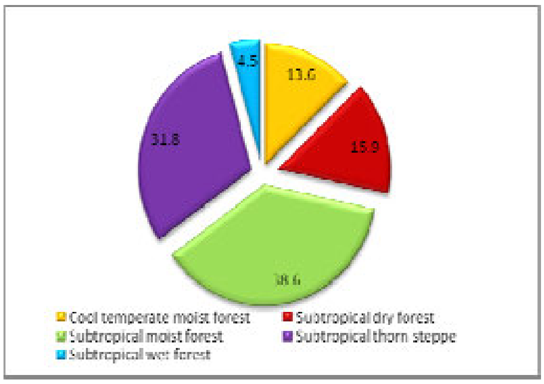


Table 16. Availability of fit statistics for tree allometric equations in Pakistan

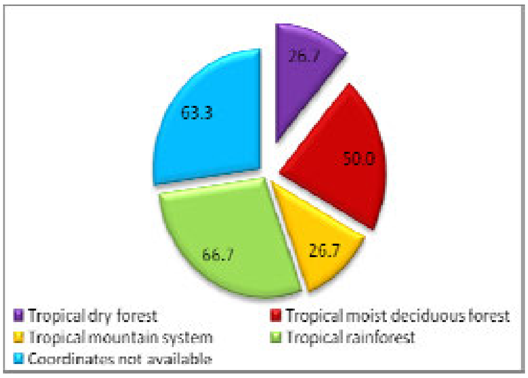
Fit statistics	Number	%
R^2	23	52.27
Adjusted R^2	0	0.00
RMSE	0	0.00
SSE	8	18.18
Bias correction	0	0.00

5.6 Sri Lanka

A total of 65 equations were derived from 24 documents collected from Sri Lanka. 30 species belonging to 29 genera and 18 families are presented in the database. More than 90% of these species and equations from Sri Lanka were from plantation systems. *Pinus caribaea*, *Tectona grandis* and *Eucalyptus grandis* cover 34% of the total allometric equations from the island nation. More than 60% of the allometric equations developed in Sri Lanka had fit statistical analyses associated with them. The distribution of species and allometric equations across different biome systems (FAO, UDVARDY, WWF and Holridge) is given in Figures 20 – 23.

Figure 20 a & b. Percent coverage of species and tree allometric equations across different FAO Biomes in Sri Lanka.

a. Species coverage



b. Allometric equation coverage

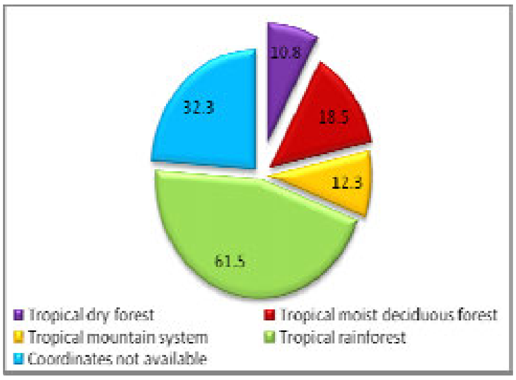


Figure 21 a & b. Percent coverage of species and tree allometric equations across different UDVARDY Biomes in Sri Lanka

a. Species coverage b. Allometric equation coverage

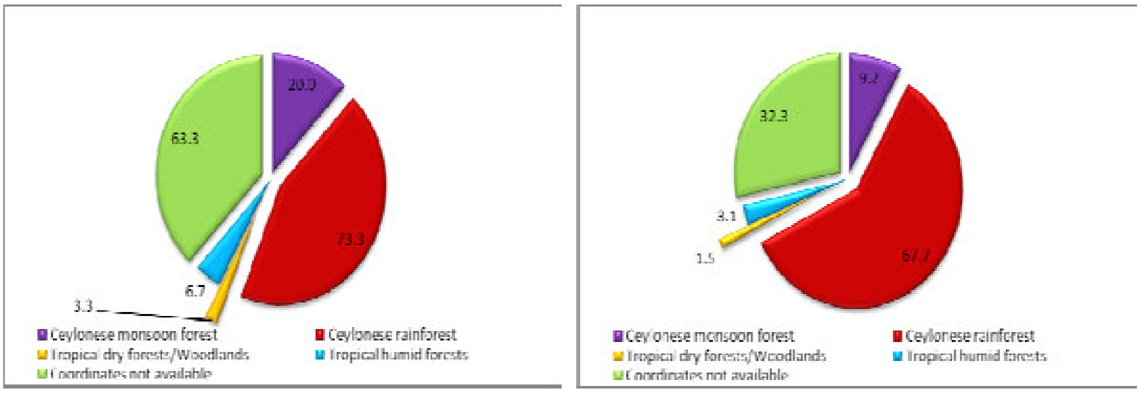


Figure 22 a & b. Percent coverage of species and tree allometric equations across different WWF Biomes in Sri Lanka

a. Species coverage b. Allometric equation coverage

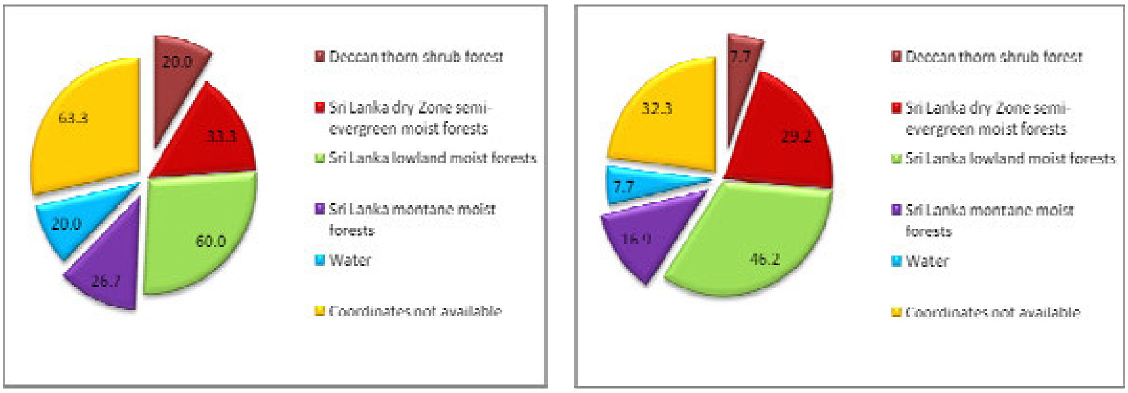
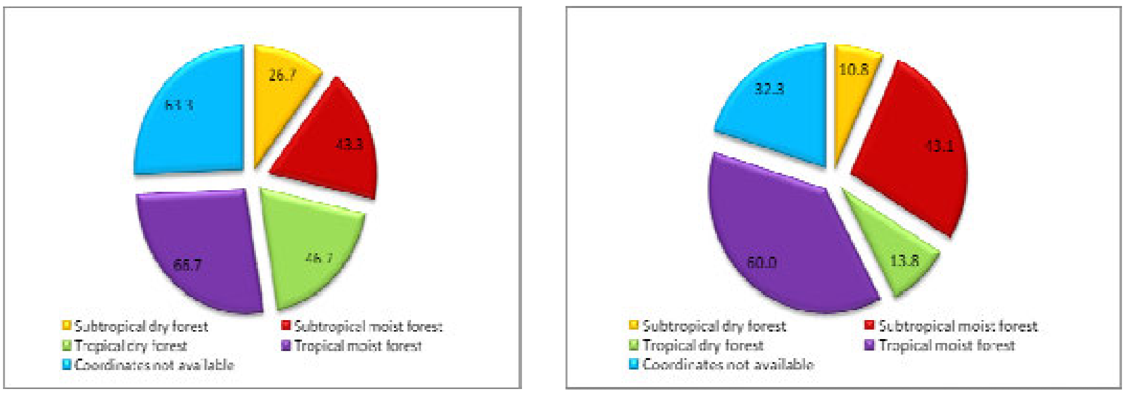


Figure 23 a & b. Percent coverage of species and tree allometric equations across different Holdridge Biomes in Sri Lanka

a. Species coverage b. Allometric equation coverage



6. Conclusions and recommendations

This compilation project entitled 'Inventory of volume and biomass tree allometric equations for South Asia' was an attempt to inventory all available published data on tree allometric equations in the study region. The database has been prepared by extensive and exhaustive literature collected from the region. Nevertheless, there will be several lacunae which can be progressively corrected.

The database covers a total of 466 documents on tree allometry. 4456 equations on volume, biomass, BEF, carbon and other growth variables in South Asia for 375 species belonging to 96 families and 275 genera are included in the database. Though root biomass is as important as shoot in carbon stock estimations, there were very few documents on root growth parameters. Also proportionate allocation of allometric models for different species in the collected documents is not homogenous with commercially important ones capturing more percentage share of equations (Eg. *Tectona grandis, Populus deltoides etc*.). The geographical distribution of these allometric equations is highly skewed and conscious efforts should be taken to unearth documents on allometry in the neglected life zones.

Given the high biodiversity within and among different life zones in South Asia, further scientific analysis of the allometric equations in the database is needed to derive more elaborate results. Research activities in the region should be directed to fill the existing gaps in allometric equations database. Studies should be taken up to improve the geospatial distribution of sample plots and thereby include under-represented biomes such as subtropical steppe and tropical desert (FAO biome system) in the South Asian region . Efforts to develop allometric equations of neglected species (eg. Melanorrhoea usitata, Zizyphus mauritiana, Ficus benghalensis etc.) should be taken up for a comprehensive assessment of carbon stocks in the region. Though home gardens and trees outside forest contribute much to the vegetation, biomass and carbon storage, these ecosystems remain outside the purview of most tree allometric works .

Since felling is banned in many countries, there have been difficulties in obtaining permission to fell sample trees. This discourages the researchers to take up new studies related to developing volume and biomass allometric equations. Among the population, biomass estimates are available for many shrubs and seedlings. However, such estimates are not useful for extrapolation as they lack minimum statistical measures like standard error and thus not found place in the database developed here. Similarly, there are many stand level volume equations developed, most of them are of non-linear nature and hence conceiving a common database for carbon storage estimation appears to be a difficult task.

Mangroves were a negelected population in the region. But of late it is gaining lot of importance due to improved understanding on its vital role in the ecological maintenance and carbon sequestration. Allometric studies on mangroves should be encouraged so as the have precise estimates of carbon storage.

Given the huge spatial variability of estimates of the parmeters associated with allometric equations and absence of GPS (Geographical Postioning System) measurements for large number of equations published before the advent of GPS, the calibration of the equations for carbon estimation at local and regional level has been a big issue. The availability of suitable analytical and decision support tools related to carbon issues has also been a weak area in the region. Lack of minimum publishing and reporting standards is another weakness in allometric database reporting in the region. Vague description of tree components and output terms reduces the quality of allometric equations developed in the region.

Recently there has been a considerable interest in using site and species specific allometric equations for estimating volume, biomass and carbon stocks in the region. This should be capitalized and conscious efforts should be made so that the published database is used by researchers/ stakeholders for cost effective and accurate biomass, carbon and bioenergy estimations. A capacity building programme on international set of “good practice” guidelines focused on sampling methods, regression methods and inventorying allometric equations is quite essential to improve the quality of works and reporting procedures. It would also be important to periodically update the database so as to provide up-to-date information on tree allometry to all stake holders in the region. This can be achieved by encouraging researchers in the region to provide relevant information to the database as and when developed and by periodic literature surveys. A comprehensive repository of allometric works in South Asia will provide policy makers valuable inputs during REDD+ policy formulations in the region in tune with International standards.

Finally, carbon stock inventorying of an ecosystem remains incomplete without assessment of soil carbon. A unified soil carbon monitoring mechanism (surveys and modeling) for South Asia along with tree biomass estimates will help countries in the region to assess and plan common strategies to reduce emissions from deforestation and forest degradation, conserve forest carbon stocks and manage forests sustainably. A co–ordinated network of researchers working on various aspects of plant biomass and terrestrial carbon stocks could be established in the region to share information, avoid duplication of works and channelize the availble resources to new avenues in an effort to fill the existing research gaps. The co - odinated network can be used to design meaningful courses of future action leading towards a common goal.

7. References cited

Baldasso, M., Birigazzi, L. & Henry, M. 2012. *Tutorial for Insertion of Volume and Biomass Allometric Equations in the Database* (Food and Agriculture Organization of the United Nations, Università degli Studi della Tuscia).

De Koning, F., Olschewski, R., Veldkamp, E., Benítez, P., López-Ulloa, M., Schlichter, T. & De Urquiza, M. 2005. The ecological and economic potential of carbon sequestration in forests – examples from South America. *Ambio*, (34): 224–229.

Dixon, R.K., Brown, S., Solomon, R.A., Trexler, M.C. & Wisniewski, J. 1994. Carbon pools and flux of global forest ecosystems. *Science*, 263: 185-190.

Eerikäinen, K., Hinh, V. T., Huy, B. et al. 2012. *A review of the applicability of existing tree and forest characteristics prediction models to forest inventory in Vietnam and Nepal*.

Henry M., Picard N., Trotta C., Manlay R., Valentini R., Bernoux M. & Saint-André L. 2011. Estimating tree biomass of Sub-Saharan African forests: a review of available allometric equations. *Silva Fennica*, (45): 477-569.

Henry, M., Bombelli, A.,Trotta, C., Alessandrini, A., Birigazzi, L., Sola, G., Vieilledent, G., Picard, N., Saint André, L. & Henry, M. 2012. *Manual for Building Tree Volume and Biomass Allometric Equations: From Field Measurement to Prediction.* (CIRAD, FAO).

Santenoise, P., Longuetaud, F., Valentini, R., Picard, N. & Saint-André, L. 2013. GlobAllomeTree: international platform for tree allometric equations to support volume, biomass and carbon assessment. *iForest – Biogeosciences and Forestry*. 326 – 330.

Wilson, B.R.S.A. & Daff, J.T. 2003. *Australia's state of the forests report*. *Department of Agriculture, Fisheries and Forestry, Govt. of Australia*.

8. References included in the database

Abbas, M., Nizami, S. M, Saleem, A., Gulzar, S.& Khan, I.A. 2011. Biomass expansion factors of *Olea ferruginea* (Royle) in sub tropical forests of Pakistan. *African Journal of Biotechnology, 10(*9): 1586–1592.

Acharya, K. P., Regmi, R. & Acharya, B. 2003. *Biomass and Volume Tables for Terai Sal (Shorea . Robusta) Forest Of Nepal.*

Adhikari, B.S., Rawat, Y.S. & Singh, S.P. 1995. Structure and Function of High Altitude Forests of Central Himalaya-I.Drymatter Dynamics. *Annals of Botony,*(75): 237-248.

Afzal, M. & Akhtar, A. M. 2013. Factors Affecting Carbon Sequestration in Trees. *Journal of Agricultural Research,*(51): 61-69.

Ahmad, G. 1968. *Report on Panjkora Valley Forests*. 36pp.

Ahmed, M., Shoukat, S.S. & Buzdar, A.H. 1990. Population Structure and Dynamics of Juniperus Excelsa in Balouchistan,Pakistan. *Journal of Vegetation Science,*(1): 271-276.

Ajit, Das, D.K., Chaturvedi, O.P., Jabeen, N. & Dhyani, S.K. 2011. Predictive Models for Dry Weight Estimation of above and Below Ground Biomass Components of Populus Deltoides in India: Development and Comparative Diagnosis. *Biomass and Bioenergy,*(35): 1145-1152.

Ajit, V.K., Gupta, K.R., Solanki, R.V.S. & Datta, A. 2000. Modelling for Timber Volume of Young Eucalyptus Tereticornis Plantations. *Indian Journal of Forestry,*(23): 233-237.

Akter, S., Al-Amin, M. & Rahman, M.S. 2011. Carbon Sequestration Potential of Dipterocarps at Chittagong University Plantations in Bangladesh. *SAARC Forestry,*(1): 103-112.

Alamgir, M. & Al-Amin, M. 2007. Organic Carbon Storage in Trees within Different Geopositions of Chit - Tagong (South) Forest Division , Bangladesh. *Jourrnal of Forestry Research,*(18): 174-180.

Al-Amin, M. 2002. *Assessment of Organic Carbon Sequestration of Three Different Tree Species in Chittagong.*

Al-Amin, M. 2005. *Composition and Organic Carbon Stock of Undergrowth in Selected Geoposition of Chittagong Hill Tracts.*

Al-Amin, M. 2005. *Estimation and Modelling of Organic Carbon Stock Using Spatial Datasets at Chittagong(South)Forest Division.*

Al-Amin, M. 2005. *Tree Composition and Organic Carbon Stock of Selected Geopositions in Sylhet Division.*

Al-Amin, M. 2006. *Composition of Shrubs,Herbs and Grasses in Different Landuses with Their Organic Carbon Contents in Sylhet District.*

Al-Amin, M. 2006. *Development of Allometric Model to Assess Organic Carbon Stock of Bambusa Tulda and Melocanna Baccifera Roxb.*

Al-Amin, M. 2006. *Development of Allometric Model to Assess Organic Carbon Stock of Shorea Robusta Gaertn.At Comilla.*

Al-Amin, M. 2007. *Vegetative Composition and Organic Carbon Stock Potentiality under Different Forest Management Systems at Sitakund.Pdf.*

Alamgir, M. & Al-Amin, M. 2008. Allometric Models to Estimate Biomass Organic Carbon Stock in Forest Vegetation. *Journal of Forestry Research, (19*): 101–106.

Al-Amin, M. 2009. *Climate Signature on Tree Growth and Organic Carbon Stock of Forest Plantations.*

Al-Amin, M. 2010. *Estimation of Macronutrients and Organic Carbon Stock of Shorea Robusta Gaertn.Dominated Forest in Mymensingh.*

Al-Amin, M. 2010. *Species Composition ,Carbon Stock and Soil Macronutrients in Natural and Man Made Forests in Chittagong.*

Al-Amin, M. 2011. *Carbon Stock at Coast of Chittagong Applying Remote Sensing.*

Al-Amin, M. 2011. *Identifying and Developing the Management Techniques of Suitable Forest Tree Species of Agro-Ecological Zones Using Climate Change Scenarios for Bangladesh.*

Ambagahaduwa, I. M., Prasad, N., Gunatilleke, I. A. U. N., Seneviratne, G. & Gunatilleke, C.V.S. 2009. Estimation of above Ground Biomass of a Pinus Caribaea Morelet Stand in Lower Hantana. *Journal of National Science Foundation,Srilanka,*(37): 195-201.

Andel, S. 1986. *Forest inventory for Management Planning*.

Appuhamyl, K.A.N.A., Samarappule, L. & Karunaratne, S.B. 2009. Variation in Growth , Biomass and Carbon Accumulation among Rubber (Hevea Brasiliensis), Teak (Tectona Grandis) and Mahogany (Swietenia Macrophylla). *Proceedings of 9th Agricultural Research Symposium,*(218-223.

Ara, I. & Yahya, N. S. M. 1988. Studies on Growth and Yield of Seedling Crops of Eucalyptus Camaldulensis in Bangladesh. *Bano Biggyan Patrika,*(17): 31-40.

Bahar, N. 2002. Studies on Morphological,Biomass and Root Characters of Rumex Nepalensis Spreng.,in Temperate Regions of Himalayas. *Indian Forester,*(128): 707-708.

Balmforth, E.G. 1997. *Forest Management Plan for Sylhet Division*.

Bandara, K. M. A. 1999. Early Performance of Introduced Eucalyptus Microcorys Provenances in the up Country Intermediate Zone,Erabedda. *The Sri Lanka Forester,*(23): 50-54.

Banyal, R., Bhardwaj, S. D. & Gupta, S. K. 2001. Rhizobhium Inoculation of Acacia Catechu and Acacia Mollissima:Effect on Seedling Growth and Biomass Production. *Journal of Tropical Forest Science,*(13): 219-222.

Barakoti, T. P. 2005. Monitoring Growth of Uttis(Anus Nepalensis) at a Plantation Cite at Dhankuta,Nepal. *Banko Janakari,*(15): 19-23.

Baral, S. K., Malla, R. & Ranabhat, S. 2009. Above-Ground Carbon Stock Assessment in Different Forest Types of Nepal. *Banko Janakari,*(19): 9-14.

Bhadwal, S. & Singh, R. 2002. Carbon Sequestration Estimates for Forestry Options under Different Land-Use Scenarios in India. *Current Science,*(83): 1380-1386.

Bhatt, B.P., Chauhan, D.S & Todaria, N.P. 1998. Growth Performance and Biomass Yield of Some Leguminous Taxa in Garhwal Himalaya. *Indian Journal of Forestry,*(21): 171-173.

Bhatt, B .P., Jha, A.K. & Rathore, S.S. 2007. Studies on Growth Attributes of Some Economically Important Indigenous Mutipurpose Tree Species of Estern Himalaya,India. *Indian Journal of Forestry,*(33): 289-292.

Bhuiyan, M. G. K. 2008. *Carbon Stock for Eight Selected Forest Tree Species at Specific Ages.*

Bürgi, A. 2002. Fir (Abies Densa) Forests in Central Bhutan : A Model-Based Approach to Assess a Suitable Utilization. *Forestry,*(75): 457-463.

Buvaneswaran, C., George, M., Perez, D.& Kanninen, M.2006. Notes Biomass of Teak Plantations in Tamilnadu , India and Costa Rica Compared. *Journal of Tropical Forest Science,*(18): 195-197.

Chaffey, D.R., Miller, F.R. & Sandom, J.H. 1985. *A Forest Inventory of the Sundarbans, Bangladesh.*

Chakrabarti, S. K. & Gaharwar, K. S. 1995. A Study on Volume Estimation for Indian Teak. *Indian Forester,*(121): 503-509.

Chakrabarti, S. K. & Gaharwar, K. S. 1996. A Study on Volume Estimation of Pterocarpus Marsupium. *Indian Forester,*(122): 734-739.

Chakrabarti, S. K. & Gaharwar, K. S. 1998. A Study on Volume Estimation of Shorea Robusta. *Indian Forester,*(124): 225-230.

Chaturvedi, A. N. & Behl, H. M. 1996. Biomass Production Trails on Sodic Site. *Indian Forester,*(122): 439-455.

Chaturvedi, A. N. & Pande, G. C. 1973. General Standard Volume Tables for Eucaliptus Grandis. *Indian Forest Records,*(12): 1-8.

Chaturvedi, A. N. & Sharma, R. S. 1980. Stand Volume and Yield Tables for Sal(Coppice). *Indian Forester,*(106): 383-396.

Chaturvedi, A. N. & Sood, R. 1995. Variation in Growth,Form and Volume of Clonal and Seedling Plants of Eucalyptus Hybrid. *Journal of Tropical Forestry,*(11): 23-29.

Chaturvedi, A. N. & venkataraman, K. G. 1973. Volume & Weight Table for Eucalyptus Hybrid (Based on the Data from Tamilnadu). *Indian Forester,*(99): 599-608.

Chaturvedi, A. N. 1971. General Standard Volume Tables for Cedrela Toona Roxb. *Indian Forest Records,*(12): 1-9.

Chaturvedi, A. N. 1973. General Standard Volume Tables and Height-Diameter Relationship for Teak (Tectona Grandis). *Indian Forest Records,*(12): 1-9.

Chaturvedi, A. N. 1973. General Standard Volume Tables for Deodar(Cedrus Deodara). *Indian Forest Records,*(12): 1-9.

Chaturvedi, A.N. 1973. General standard volume Tables for Eucaliptus Grandis. *Indian Forest Records,* (12): 1–8.

Chaturvedi, A. N. 1973. General Standard Volume Tables for Eucaliptus Hybrid. *Indian Forest Records,*(12): 1-10.

Chaturvedi, A. N. 1973. General Standard Volume Tables for Gmelina Arborea Linn. *Indian Forest Records,*(12): 1-8.

Chaturvedi, A. N. 1973. General Standard Volume Tables for Holoptelia Integrifolia Planch. *Indian Forest Records,*(12): 1-8.

Chaturvedi, A. N. 1973. General Standard Volume Tables for Sal (Shorea Robusta). *Indian Forest Records,*(12): 1-8.

Chaturvedi, A. N. 1973. General Standard Volume Tables for Semal (Bombax Ceiba L.). *Indian Forest Records,*(12): 1-8.

Chaturvedi, A. N. 1973. General Standard Volume Tables for Shisham (Dalbergia Sisoo,Roxb.). *Indian Forest Records,*(12): 1-14.

Chaturvedi, A. N. 1973. Stand Volume and Yield Tables for Kail Pinus Wallichiana. *Indian Forest Records,*(12): 1-16.

Chaturvedi, A. N. 1974. Tree Quality Volume Tables for Eucalyptus Hybrid. *Indian Forester,*(100): 595-600.

Chaturvedi, A. N. 1975. Crown Width,Stem Diameter and Tree Height in Sal. *Indian Forester,*(101): 396-398.

Chaturvedi, A. N. 1984. Assessment of Biomass Production. *Indian Forester,*(110): 726-738.

Chaturvedi, A.N. 1987. *Methodology for Survey of fuelwood Production from Non-Forest Lands in Villages Berka Alimuddin & Dhanawas*.

Chaturvedi, A.N.,Bhatia,S. & Behl, H.M. 1991. Biomass Assessment for Shrubs. *Indian Forester,*(117): 1032-1035.

Chaturvedi, O. P. 2001. Effect of Root Cutting Diameter and Planting Orientation on Sprouting ,Rooting,Survival and Growth of Dalbergia Sisoo Roxb. *Journal of Tropical Forestry,*(17): 19-24.

Chaturvedi, R.K., Raghubanshi, A.S.& Singh, J.S. 2011. Carbon Density and Accumulation in Woody Species of Tropical Dry Forest in India. *Forest Ecology and Management,*(262): 1576-1588.

Chauhan, K. V. S. & Bhatia, N. K. 2006. A Study of Local Volume Equations for Tectona Grandis (Teak) in Agro-Ecological Region No.10 of India. *Indian Forester,*(132): 1200-1206.

Chauhan, P. S. & Raina, V. 1980. Effect of Seed Weight on Germination and Growth of Chir Pine (Pinus Roxburghi Sargent). *Indian Forester,*(106): 53-59.

Chavan, B. & Rasal, G. 2012. Total Sequestered Carbon Stock of Mangifera Indica. *Journal of Environment and Earth Science,*(2): 37-49.

Chhetri, D. B. K. & Fowler, G. W. 1996. Estimating Diameter at Breast Height and Basal Diameter of Trees from Stump Measurements in Nepal's Lower Temperate Broad-Leaved Forests. *Forest Ecology and Management,*(81): 75-84.

Chhetri, D. B. K. 2008. Comparison of Forest Biomass across a Human-Induced Disturbance Gradient in Nepal ' S Schima-Castanopsisforests. *Journal of Substainable Forestry,*(9): 69-82.

Chittranshi, V. N. & Chitwadgi, S. S. 1971. *Standard Volume Tables for Teak.*

Costa, W. A. J. M. D. & Suranga, H. R. 2012. Estimation of Carbon Stocks in the Forest Plantations of Sri Lanka. *Journal of National Science Foundation,Srilanka,*(40): 9-41.

Cox, F. 1984. *Volume Functions for Plantation Species and Element of Growth Model for Teak*.

Das, D. K. & Chaturvedi, O. P. 2005. Structure and Function of Populus Deltoides Agroforestry Systems in Eastern India1.Dry Matter Dynamics. *Agroforestry Systems,*(65): 215-221.

Das, D. K. & Chaturvedi, O. P. 2008. Root Biomass and Distribution of Five Agroforestry Tree Species. *Agroforestry Systems,*(74): 223-230.

Das, D. K. & Chaturvedi, O. P. 2008. Root Phytomass Recovery and Rooting Characteristics of Five Agroforestry Tree Species in Eastern India. *Journal of Tropical Forest Science,*(20): 156-166.

Das, D. K. & Chaturvedi, O. P. 2009. Energy Dynamics and Bioenergy Production of Populus Deltoides G-3 Marsh Plantation in Eastern India. *Biomass and Bioenergy,*(33): 144-148.

Das, S. 1992. *Tree Volume Tables for Sal (Shorea Robusta Gaertn.F) in the Plantations of Bangladesh.*

Das, S., Islam, S. M. Z. & Latif, M.A.2000. Initial Growth Models for Swietenia Macrophylla King Planted in Chittagong City Areas of Bangladesh. *Bangladesh Journal of Forest Science,*(29): 48-52.

Dash, G.C., Rout, M.C., Sahoo, A. & Das, P. 1991. Biomass Equations for Casuarina Equisetifolia. *Indian Journal of Forestry,*(14): 28-32.

Dayananda, K. J. T. 1988. Tree Volume and Taper Function for Caribbean Pine Plantations in Sri Lanka. *The Sri Lanka Forester,*(18): 115-120.

Deb, J.C., Halim, M. A.& Ahmed, E. 2012. An Allometric Equation for Estimating Stem Biomass of Acacia Auriculiformis in the North-Eastern Region of Bangladesh. *Southern Forests: a Journal of Forest Science,*(74): 103-113.

Deparment of Forest Research & Survey,Nepal. 2006. *Local Volume Tables for Major Tree Species in Dhaulagiri Area.*

Deparment of Forest, Nepal. 2000. *Tree Improvement and Silviculture Component Biomass and Volume Tables with Species Description for Management.*

Department of Agriculture & Corporation, Govt of India .1981. *Report on Plywood Resources Survey of Gedu and Changekha in Western Bhutan*.

Department of Agriculture,Govt of India. 1979. *Report on Preinvestment Survey of Forest Resources in Central and Eastern Bhutan.Volume-II Methodology.*

Department of Forest ,Chittagong. 1988. *Forest Menagement Plan Chittagong Division Forest Department 1988 to 1992*.

Devagiri, G. M., Money, S., Singh, S., Dadhawal, V. K., Patil, P., Khaple, A., Devakumar, A.S. & Hubballi, S. 2013. Assessment of above Ground Biomass and Carbon Pool in Different Vegetation Types of South Western Part of Karnataka , India Using Spectral Modeling. *Tropical Ecology,*(54): 149-165.

Dhanda, R. S. & Verma, R. K. 2001. Timber Volume and Weight Tables of Farm-Grown Poplar(Populus Deltoides Bartr.Ex Marsh.) in Punjab (India). *Indian Forester,*(127): 115-130.

Dhanda, R.S., Dhillon, G.P.S.& Sharma, S.C. 2006. Timber Volume and Biomass Tables for Leucaena Luecocephala(Lam.) De Wit. From Punjab,India. *Indian Forester,*(132): 931-940.

Dhillon, G.P.S., Dhanda, R.S., Gill, R.I.S. & Singh, P. 2011. Estimation of over- and under- Size Merchantable Volume of Populus Deltoides Bartr. *Indian Forester,*(137): 356-362.

Dorga, A. S. & Sharma, S. C. 2003. Volume Prediction Equations for Eucaliptus Hybrid in Punjab. *Indian Forester,*(129): 1451-1460.

Dorga, A. S. & Sharma, S. C. 2009. Above Ground Productivity and Carbon Sequestration Potential of Eucalyptus Hybrid in Punjab. *Indian Forester,*(135): 3-16.

Dugarjav, D. & Pandey, R. 2009. Modelling and Validation for Volume Estimation of Eucalyptus. *Indian Forester,*(135): 231-238.

Eerikäinen, K., Hinh, V. T., Huy, B., Khanh, D. C., Khoa, P. V., Khoi, N. K., Lung, N. N., Mandal, R. A., Phuong, V. T., Pokharel, Y. P., Shrestha. H. L., The, T.N. & Yadav, B. 2012. *A Review of the Applicability of Existing Tree and Forest Characteristics Prediction Models to Forest Inventory in Vietnam and Nepal*.

FAO-UNDP. 1969. *Pre-investment study on forest industries development Ceylon Final Report*.

Forest Resources Management Division,Bhutan.*Volume equations*.

FRI. 1970. *Growth and yield statistics of timber common Indian timber species: volume II*. Forest Research Institute & Colleges, Dehradun.

FSI. 1983. *Forest Survey of India Report on Forest Resources of Singhbhum District (Bihar)*.

FSI. 1985. *Report on the Forest Resources of Santhel Parganas and Part of Bhagalpur District of Bihar*.

FSI. 1986. *Report on the Forest Resources of West Champran District (Bihar)*.58pp .

FSI. 2001. *Carbon Stocks in Indias Forest*.

FSI.1995. *Report on Inventory of Forest Resources of Kodagu District Karnataka.27pp* .

Gangwar, S. K. & Rai, S. 1997. Growth Studies in Winter Pruned Rainfed Mulbery,Morus Spp. *Indian Forester,*(123): 846-850.

Gautam, S. K. & Thapa, H. B. 2007. Volume Equation for Populus Deltoides Plantation in Western Terai of Nepal. *Banko Janakari,*(17): 70-73.

Ghosh, R.C., Gupta, B.N. & shedha, M.D. 1977. Provenance Trail of Eucalyptus Camaldulensis Dehn. *Indian Forester,*(103): 441-453.

Goel, V. L. & Behl, H. M. 2000. Growth , Biomass Estimations and Fuel Quality Evaluation of Coppice Plants of Prosopis Juliflora on Sodic Soil Site. *Journal of Tropical Forest Science,*(12): 139-148.

Goel, V. L. & Behl, H. M. 2005. Growth and Productivity Assessment of Casuarina Glauca Sieb. Ex. Spreng on Sodic Soil Sites. *Bioresource Technology,*(96): 1399-404.

Goel, V. L. & Singh, B. 2008. Growth and Productivity Potential of Dalbergia Sissoo in Short Rotation Coppice System on Sodic Soil. *Indian Journal of Forestry,*(31): 491-499.

GOSL-UNDP-FAO. 1982. *A National Forest Inventory of Sri Lanka 1982-85.Provisionakl Draft Report*.

Gunawardena, A. R., Nissanka, S. P. & Dayawansa, N.D.K. 2008. Development of Merchantable Timber Volume Estimation of Pinus Caribaea Plantations Using Multi-Spectral Satellite Images. *Engineer,*(41): 68-73.

Gupta, R. K. 1978. Seedling Morphology and Phytomass of Bauhinia Retusa Buch-Ham.Ex Roxb.-a Promising Species for Reforestation of Limestone Spoils in W.Himalaya. *Indian Forester,*(104): 385-490.

Gupta, R.K., Agarwal, M.C. & Kumar, N. 1996. Effect of Lopping Intensities on Growth and Biomass Production of Bauhinia Purpurea L. In North-West Himalaya Low Hill Region. *Indian Forester,*(122): 396-403.

Gupta, R.K., Agarwal, M.C. & Kumar, N. 1996. Growth and Phytomass Production in Leucaena Lucocephala under High Density Plantations on Degraded Lands of Doon Valley. *Indian Forester,*(122): 241-246.

Gupta, R.K., Agarwal, M.C. & Lal, H. 1990. Prediction Model for Thirteen Tree Species Suitable for Agro-Forestry Systems in the Himalaya. *Indian Forester,*(116): 699-713.

Gurumurti, K., Kimoti, M. M., Raturi, D.P. & Rawat,J.S. 1984. Biomass Production and Energy Conversion Efficiency by Eucalyptus in Energy Planlnations. *Indian Forester,*(110): 150-170.

Gurumurti, K., Raturi, D.P. & Bhandari, H.C.S. 1984. Biomass Production in Energy Plantations of Prosopis Juliflora. *Indian Forester,*(110): 879-893.

Gurung, N.B., Sankhayan, P.L., Hosfstad, O. & Sitaula, B.K. 2002. Factors Affecting Forest Volume and Biomass at Water Shed Level :A Study in Annapurna Conservation Area ,Nepal. *Indian Forester,*(128): 379-390.

Haripriya, G. S. 2002. Biomass Carbon of Truncated Diameter Classes in Indian Forests. *Forest Ecology and Management,*(168): 1-13.

Hawkins, T. 1987. *Biomass and Volume Tables for Eucalyptus Camaldulensis,Dalbergia Sissoo,Acacia Auriculiformis and Cassia Siamea in the Central Bhabar-Terai of Nepal.*

Holmgren, P. 1994. *Institutional Strenghtening of Sindh Forest Department. Forest Inventory. Final Report. 39pp*.

Hossain, M., Siddique, M.R.H., Bose, A., Limon, S.H., Chowdhury, M.R.K.& Saha, S. 2012. Allometry, above-Ground Biomass and Nutrient Distribution in Ceriops Decandra (Griffith) Ding Hou Dominated Forest Types of the Sundarbans Mangrove Forest, Bangladesh. *Wetlands Ecology and Management,*(20): 539-548.

Islam, M.R., Khan, M.A.S., Siddiqi, N.A. & Sacnger, P. 1991. Effect of Thinning on the Growth and Survival of Keora (Sonneratia Apetala). *Bangladesh Journal of Forest Science,*(20): 8-24.

Islam, S. M, Z., Khan, M .I. & Ahmed, K.U. 2012. Volume Equations and Tables for Rajkoroi (Albizia Richardiana King and Prain)Planted in the Southern Part of Bangladesh. *Bangladesh Journal of Forest Science,*(32): 28-39.

Islam, S.M.Z. & Latif, M.A. *Mathematical Models and Tables on Growth,Yield,Volume and Biomass for Important Tree Species in Bangladesh*.

Islam, S. S. 1988. Commercial Volume Table for Teak(Tectona Grandis Linn.F.)in Bangladesh by Regression Technique. *Bano Biggyan Patrika,*(17): 55-67.

Islam, S. S. K. J. & Masum, A. K. M. 2012. Volume Table of Raintree (Samanea Saman) in Bangladesh by Regression Technique. *Open Journal of Statistics,*(02): 115-119.

Islam, S.S., Reza, N.A., Hasnin, M., Khan, M.A.S., Islam, M.R. & Siddiqi, N.A. 1992. *Volume Tables of Young Keora (Sonneratia Apetala)Trees for Western Costal Belt of Bangladesh.*

Islam, S. S. *Volume Tables for Some Indigenous Forest Species in Bangladesh.*

Islam, S.S., Wazihullah, A. K .M. & Reza, N.A. 1992. Validation of the Existing Volume Tables for Telya Garjan (Dipterocarpus Turbinatus) in Bangladesh. *Bangladesh Journal of Forest Science,*(21): 60-66.

Jadon, U.S., Nema, B.K., Sharma, H.L., Pandey, S.K. & Srivastava, S.R. 1999. Correlation and Regression Analysis in Jamun(Syzygium Cumini(L.) Skeels). *Journal of Tropical Forestry,*(15): 71-75.

Jain, K. K. & Sharma, H. L. 2010. Volume Table of Terminalia Arjuna Bedd in Kymore Plateau and Satpura Hills of Madhya Pradesh. *Journal of Tropical Forestry,*(26): 62-66.

Jain, K. K. & Sharma, H. L. 2012. Timber Volume Table of Farm Planted Eucalyptus Commaldulensis Grown in Semi Arid Environmental Conditions of Madhya Pradesh. *Journal of Tropical Forestry,*(28): 25-30.

Jain, R.C., Bhattacharya, P.K. & Rawat, J.K. 1989. Volume Tables for Pinus Kesiya. *Indian Forester,*(115): 789-792.

Jain, R.C. & Pande, G.C. 1976. Crop Volume Tables for Eucalyptus Grandis. *Indian Forest Records, (*1): 1–16.

Jain, R.C., Rai, M.P. & Rawat, J.K. 1991. Application of "Piecewise Fitting of a Model" Technique in Construction of Volume Tables. *Indian Forester,*(117): 1036-1040.

Jain, R.C. & Sharma, R.P. 1977. General Standard Volume Tables for Babul(Acacia nilotica ssp. indica). *Indian Forest Records, (*1): 1–7.

Jain, R.C. & Sharma, R.P. 1977. General Standard Volume Tables for Jamun(Syzygium cumini). *Indian Forest Records, (*1): 1–8.

Jain, R.C. & Sharma, R.P. 1978. Standard Volume Tables for Dalbergia Latifolia Roxb. *Indian Forest Records, (*1): 1–8.

Jain, R.C., Singhi,G. & Rawat, J.K. 1993. Volume Tables for Eucalyptus Camaldulensis Plantations. *Indian Forester,*(119): 460-465.

Jain, R.C., Singh, J., Singh, G. & Rawat, J.K. 1993. Volume Tables for Eucalyptus Globulus Plantations in the Nilgiri Plantations. *Indian Forester,*(119): 994-998.

Jain, R.C., Tripathi, S.P., Kumar.V.S.K. & Kumar, S. 1996. Volume Tables for Acacia Tortilis Plantations Based on Data Collected from Kjd Abadi Plantation of Khajuwala Range Chattergarh Division,Ingp Area Rajastan. *Indian Forester,*(122): 316-322.

Jain, R.C., Tripathi, S.P., Singh, M. & Kumar, V.S.K. 1998. Volume Tables for Azadirachta Indica for Gujrat Region. *Indian Forester,*(124): 123-133.

Jayaraman, K. & Prajitha, K. P. 2011. Standardisation of Volume Prediction Equations for Teak in India. *Teaknet Bulletin,*(4): 1-9.

Jayaraman, K. & Sunanda, C. 2007. Yield Prediction Models for Acacia Auriculiformis Plantations in Kerala. *Indian Journal of Forestry,*(30): 1-4.

Jayaraman, K. 2004. *Preparation of Local Volume Tables for Acacia Auriculiformis and Acacia Mangium Plantations Raised under Kerala Forestry Project.* Kerala.:

Jayaraman, K., Muraleedharan, P. K.& Gnanaharan, R. 1992. *Evaluation of Social Forestry Plantations Raised under the Worldbank Schemein Kerala.*

Jha, A.N., Das, D.K. & Chaturvedi, O.P. 2000. Effect of Nitrogen Levels on Growth and Biomass Production Dalbergia Sisoo Roxb.Seedlings in Nursery.Pdf.Pdf. *Journal of Tropical Forestry,*(16): 45-49.

Jha, K. K. 2005. Storage and Flux of Organic Carbon in Young Tectona Grandis Plantations in Moist Deciduous Forest. *Indian Forester,*(131): 647-659.

Jha, K. K. 2008. Crown Characteristics and Bole Attributes in a Chronosequence of Tectona Grandis Linn.F. Young Stands in the Moist Deciduous Forests of Northern India. *Indian Forester,*(134): 3-16.

Joseph, S., Reddy, C.S., Thomas, A.P., Srivastava, S.K.& Srivastava, V.K. 2010. Spatial Interpolation of Carbon Stock: a Case Study from the Western Ghats Biodiversity Hotspot, India. *International Journal of Sustainable Development & World Ecology, 17(*6): 481–486.

Joshi, S. C. 1973. Stand Aerial Volume Tables for Miscellaneous Forests of Bastar. *Indian Forester,*(99): 655-658.

Kabir, M. E. & Webb, E. L. 2005. Productivity and Suitability Analysis of Social Forestry Woodlot Species in Dhaka Forest Division, Bangladesh. *Forest Ecology and Management,*(212): 243-252.

Kakkar, R. & Nagaraja, R. 2011. Studies on Carbon Sequestration in Forest Research Plantations of Banglore Research Circle. *My Forest,*(47): 5-10.

Kakoli, B., Sengupta, K., Raha, A. & Mitra, A. 2013. Salinity Based Allometric Equations for Biomass Estimation of Sundarban Mangroves. *Biomass and Bioenergy,*(56): 382-391.

Kale, M., Singh, S. & Roy, P.S. 2004. Biomass Equations of Dominant Species of Dry Deciduous Forest in Shivpuri District , Madhya Pradesh. *Current Science,*(87): 683-687.

Kapur, S.K.& Dorga, A.S. 1987. Provenance Trial of Eucalyptus tereticornsis in Punjab. *Indian Forester, 113(*1): 2–5.

Karmacharya, S. B. & Singh, K. P. 1992. Biomass and Net Production of Teak Plantations in a Dry Tropical Region in India. *Forest Ecology and Management,*(55): 233-247.

Karunaratne, M. C. 1998. *Statistical & Cost Efficiency of Simple Random Sampling & Systematic Random Sampling in Estimating Forest Stand Parameters at Yagirala.*

Kaul, R. N. & sharma, K. K. 1982. Initial Spacing and Growth of Pinus Caribaea. *Indian Forester,*(108): 69-74.

Khan, M. N. I. & Faruque, O. 2010. Allometric Relationships for Predicting the Stem Volume in a Dalbergia Sissoo Roxb. Plantation in Bangladesh. *iForest - Biogeosciences and Forestry,*(3): 153-158.

Khan, T. A. & Pathak, P. S. 1994. Biomass Prediction in Leucaene Luecocephala. *Indian Forester,*(120): 533-537.

Khan, Y.M. 1983. *Swat-Swat Kohistan forests Inventory Report*.

Khosla, P.K., Toky, O.P., Bisht, R.P. & Hamidulllah, S.1992. Leaf Dynamics and Protein Content of Six Important Fodder Trees of the Western Himalaya. *Agroforestry Systems,*(19): 109-118.

Kingston, B. 1979. *A compendium of Mensuration Statistics*.

Krishnankutty, C. N. 2011. *Commercial Volume Tables for Selected Home Garden Trees of Kerala.* Kerala: (Kerala Forest Research Institute,Peechi).

Kumar, B.M., George, S.J., Jamaludheen, V. & Suresh, T.K. 1998. 1998. Comparison of Biomass Production , Tree Allometry and Nutrient Use Efficiency of Multipurpose Trees Grown in Woodlot and Silvopastoral Experiments in Kerala , India. *Forest Ecology and Management,*(112): 145-163.

Kumar, B.M., Rajesh, G.. &Sudheesh, K.G.2005. Aboveground Biomass Production and Nutrient Uptake of Thorny Bamboo(Bambusa Bambos(L.) Voss) in the Home Gardens of Thrissur,Kerala. *Journal of Tropical Agriculture,*(43): 51-56.

Kumar, J. I. N., Sajish, P. R., Kumar, R. N. & Patel, K. 2011. Biomass and Net Primary Productivity in Three Different Aged Butea Forest Ecosystems in Western India , Rajasthan. *Our Nature,*(9): 73-82.

Kumar, K. G. & Bindu, S. 1997. Correlation and Regression Studies between Seed and Seedling Characters of Selected Forest Tree Species in the Nursery. *Journal of Tropical Forestry,*(13): 43-48.

Kumar, P., Singh, N. P., Bhar, L. & Shinde, G. S. 2005. Relationships Study between Diameter and Height of Agroforesty Species to Predict Volume Growth. *Indian Journal of Forestry,*(28): 349-352.

Kumar, P.D., Rajesh, N., Kumar, A.V.S., Vidyasagar, K. & Anaz, M.A. 1997. Crown Diameter/Bole Diameter Relationship as an Aid to Thinning in Teak (Teak grandis L.). *Indian Journal of Forestry, (*20): 355–361.

Kumar, V., Nagavani, H.C, Kumar, D. & Singh, V.P. 1996. Propagation and Growth Studies of Calligonum Polygonoides (Phog). *Indian Forester,*(122): 377-382.

Kunhamu, T. K., Kumar, B.M.& and Samuel, S. 2011. *Does Tree Management Affect Biomass and Soil Carbon Stocks of Acacia Mangium Wild.Stands in Kerala,India*. Dordrecht, Springer Netherlands, 8: 217-228 pp.

Kushalappa, K. A. 1984. Biomass of Mysore Gum Trees in Jedigenahally,Karnataka. *Indian Forester,*(110): 854-860.

Kushalappa, K. A. 1991. Performance of Acacia Auriculiformis in India. *Journal of Tropical Forestry,*(7): 81-91.

Laamanen, R., Joshi, M.R. & Sharma, S.P. 1995. *Biomass and Volume Models for Sal(Shorea Robusta) in the Central Terai of Nepal.* M.

Lakmali, W. A. S. & Subasinghe, S. M. C. U. P. 2010. *Change of Breast Height Diameter with Age of Swietenia Macrophylla (Mahogany) Even-Aged Monocultures.Proceedings Ii of International Forestry and Environment Symposium, DFES, USJP.*

Latif, M. A. & Islam, S. M. Z. 2001. Growth Rates of Sissoo , Koroi , Akashmoni , Bahia , Mahogany and Raintree Planted on Embanklnents and Roadsides in the Coastal Areas of Bangladesh. *Bangladesh Journal of Forest Science,*(30): 52-57.

Latif, M. A. & Islam, S. M. Z. *Mathematical Models and Tables on Growth,Yield,Volume and Biomass for Important Trees in Bangladesh.*

Latif, M. A. & Islam, S. M. Z. *Timber and Fuel Wood Volume Tables for Acacia Auriculiformis ,A.Mangium,Eucalyptus Camaldulensis and Dalbergia Sissoo in Plantations in Bangladesh.*

Latif, M. A. 1988. Biomass Tables for Young Eucalyptus Grown in Bangladesh. *Bano Biggyan Patrika,*(17): 46-54.

Latif, M. A. 1994. *Tree Volume Tables for Keora (Sonneratia Apetala) and Baen(Avicennia Officinalis)in the Coastal Plantations of Bangladesh.*

Latif, M. A. 1999. Estimation of Site Index of Teli Garjan (Dipterocarpus Turbinatus Gaertn.F.) in Bangladesh. *Bangladesh Journal of Forest Science,*(28): 54-58.

Latif, M. A. 2000. *Volume Tables for Sissoo,Akashmony,Babla,Mahagony and Rain Tree Planted on Embankments and Roadsides in the C0astal Areas of Bangladesh.*

Latif, M.A. & Castillo, R. A. D. 1990. Growth and Yield of Keora(Sonneratia apetala) in the Coastal Plantations of Bangldesh. *Bangladesh Journal of Forest Science*, (19): 11–18.

Latif, M. A., Chowdhury, J. A., Das, S. & Rahman, M. F. 1997. Growth and Yield of Paraserianthes Falcataria in the Forests of Bangladesh. *Bangladesh Journal of Forest Science,*(26): 23-30.

Latif, M.A., Chowdhury, J.A., Das, S., Rahman, M.F. & Habib, M. A.1995. Growth and Yield Models for Gamar (Gmelina Arborea Grown in the Plantations in Bangladesh. *Bangladesh Journal of Forest Science,*(24): 7-12.

Latif, M. A., Das, S., Rahman, M. F. & Habib, M.A.1995. Growth and Yield Tables for Acacia Mangium Grown in the Plantations in Bangladesh. *Journal of Tropical Forest Science,*(7): 591-598.

Latif, M.A., Das, S., Rahman, M.F. & Habib, M.A. 1995. *Mathematical Models for Estimation of Growth and Yield of Cassia Siamea in Bangladesh.*

Latif, M.A. & Habib, M.A. 1993. Biomass tables for Acacia auriculiformis grown in the plantations in Bangladesh. *Indian Journal of Forestry, (*16): 323–327.

Latif, M.A., Habib, M.A. & Das, S. 1993. Tree Volume Tables for Acacia Mangium in the Plantations of Bangladesh. *Bangladesh Journal of Forest Science,*(22): 23-29.

Latif, M.A., Islam, M.N. & Choudhary, J.H. 1983. Effect of Stump Diameter of Teak on Post Planting Survival and Subsequent Growth of Height and Diameter. *Bano Biggyan Patrika,*(12): 17-21.

Latif, M. A., Islam, M. N. & Islam, S.S. *Tree Volume Tables for Teak (Tectona Grandis) in Bangladesh.*

Latif, M. A., Islam, S.S. & Davidson, J.1986. *Metric Volume Tables for Some Tree Species Found in the Natural Forests of Bangladesh.*

Latif, M.A., Khan, A.F.M.K. & Hossain, M.M. 1998. Stump Diameter-Dbh-Volume Relationships for Teli Garjan (Dipterocarpus Turbinatus)Dhakijam(Sygyzium Grande)and Teak(Tectona Grandis in Bangladesh. *Bangladesh Journal of Forest Science,*(27): 16-24.

Latif, M. A.,Rahman, M. F. & Das, S. 1995. Volume Tables for Acacia auriculiformis , Cassia siamea and Pinus caribaea in Bangladesh. *Bangladesh Journal of Forest Science*, (24): 22–30.

Laumans, P. 1994. *Height -Daimeter Functions from PIS for Country Level Site Classifications and Local Volume Table Selection.* 11.

Lodhiyal, L. S. & Lodhiyal, N. 1997. Variation in Biomass and Net Primary Productivity in Short Rotation High Density Central Himalayan Poplar Plantations. *Forest Ecology and Management,*(98): 167-179.

Lodhiyal, L.S., Rana, B.S.& Singh, R.P.1995. Dry Matter Production in a Poplar(Populus Deltoides Marsh.) Plantations of Central Himalayan Tarai. *Indian Forester,*(121): 383-389.

Lodhiyal, L.S., Singh, R.P. & Singh, S.P. 1995. Structure and Function of an Age Series of Poplar Plantations in Central Himalaya: I Dry Matter Dynamics. *Annals of Forestry, 76:*191–199.

Lodhiyal, N. & Lodhiyal, L. S. 2003. Biomass and Net Primary Productivity of Bhabar Shisham Forests in Central Himalaya, India. *Forest Ecology and Management,*(176): 217-235.

Lodhiyal, N. Lodhiyal, L.S. & Pangtey, Y. P. S. 2002. Structure and Function of Shisham Forests in Central Himalaya , India : Dry Matter Dynamics. *Annals of Botony,*(89): 41-54.

Lohani, D. N. & sharma, R. P. 1977. Regional Volume Tables for Poplar(Populus Deltoides). *Indian Forester,*(103): 818-821.

Luna, R. K. Thakur,N.S. & Kumar, V. 2009. Performance of Clonal Eucalyptus in Different Agro-Climatic Zones of Punjab,India. *Indian Forester,*(135): 1455-1464.

Maguire, D. A., Schreuder, G.F. & Shaikh, M. 1990. Abiomass / Yield Model for High-Density Acacia Nilotica Plantations in Sind , Pakistan. *Forest Ecology and Management,*(37): 285-302.

Mani, S. & Parthasarathy, N. 2007. Above-Ground Biomass Estimation in Ten Tropical Dry Evergreen Forest Sites of Peninsular India. *Biomass and Bioenergy,*(31): 284-290.

Meenattoor, J.R., Gireesh, T., Nair, R. B. & Jayaraman, K. 2006. *Final Report Caliberation of Volume Prediction Equations for Different Clones of Rubber Based on Random Parameter Models.* Kerala.

Ministry of Agriculture & Irrigation, Govt.of India. 1976. *Tripura (Hardwood Resources) Pre-Investment survey of Forest resources*.

Ministry of Agriculture & Irrigation, Govt.of India. 1977. *Report on Forest Resources of S.W. Bihar (Part) Volume I*.

Ministry of Agriculture and Irrigation, Govt.of India.1976.*Report on Preinvestment Survey of Forest Resources in North Western Bhutan.Volume-I Forest Resources.*

Ministry of Agriculture & Irrigation, Govt.of India. 1977. *Report on Forest Resources of S.W. Bihar (Part) Volume II (The Methodology)*.

Ministry of Agriculture Lands and Forestry ,Sri Lanka . 1996. *Forest Inventory Manual for Sri Lanka*. **Ministry of Agriculture, Govt.of India.** 1968. *Preinvestment Survey of Forest Resources (na) Report on Forest Resources of Kashmir Valley (J & K)*.

Mishra, H.C., Chandra, S.& Khanduja, C.P. 1994. *Menagement of Forest Plantation Resources of Central Tarai Forest DivisionUsing Remote Sensing and GIS*.

Misra, H. R. 1976. Construction of Volume Equations for Determination of Growing Stock. *Indian Forester,*(102): 290-294.

Misra, N. M. & Jain, R. C. 1984. Regional Volume Tables for Paper Mulbery (Broussonetia Papyrifera). *Indian Forester,*(110): 1084-1092.

Misra, N. M. & Singh, J. 1985. Local Volume Tables of Acacia Catechu (Khair)and Lannea Grandis. *Indian Forester,*(111): 385-395.

Misra, R., Bankhwal, D.P., Pancholi, R.K. & Singh, V.P. 1998. Biomass Status of Mixed Dry Deciduous Forest of Shiwalik Hills in Hariyana. *Indian Forester,*(124): 287-291.

Mitra, A., Sengupta, K. & Banerjee, K. 2011. Standing Biomass and Carbon Storage of above-Ground Structures in Dominant Mangrove Trees in the Sundarbans. *Forest Ecology and Management,*(261): 1325-1335.

Mittal, M.C., Singh, J. & Rawat, J.K. 1990. Volume Tables of Alnus Nepalensis. *Indian Forester,*(116): 953-957.

Mittal, M.C., Singh, J., Rai,M.P. & Rawat, J.K. 1991. Volume Tables for Acacia Auriculiformis. *Indian Forester,*(117): 632-634.

Murali, K.S., Bhat, D.M. & Ravindranath, N.H. 2005. Biomass Estimation Equations for Tropical Deciduous and Evergreen Forests. *Int.J.Agricultural Resources,Governance and Ecology,*(4): 81-92.

Nalaka, G. D. A., Sivanathawerl, T. & Iqbal, M.C.M. 2013. Scaling Aboveground Biomass from Small Diameter Trees. *Tropical Agricultural Research,*(24): 150-162.

Nath, A.J., Das, G. & Das, A.K. 2009. Above Ground Standing Biomass and Carbon Storage in Village Bamboos in North East India. *Biomass and Bioenergy,*(33): 1188-1196.

Nath, B., Singh, R.P., Kharche, M.L. 1966. *Volume Tables of Terminalia tomentosa for Madhya Pradesh*.

Natiyal, R.K., Sarma, D.P. & Verma, K.S. 1995. Growth Performance of Grewia Optiva Burrett Seedlings in Different Growing Media. *Indian Journal of Forestry,*(18): 239-241.

Negi, J. D. S. & Sharma, D. C. 1987. Biomass Estimation of Two Eucalyptus Species by Regression Method. *Indian Forester,*(113): 180-184.

Negi, J.D.S., Sharma, S.C. & Sharma, D.C. 1988. Comparative Assessment of Methods for Estimating Biomass in Forest Ecosystem. *Indian Forester,*(144): 136-144.

Negi, M. S. & Tandon, V. N. 1997. Biomass and Nutrient Distribution in the Age Sequence of Populas Deltoides Ecosystems in Haryana. *Indian Forester,*(123): 111-117.

Negi, M.S.,Banwal,N.R. & Srivastava, R. 1998. Local Volume Table of Proposis Juliflora for Timber and Small Wood/Firewood. *Indian Forester,*(124): 1998-1998.

Negi, M.S., Tandon, V.N. & Rawat, H.S. 1995. Biomass and Nutrient Distribution in Young Teak (Tectona Grandis Linn.F) Plantations in Tarai Region of Uttar Pradesh. *Indian Forester,*(121): 455-464.

Nema, B.K., Nayak, S., Sharma, S.L., Pandey, S.K. & Shrivastava, S.R. 2001. Correlation and Regression Analysis in Custard Apple(Annona Squamosa L.). *Journal of Tropical Forestry,*(17): 58-60.

Nepal, S. K. 1987. A New Volume Equation for Eucalyptus (Eucalyptus Camaldulensis) in Central Bhabar Terai Region of Nepal. *The Nepal Journal of Forestry,*(7): 71-79.

Newas, M. S. & Kamaluddin, M. 2006. Growth and Yield Prediction Models for Acacia Auriculiformis Grown in the Plantations of Bangladesh. *Indian Forester,*(132): 221-228.

Nizami, S. M. 2012. The Inventory of the Carbon Stocks in Sub Tropical Forests of Pakistan for Reporting under Kyoto Protocol. *Journal of Forestry Research,*(23): 377-384.

Nizami, S.M. 2010. *Estimation of carbon stocks in subtropical managed and unmanaged forests of Pakistan.*

Oli, B. N. & Kandel, C. M. 2005. Biomass Estimation of Bambusa Nutans Subspecies Cupulata Grown at Eastern Terai , Nepal. *Banko Janakari,*(15): 34-37.

Oli, B. N. & Kandel, C. M. 2005. Biomass Estimation of Bambusa Nutans Subspecies Cupulata Grown at Eastern Terai,Nepal. *Banko Janakari,*(15): 22-25.

Oli, B. N. & Kandel, C. M. 2006. Biomass Estimation of Dendrocalamus Bookeri Grown at Far-Western Terai,Nepal. *Banko Janakari,*(16): 12-16.

Oli, B. N. 2005. Biomass Estimation of Bambusa Tulda Grown at Eastern Terai, Nepal. *Journal of Bamboo and Rattan,*(4): 33-39.

Paliwal, K. & Kannan, D. 1999. Growth and Nutritional Characteristics of Four Woody Species under Nursery Conditions and Growth after Transplantation in Semi- Arid Field Conditions at Madurai,India. *Journal of Arid Environments,*(43): 133-141.

Pande, G. C. & Chaturvedi, A. N. 1972. Stand Volume, Weight Tables and Other Crop Studies in Mysore Gum (Eucalyptus Hybrid). *Indian Forester,*(98): 286-297.

Pande, G. C. & Jain, R. C. 1974. Basal Area-Volume Relations for Eucalyptus Grandis Crops. *Indian Forester,*(100): 670-680.

Pande, G. C. & Jain, R. C. 1976. Tree Volume Tables for Eucaliptus Grandis. *Indian Forester,*(102): 362-387.

Pande, G. C. 1974. Volume Prediction in Eucalyptus Grandis Crops. *Indian Forester,*(100): 533-543.

Pande, M.C., Tandon, V.N. & Negi, M. 1986. Biomass Production and Distribution in an Age Series Plantations of Eucalyptus Hybrid and Acacia Auriculaeformis in Bihar. *Indian Forester,*(112): 975-985.

Pande, M.C.,Tandon, V.N. & Negi, M. 1988. Biomass Production in Plantation Ecosystem of Ailanthus Excelsa at Five Different Ages in Uttar Pradesh. *Indian Forester,*(114): 362-371.

Pande, P. K. 2005. Biomass and Productivity in Some Disturbed Tropical Dry Deciduous Teak Forests of Satpura Plateau , Madhya Pradesh. *Tropical Ecology,*(46): 229-239.

Pandey, R., Dhall, S.P. & Kumar, R. 1999. Cross-Validation- a Tool for Forest Modellers. *Indian Forester,*(125): 1224-1227.

Pandey, R., Dhall, S.P., Kanwar, B.S. & Bharadwaj, S.D. 1998. Some Models for Predicting Volume of Populas Deltoides. *Indian Forester,*(124): 629-632.

Pant, N. C. 2001. Volume Table Model and Inventory for Pinus Caribaea in Madhya Pradesh. *Indian Forester,*(127): 280-288.

Perera, K. A. R. S. & Amarasinghe, M. D. 2013. Carbon Partitioning and Allometric Relationships between Stem Diameter and Total Organic Carbon in Plant Components of Bruguiera Gymnorrhiza(L.)Lamk.And Lumnitzera Racemosa Wild. In a Microtidal Basin Estuary in Sri Lanka. *International Journal of Marine Science,*(3): 72-78.

Perera, K. A. R. S. 2011. Carbon Retention Capacity of Two Mangrove Species ,Bruguiera Gymnorrhiza(L.)Lamk.And Lumnitzera Racemosa Wild. In Negombo Estuary,Srilanka. *Faculty of Graduate Studies,University of Kelaniya,Sri Lanka,*(14pp-14pp.

Poudel, B .S., Gautam, S. K. & Bhandari, D.N. 2011. Above-Ground Tree Biomass and Allometric Relationships of Cinnamomum Tamala Grown in the Western Hill Regions of Nepal. *Banko Janakari,*(21): 3-12.

Prajapati, R. C. 1993. Local Volume Equation for Eucalyptus Pole Crop. *My Forest,*(29): 256-257.

Prasanna, K.T., Gowda, C., Prasad, T.G. & Kumar, M.U. 1990. Effect of Carbon Dioxide Enrichment on Seedling Growth Rates in a Few Forest Species. *My Forest,*(26): 327-334.

Rahman, M. F., Das, S.& Latif, M.A. 2001. Volume Tables for Koroi(Albizia Procera and Arjun(Terminalia Arjuna)Trees Planted in the Central Part of Bangladesh. *Bangladesh Journal of Forest Science,*(30): 39-46.

Rahman, M. M. & Ahmad, I. U. 2000. Growth and Yield Prediction Model of Gamar (Gmelina Arborea)in Chittagong Hill Tracts, Bangladesh. *Journal of Tropical Forest Science,*(12): 276-285.

Rahman, M. M., Csaplovics, E.& and Koch, B. 2008. Satellite Estimation of Forest Carbon Using Regression Models. *International Journal of Remote Sensing,*(29): 6917-6936.

Rai, A.P., Singh, U.P. & Jabeen, N. 2010. Statistical Models for Prediction of Growth and Yield of Dalbergia sisoo and Hardwickia binnata under Silvipastoral System in India. *Indian Journal of Forestry, 33(*1): 13–20.

Rai, S. N. & Proctor, J. 1986. Ecological Studies on Four Rainforests in Karnataka , India. *Journal of Ecology,*(74): 439-454.

Rai, S. N. & Sharma, C. R. 1990. Perodic Annual Diameter Increment of Tectona Grandis and Xyla Dolabriformis in Moist Deciduous Forests of Karnataka. *Journal of Tropical Forestry,*(6): 208-216.

Rai, S. N. & Sharma, C. R. 1993. Diameter Increment in Artocarpus Histula,Dalbergia Latifolia & Grewia Tilaefolia in Mixed Deciduous Forests of Wynaad (Kerala). *Indian Forester,*(119): 11-16.

Rai, S. N. 1978. Regional Volume Table for Syzygium Cumini(Linn.)Skeel.(Data from Karnataka). *My Forest,*(14): 137-139.

Rai, S. N. 1978. Regional Volume Tables for Poon-Spar (Callophyllum Elatum Bedd.)and Its Certain Other Relationships(Data from Karnataka). *Indian Forester,*(104): 501-505.

Rai, S. N. 1979. Regional Volume Table for Aphanamixis Polystachya(Wall) Parker.(Syn.Amoora Canarana.W.&A.)Data Karnataka. *My Forest,*(15): 243-245.

Rai, S. N. 1979. Regional Volume Table for Black Dammer Tree(Canarium Strictum .Roxb) Data from Karnataka. *My Forest,*(15): 157-159.

Rai, S. N. 1979. Regional Volume Table for Euphoria Longana(Data from Karnataka). *My Forest,*(15): 87-90.

Rai, S. N. 1979. Regional Volume Tables for White Cedar(Dysoxyllum Malabaricum Bedd.)(Data from Karnataka). *Indian Forester,*(105): 230-231.

Rai, S. N. 1980. Diameter Increment of Terminalia Paniculata and Lagerstromia Lanceolata. *Indian Forester,*(106): 856-864.

Rai, S. N. 1980. Regional Volume Table for Indian Gutta Percha(Palaquium Ellipticum Engn.)and Its Certain Other Relationships(Data from Karnataka). *My Forest,*(16): 95-99.

Rai, S. N. 1980. Regional Volume Tables for Gurjan Oil Tree (Dipterocarpus Turbinats Garrtn-Syn.Dipterocarpus Indicus-Bedd.)and Its Certain Other Relationships (Data from Karnataka). *Indian Forester,*(106): 574-577.

Rai, S. N. 1980. Regional Volume Tables for Holigarna Grahmii,Hook and Its Certain Other Relationships(Data from Karnataka). *Indian Forester,*(106): 112-115.

Rai, S. N. 1981. Regional Volume Table for Lophopetalum Wightianum,Arn.(Data from Karnataka). *My Forest,*(17): 91-94.

Rai, S. N. 1981. Regional Volume Tables for Indian Copal (Vateria Indica. Linn.)Tree and Its Certain Other Relationships (Data from Karnataka). *Indian Journal of Forestry,*(4): 99-102.

Rai, S. N. 1982. Regional Volume Tables for Artocarpus Hirsutus(Urticacea)Data from Karnataka. *My Forest,*(18): 15-17.

Rai, S. N. 1982. Regional Volume Tables for Carallia Brachiata. *My Forest,*(18): 189-191.

Rai, S. N. 1982. *Summary of the Thesis-Productivity of Tropical Rain Forests of Karnataka.*

Rai, S. N. 1983. Regional Volume Table for Eugenia Laetum. *My Forest,*(19): 3-5.

Rai, S. N. 1984. Above Ground Biomass in Tropical Rain Forests of Western Ghats,India. *Indian Forester,*(110): 754-764.

Rai, S. N. 1984. Bole,Branch,Current Year Twig,Leaf and Root Biomass Production in Tropical Rain Forests of Western Ghats of Karnataka. *Indian Forester,*(110): 901-913.

Rai, S. N. 2000. *Productivity of Tropical Rain Forests of Karnataka*.

Rai,S.N.,Ansari,Y.,Upadhyaya,C.P.,Adhikari,S.N.,Mahato,B.,Mishra,S.M. & Rayamanjhi, S. 2000. Environment,Rate of Growth,Effect of Inter Cultivation and Volume Production in Dalbergia Sisoo and Eucalyptus Camaldulensis Plantations at Sagarnath(Nepal). *Indian Forester,*(126): 119-131.

Raizada, A., Rao, M.S.R.M., Nambiar, K.T.N. & Padmaiah, M. 2007. Biomass Production and Prediction Models for Acacia Nilotica Affected Vertisols in Karnataka. *Indian Forester,*(133): 239-246.

Ramachandran, A., Jayakumar, S., Haroon, R.M., Bhaskaran, A. & Arockiasamy, D.I. 2007. Carbon Sequestration : Estimation of Carbon Stock in Natural Forests Using Geospatial Technology in the Eastern Ghats of Tamil Nadu , India. *Current Science,*(92): 323-331.

Rana, B. S., Rao, O. P. & Singh, B.P. 2001. Biomass Production in 7 Year Old Plantations of Casuarina Equisetifolia on Sodic Soil. *Tropical Ecology,*(42): 207-212.

Ranasinghe, D.M.S.H.K. & Mayhead, G.J. 1991. Dry Matter Content and Its Distribution in an Age Series of Eucalyptus Camaldulensis(Dehn.)Plantations in Srilanka. *Forest Ecology and Management,*(41): 137-142.

Rautiainen, O. 1999. Spatial Yield Model for Shorea Robusta in Nepal. *Forest Ecology and Management,*(119): 151-162.

Rautiainen, O., Pukkala, T. & Miina, J. 2000. Optimising the Management of Even-Aged Shorea Robusta Stands in Southern Nepal Using Individual Tree Growth Models. *Forest Ecology and Management,*(126): 417-429.

Ravichandran, V. K. & Balasubramanian, T. N. 2000. Relationship between Dbh and Wood Volume in Casuarina Equisetifolia. *Indian Forester,*(126): 653-656.

Rawat, J. K. & Tandon, V. N. 1993. Biomass Production and Mineral Cycling in Young Chir Pine Plantations in Himachal Pradesh. *Indian Forester,*(119): 977-985.

Rawat, J. K. 1988. Modified Volume Table for Eucalypts in Hariyana. *Indian Forester,*(114): 837-843.

Rawat, J. K. 1989. Bark Content of a Mature Eucalyptus Tree. *Indian Forester,*(115): 105-108.

Rawat, L., Luna, R.K., Kholiya, D. & Kamboj, S.K. 2008. Biomass,Productivity and Nutrient Retention in Acacia Catechu Willd.Plantations in Shiwalik Hills of Punjab. *Indian Forester,*(134): 212-225.

Ray, R., Ganguly, D., Chowdhury, C. and Dey, M., Das, S., Dutta, M.K., Mandal, S.K., Majumder, N., De, T.K., Mukhopadhyay, S.K. & Jana, T.K. 2011. Carbon Sequestration and Annual Increase of Carbon Stock in a Mangrove Forest. *Atmospheric Environment,*(45): 5016-5024.

Ray, R.G. 1971. *Six Forest Inventories in the Tropics. Report No.4 Chittagong Hill Tracts*.

Revilla, J.A.V. & Ahmad, I.U. 1998. *Final Report: Forest Inventory of the Sundarbans Reserved Forest (volume 1)*.42pp .

Revilla, J.A.V. & Ahmad, I.U. 1998. *Final Report Forest Inventory of the Natural Forest and Forest Plantations (COXS BAZAR Forest Division).*

Revilla, J.A.V. & Ahmad, I.U. 1998. *Final Report: Forest Inventory of the Coastal Afforestation Divisions*.

Rinchen, D. 1993. *Management Plan for Wangdigang Forest Management Unit Shemgang Dzongkhag.*

Rizvi, R.H., Dhyani, S.K. & Maurya, D. 2011. Models for Estimating Carbon Stock in Stemwood Biomass of Poplar Trees in Agroforestry Plantations in Tarai Plains of North-Western India. *Indian Journal of Forestry,*(34): 253-256.

Rizvi, R.H., Dhyani, S.K.& Maurya, D. 2012. Assessment of Carbon Stock in Eucalyptus Tereticornis Based Agroforestry System in Saharanpur District of North-Western India. *Range Management and Agroforestry,*(33): 92-95.

Rizvi, R.H., Gupta, V.K., Ajit., Ahlawat, S.P. & Datta, A. 2007. Preliminary Growth Models for Dalbergia Sisoo Roxb. Plantation in Semi-Arid Region of Central India. *Indian Journal of Forestry,*(30): 421-425.

Roy, M.M., Pathak, P.S., Rai, A.K. & Kushwaha, D. 2006. Tree Growth and Biomass Production in Melia Azedarach on Farm Boundaries in Semi-Arid Region. *Indian Forester,*(132): 105-110.

Rugmini, P. & Jayaraman, K. 1995. Estimation of Tree Volume from Girth Measurements Below Breast-Height. *Journal of Tropical Forestry,*(11): 16-22.

Rugmini, P. & Sunanda, C. 2012. Local Volume Table for Acacia Mangium Plantations in the Southern Forest Divisions of Kerala. *Indian Journal of Forestry,*(35): 285-289.

Rugmini, P. 2010. *Preparation of Local Volume Tables for Acacia Auriculiformis and Acacia Mangium Plantations Raised under Kerala Forestry Project.* Kerala: (Kerala Forest Research Institute,Peechi).

Sahoo, T. K. & Chauhan, P. S. 1996. Site Index Curves Forpinus Roxburghii Sargent Plantations. *Indian Journal of Forestry,*(21): 214-216.

Sakman, E. 1983. *Volume Tables for Forest Trees in Bangladesh*.

Sapkota, P. & Meilby, H. 2009. Modelling the Growth of Shorea Robusta Using Growth Ring Measurements. *Banko Janakari,*(19): 25-32.

Sarkar, D.C., Das, S. & Kibria, M.G. 2008. Growth Statistics of Akashmoni (Acacia Auriculiformis)in Strip and Block Plantations of Bangladesh. *Bangladesh Journal of Forest Science,*(31): 43-50.

Sarkeala, J. & Tokola, T. 1993. *Stand Volume Equations and Tables for Western Terai.*

Sarker, S. K., Das, N., Chowdhury, M. Q., Haque, M.M. 2013. Developing Allometric Equations for Estimating Leaf Area and Leaf Biomass of Artocarpus Chaplasha in Raghunandan Hill Reserve, Bangladesh. *Southern Forests: a Journal of Forest Science,*(75): 51-57.

Schieler, K.1992. *Bhutan-Local forest inventory***.**

Seth, R. & Prakash, R. 2008. Volume Tables of Tectona Grandis (Teak) for North Sagar Division. *Vanki Sandesh,*(32): 1-7.

Seth, R. & Prakash, R. 2009. Volume Tables of Tectona Grandis (Teak) for Hoshangabad Division. *Vanki Sandesh,*(October): 13-22.

Seth, R. & Prakash, R. 2010. Volume Tables of Tectona Grandis (Teak) for Raisen Division. *Journal of Tropical Forestry,*(26): 32-41.

Seth, R. & Prakash, R. N. 2010. Volume Equations for Calculating Local Volume Tables of Tectona Grand's (Teak) for Khandwaand South Narmada Divisions. *Vanki Sandesh,*(June): 24-29.

Shanmughavel, P. & Francis, K. 1996. Above Ground Biomass Production and Nutrient Distribution in Growing Bamboo (Bambusa Bambos (L.)Voss). *Biomass and Bioenergy,*(10): 383-391.

Shanmughavel, P. & Francis, K. 1996. Biomass Models for Bambusa Bambos Grown in the Plantations in India. *Bangladesh Journal of Forest Science,*(25): 71-74.

Sharma, A., Singh, R. P. & Saxena, A.K. 2011. Performance of Teak (Tectona Grandis Linn . F .) in Sole and Agroforestry Plantation on Wheat Fields in Eastern Uttar Pradesh. *Research journal of Agricultural Sciences,*(2): 244-247.

Sharma, C.M., Baduni, N. P., Gairola, S. and Ghildiyal, S.K. & Suyal, S. 2010. Tree Diversity and Carbon Stocks of Some Major Forest Types of Garhwal Himalaya, India. *Forest Ecology and Management,*(260): 2170-2179.

Sharma, D. P. & Malik, R. A. 1995. Influence of Site Factors on the Growth of Chir Pine (Pinus Roxburgii Sargent) Forests Along Elavational Gradient. *Indian Forester,*(137): 71-82.

Sharma, D. P. & Nanda, R. 2008. Volume Prediction Model for Chir Pine (Pinus Roxburghii Sargent). *Indian Journal of Forestry,*(31): 57-60.

Sharma, E. R. & Pukkala, T. 1990. *Volume Equations and Biomass Prediction of Forest Trees of Nepal.*

Sharma, E. R. & Pukkala, T. 1990. *Volume Tables for Forest Trees of Nepal.*

Sharma, R. A. 1999. Tree Aerial Volume Models for Pinus Roxburghii. *Indian Forester,*(125): 282-284.

Sharma, R. P. & Jain, R. C. 1977. Regional Volume Tables for Duabanga Grandiflora Walp.(Based on the Data of Manipur State). *Indian Forester,*(103): 731-732.

Sharma, R. P. & Jain, R. C. 1977. Regional Volume Tables of Dipterocarpus Turbinatus Gaertn.F.(Based on the Data of Manipur State). *Indian Forester,*(103): 395-396.

Sharma, R. P. & Jain, R. C. 1977. Regional Volume Tables of Melanorrhoea Usitata Wall.(Based on the Data of Manipur State). *Indian Forester,*(103): 669-670.

Sharma, R. P. & Jain, R. C. 1977. Regional Volume Tables of Pinus Kesiya Royle Ex Gord (Based on the Manipur State). *Indian Forester,*(103): 458-459.

Sharma, R. P. & Jain, R. C. 1977. Standard Volume Tables for Gmelina Arborea Roxb.(Based on Data from Tripura). *Indian Forester,*(103): 536-538.

Sharma, R. P. & Jain, R. C. 1978. Regional Volume Tables of Dipterocarpus Tuberculatus Roxb.(Based on the Data of Manipur State). *Indian Forester,*(104): 94-95.

Sharma, R. P. & Jain, R. C. 1978. Regional Volume Tables of Four Native Tree Species of North Eastern Region of India. *Indian Forester,*(104): 734-744.

Sharma, R. P. & Jain, R. C. 1979. Regional Volume Tables of Six Native Tree Species of North-Eastern Region,India. *Indian Forester,*(105): 203-210.

Sharma, R. P. 1978. Wieght Tables and Volume-Weight Relation for Eucaliptus Hybrid. *Indian Forester,*(104): 554-557.

Sharma, R. P. 1979. Production and Other Crop Characters of the First Generation Coppice of Eucalyptus Hybrid. *Indian Forester,*(105): 89-100.

Sharma, R. P. 1979. Variable Density Yield Tables of Dalbergia Sisoo (Plantation Origin). *Indian Forester,*(105): 421-435.

Sharma, R. P. 1979. Weight and Volume Tables and Volume-Weight Relation for Poplar(Populus Deltoides). *Indian Forester,*(105): 509-512.

Sharma, R. P. 1981. Yield Tables of Acacia Catechu(Khair) (Plantation Origin) for Various Levels of Stocking. *Indian Forester,*(107): 551-562.

Sharma, R. P. 2000. Allometric Models for Total-Tree and Component-Tree Biomass of Alnus Nepalensis D.Don in Nepal. *Indian Forester,*(137): 1386-1390.

Sharma, R. P. 2009. Modelling Height-Diameter Relationship for Chir Pine Trees. *Banko Janakari,*(19): 3-9.

Sharma, R. P. 2012. Modelling Dry Matter Allocation within Alnus Nepalensis D. Don Trees in Nepal. *International Journal of Biodiversity and Conservation,*(4): 47-53.

Sharma, R. P. J. R. C. & Shet, S. N. 1979. Regional Volume Tables for Careya Arborea Roxb. *Indian Forest Records,*(3): 1-8.

Sharma, R.P., Jain, R.C.& Shet, S.N. 1979. Regional Volume Tables for Lagerstroemia Lanceolata Wall.Ex W.&A. *Indian Forest Records,*(3): 1-8.

Sharma, R.P., Jain, R.C.& Shet, S.N. 1979. Regional Volume Tables for Terminalia Bellirica Roxb. *Indian Forest Records,*(3): 1-6.

Sharma, R. P. J. R. C. & Shet, S. N. 1979. Regional Volume Tables for Terminalia Paniculata Roth. *Indian Forest Records,*(3): 1-8.

Sharma, R.P., Jain, R.C.& Shet, S.N. 1979. Regional Volume Tables for Xylia Xylocarpa (Roxb.)Taub. *Indian Forest Records,*(3): 1-7.

Sharma, S., Chaitanya, K.S. K. & Naithani, S.C. 1996. Biomass and Leaf Area Relationships in Yhe Fast Growing Tropical Tree Species of Albizzia Lebbek,Albizzia Procera,Peltophorum Pterocarpum,Acacia Auriculiformis and Leucaena Luecocephala. *Journal of Tropical Forestry,*(12): 113-118.

Shetty, H. R. 1984. Crop Volume and out-Turn Table for Stands of Acacia Nilotica. *Indian Forester,*(110): 586-590.

Shrivastava, M. B. & Singh, R. A. 2003. Interrelationships among Crown Diameter, Diameter at Breast Height and Stump Diameter of Silver Fir Trees. *Indian Journal of Forestry,*(26): 150-155.

Shrivastava, M. B. 1997. Approximation of Crown and Breast Diameters of Blue Pine(Pinus Wallichiana)from Stumps. *Journal of Tropical Forestry,*(13): 35-42.

Shrivastava, M. B. 1997. Procedure to Determine Breast Height and Crown Diameters of Felled and Lost Trees. *Indian Journal of Forestry,*(20): 346-351.

Shukla, P.K., Seth, R. & Prakash, R. 2007. Volume Tables of Tectona Grandis (Teak) for Chhindwara (Production) Division. *Journal of Tropical Forestry,*(23): 87-96.

Singh, A. & Gupta, N.K. 2008. Growth and Standing Volume Estimation of Cedrus Deodara (Roxb.) Loud.Stands under the Present System of Management in Himachal Himalayas-a Case Study. *Indian Forester,*(134): 458-467.

Singh, A. 2008. Influence of Tree Canopy on Dry Matter Yield of Seedlings of Luecaena Luecocephala on Mine Spoil in a Dry Tropical Environment. *Indian Journal of Forestry,*(31): 207-208.

Singh, A. 2011. Biomass Yield in a Tropical Herbaceous Legume Stylosanthes Humilis Seeded on a Mine Spoil with and without Inorganic Fertiliser Amendment. *Indian Forester,*(137): 1037-1039.

Singh, A., Madan, M. & Vasudevan, P. 1990. Estimation of the Aerial Biomass of Weedy Shrubs by Regression Methods: Studies on Adhatoda. *Forest Ecology and Management,*(32): 167-172.

Singh, A. N. & Singh, J. S. 1999. Biomass, Net Primary Production and Impact of Bamboo Plantation on Soil Redevelopment in a Dry Tropical Region. *Forest Ecology and Management,*(119): 195-207.

Singh, A.N., Raghubanshi, A.S.& Singh, J.S. 2004. Comparative Performance and Restoration Potential of Two Albizia Species Planted on Mine Spoil in a Dry Tropical Region, India. *Ecological Engineering,*(22): 123-140.

Singh, B. & Misra, P. N. 1995. Biomass,Energy Content and Fuel-Wood Properties of Populus Deltoides Clones Raised in North Indian Plains. *Indian Journal of Forestry,*(18): 278-284.

Singh, B. & Ramam, S. S. 1981. Regional Volume Tables of Pinus Patula Plantations of Darjeeling Himalaya. *Indian Journal of Forestry,*(4): 332-333.

Singh, B. & Sharma, K. N. 2007. Tree Growth and Nutrient Status of Soil in a Poplar(Populus Deltoides Bartr.)-Based Agroforestry System in Punjab,India. *Agroforestry Systems,*(70): 125-134.

Singh, C., Dhyani, S.K., Kumar, N. & Dhiman, R.C. 2003. Establishment and Evaluation of Paulownia Fortunei for Biomass Production on Degraded Bouldery Riverbed Lands in Doon Valley,India. *Indian Forester,*(129): 578-588.

Singh, G., Mutha, S. & Bala, N. 2007. Effect of Tree Density on Productivity of Prosopis Cineraria System in North Western India. *Journal of Arid Environments,*(70): 152-163.

Singh, J. & Singh, J. S. 1993. Importance of Short-Lived Components of a Dry Tropical Forest for Biomass Production and Nutrient Cycling. *Journal of Vegetation Science,*(4): 681-686.

Singh, J., Singh, O., Negi, M.S. & Banwal, N.R. 1995. Regional Volume Tables for Eucalyptus Hybrid (Based on the Data from Muzaffarnagar). *Indian Forester,*(121): 365-370.

Singh, K. & Chand, P. 2012. Above-Ground Tree Outside Forest (Tof) Phytomass and Carbon Estimation in the Semi-Arid Region of Southern Haryana : A Synthesis Approach of Remote Sensing and Field Data. *Journal of Systems Science,*(121): 1469-1482.

Singh, K. & Rana, B. S. 2004. Biomass and Productivity of an Age Series of Three Cottonwood Clones (Populus Deltoides)in Central Himalayan Tarai Region,India. *Journal of Tropical Forest Science,*(16): 384-395.

Singh, L. & Singh, J. S. 1993. Importance of Short-Lived Components of a Dry Tropical Forest for Biomass Production and Nutrient Cycling. *Journal of Vegetation Science,*(4): 681-686.

Singh, L. & Singh, V. P. 1999. Growth Performance of Selected Native and Exotic Species on Coal Minespoil. *Journal of Tropical Forestry,*(15): 24-33.

Singh, P., Dubey, P.& Jha, K. K. 2006. Biomass Production and Carbon Storage at Harvest Age in Superior Dendrocalamus Strictus Nees. Plantations in Dry Deciduous Forest Region of India. *Indian Journal of Forestry,*(29): 353-360.

Singh, R. & Negi, J. D. S. 1997. Biomass Prediction and Distribution of Organic Matter in Natural Cinnamomum Camphora Stand. *Indian Forester,*(123): 1161-1170.

Singh, R. P. & Gupta, M. K. 1990. A Note on Biomass and Root Characteristics of Artemisia Martima Linn. *Indian Forester,*(116): 674-675.

Singh, R. P. 1982. Net Primary Productivity & Productive Structure of Eucalyptus Tereticornis Smith Plantations Grown in Gangetic Plain. *Indian Forester,*(108): 261-269.

Singh, R.P., Rana, B.S. & Garkoti, S.C. 1993. Biomass and Production Patterns of Three Dominant Tree Species Along a Girth Series in Natural Tropical Forest at Chakia,Varanasi (India). *Indian Forester,*(119): 472-480.

Singh, R. V. 1981. Crown Volume and Dbh Ratio: A Factor Affecting Distribution of Aboveground Biomass in Chir Pine Trees. *Indian Journal of Forestry,*(4): 95-98.

Singh, S. P. & Jain, R. C. 1980. Volume Table for Trewia Nudiflora(Gutel)-Application of Cosh Function and Dummy Variable in Volume Estimation. *Indian Forester,*(106): 696-702.

Singh, S. P. & Jain, R. C. 1985. Total Tree Volume Tables for Pterocarpus Dalbergioides (Andaman Paduk). *Indian Forester,*(111): 784-786.

Singh, S. P. & Jain, R. C. 1987. Yield of Heartwood in Acacia Catechu(Khair) for Use in Katha Manufacture. *Indian Forester,*(113): 404-408.

Singh, S. P. & Mittal, M. C. 1981. Standing Crop Volume Computation in Permanent Sample Plots. *Indian Forester,*(107): 104-106.

Singh, S. P. & Mittal, M. C. 1982. Provisional Volume Tables for Two Exotic Pines(Species Pinus Caribaea and Pinus Patula). *Indian Forester,*(108): 75-85.

Singh, S. P. & Mittal, M. C. 1983. Growth of Poplar Plantations in Tarai Region of Uttar Pradesh. *Indian Forester,*(109): 755-761.

Singh, S. P. & Sharma, R. S. 1982. Provisional Growth Estimate of Some Species of Mixed Tropical Forests. *Indian Forester,*(108): 230-236.

Singh, S. P. 1976. Stem Standard Timber Form Factor of Some Indian Confiers. *Indian Forester,*(102): 747-760.

Singh, S. P. 1977. Stem Prediction Model for Variable Diameter Limits. *Indian Forester,*(103): 23-28.

Singh, S. P. 1979. An Approach to the Preparation of Variable Density Yield Tables. *Indian Forester,*(105): 106-120.

Singh, S. P. 1979. Growth Potential and Thinning Yield Studies of Uttar Pradesh Chir Pine. *Indian Forester,*(105): 706-715.

Singh, S. P. 1979. Locality and Growth of Mysore Gum. *Indian Forester,*(105): 223-229.

Singh, S. P. 1979. Stand Volume Tables for Uttar Pradesh Chir-Pine (Pinus Roxburgh). *Indian Forester,*(105): 644-657.

Singh, S. P. 1980. Growth and Yield of(Shorea Robusta) Sal in Taungya Plantations of Gorakhpur Forest Division. *Indian Forester,*(106): 474-481.

Singh, S. P. 1981. Second Tree Diameter and Tree Volume Estimation. *Indian Forester,*(107): 412-415.

Singh, S. P. 1981. Total Tree Volume Table for Tectona Grandis(Teak). *Indian Forester,*(107): 621-623.

Singh, S. P. 1981. Tree Model for Kadam Plantations of West Bengal. *Indian Forester,*(107): 158-165.

Singh, S. P. 1982. Growth Studies of Acacia Nilotica. *Indian Forester,*(108): 283-288.

Singh, S.P., Adhikari, B.S. & Zobel, D.B. 1994. Biomass , Productivity , Leaf Longevity and Forest Structure in the Central Himalaya. *Ecological Monographs,*(64): 401-421.

Singh, T. C. & Singh, E. J. 2011. Sprouting Shoot Biomass Dynamics Associated with Traditional Fire in the Oak Forest Stand of Manipur ,North East India. *Current Science,*(100): 543-547.

Singh, V. & Toky, O. P. 1995. Biomass Acacia and Net Primary Productivity and Eucalyptus , ('Energy') Plantations in Arid in Leucaena , High Density India. *Journal of Arid Environments,*(31): 301-309.

Singh, V. N. & Upadhyay, A. K. 2001. Volume Tables for G48 and D121 Clones of Populus Deltoides for the Tarai and Bhabhar Region of Uttaranchal. *Indian Forester,*(127): 21-29.

Singh, V., Tewari, A., Kushwaha, S.P.S. & Dadhwal, V.K. 2011. Formulating Allometric Equations for Estimating Biomass and Carbon Stock in Small Diameter Trees. *Forest Ecology and Management,*(261): 1945-1949.

Sivananthaweri, T. & Mitlohner, R. 2002. Site Index for Eucalyptus Grandis (Hill)Maiden Grown in Srilanka. *The Sri Lanka Forester,*(25): 77-84.

Sivananthaweri, T. & Premakantha, K. T. 2010. Volume Estimation of Toona Ciliata M.Roem and Michelia Champaca.L. *The Sri Lanka Forester,*(32 &33): 11-27.

Sivananthaweri, T. & Pushpakumara, D. K. N. G. 2010. Prediction of Standing Tree Volume of Gmelina Arborea Roxb.Using Spielaskop. *The Sri Lanka Forester,*(32&33): 109-122.

Sivananthaweri, T. 2007. Volume Prediction Mdel for Eucalyptus Grandis W.Hill Ex Maiden Grown in the Upcountry of Srilanka. *The Sri Lanka Forester,*(30&31): 77-85.

Slavicky. 1992. *Management Plan for Chamgang-Halela Forest Management Unit-Thimphu District.*

Somen, C. K. & Seethalakshmi, K. K. 1991. Growth Response of Seedlings of Acacia Ailanthus and Casuarina to Triacontanol(Vipul). *Indian Journal of Forestry,*(14): 46-50.

Srinivasan, P. S., Rai, R. S. V. & Jambulingam, R. 1989. Acacias: Variation between Species in Early Growth and a Few-Adaptive Attributes. *Journal of Tropical Forest Science,*(2): 129-134.

Srivastava, A. K. 1996. Biomass and Energy Production in Casuarina Equisetifolia Plantation Stands in the Degraded Dry Tropics of the Vindhyan Plateau,India. *Biomass and Bioenergy,*(9): 465-471.

Srivastava, V.K., Rai, A.M., Dixit, R.K., Oza, M.P., Narayana, A. & Murty, E.S. 1998. Significance of Tree Crown Diameter in Forest Mensuration. *Indian Forester,*(124): 1001-1009.

Subasinghe, S. M. C. U. P. & Gunarathne, W. P. K. 2008. Construction of a Precise Growth Model to Predict the Individual Tree Stem Volume for Mature Tectona Grandis (L.F). *Sri Lanka Forester,*(30/31): 1-14.

Subasinghe, S. M. C. U. P. & Munasinghe, G. B. 2011. Estimation of above Ground Tree Biomass and Carbon of Pinus Caribaea (Morelet). *Journal of Tropical Foresy and Environment,*(01): 57-71.

Subasinghe, S. M. C. U. P. 2008. *Growth Models and Their Use in Plantation Forestry.*

Subasinghe, S. M. C. U. P. 2010. Prediction of Stem Volume of Alstonia Macrophylla Growing as Even-Aged Monocultures Using Breast Height Diameter and Total Height. *Proceedings II of International Forestry and Environment Symposium, DFES, USJP*

Sunanda, C. & Jayaraman, K. 2006. Prediction of Stand Attributes of Even-Aged Teak Stands Using Multilevel Models. *Forest Ecology and Management,*(236): 1-11.

Sundriyal, R. C. & Sharma, E. 1996. Anthropogenic Pressure on Tree Structure and Biomass in the Temperate Forest of Mamlay Watershed in Sikkim. *Forest Ecology and Management,*(81): 113-134.

Sundriyal, R. C., Sharma, E., Rai, L. K. & Rai, S.C. 1994. Tree Structure , Regeneration and Woody Biomass Removal in a Sub-Tropical Forest of Mamlay Watershed in the Sikkim Himalaya. *Vegetatio,*(113): 53-63.

Surey, R., Sharma, M.C. & Tiwari, K.P. 1999. Volume Tables of Eucaluptus Hybrid (Main Crop)for Madhya Pradesh. *Journal of Tropical Forestry,*(15): 121-128.

Suri, S. K. 1975. Correlation Studies between Bole Diameter and Crown Projection Area as an Aid to Thinning. *Indian Forester,*(101): 539-554.

Suri, S. K. 1975. Quantitative Thinning Model with Particular Reference to Sal Forests of Changbhakhar Forest Division (Madhyapradesh). *Indian Forester,*(101): 80-89.

Swami, K.R., Shivanna, H., Surendra, P., Channabasappa, K .S. & Koppad, A. G. 2011. Carbon Stocking through Shelterbelt Tree Species in Haveri District. *My Forest,*(47): 175-181.

Swami, S.L., Dutt, C.B.S., Murthy, M.S.R., Misra, A. & Bargali, S.S. 2010. Floristics and Dry Matter Dynamics of Tropical Wet Evergreen Forests of Western Ghats, India. *Current Science,*(99): 353-364.

Swamy, K.R., Shivanna, H., Surendra, P., Channabasappa, K.S. & Koppad, A.G. 2011. Standardization of Form Factor (Ff) of Different Tree Species Planted in Shelterbelt of Northern Transitional Zone of Karnataka. *My Forest,*(47): 183-185.

Swamy, S. L. K. S. K. & Puri, S. 2004. Tree Growth, Biomass, Allometry and Nutrient Distribution in Gmelina Arborea Stands Grown in Red Lateritic Soils of Central India. *Biomass and Bioenergy,*(26): 305-317.

Swamy, S. L. P. S. & Singh, A. K. 2003. Growth, Biomass, Carbon Storage and Nutrient Distribution in Gmelina Arborea Roxb. Stands on Red Lateritic Soils in Central India. *Bioresource Technology,*(90): 109-126.

Tandon, V.N., Pande, M.C. & Singh, R. 1988. Biomass Estimation and Distribution of Nutrients in Five Different Aged Eucalyptus Grandis Plantation Ecosystems in Kerala State. *Indian Forester,*(114): 184-199.

Tandon, V.N., Pande, M.C. & Singh, R. 1989. Organic Matter Production and Distribution of Nutrients in Plantations of Acacia Mearnsh in Nilgiris,Tamilnadu. *Indian Forester,*(115): 286-295.

Tandon, V.N., Pande, M.C., Rai, L. & Rawat, H.S. 1988. Biomass Production and Its Distribution by Acacia Nilotica Plantations at Five Different Ages in Hariyana. *Indian Forester,*(114): 770-775.

Tandon, V.N., Rawat, J.K. & Singh, R. 1993. Biomass and Mineral Cycling in Plantation Ecosystems of Eucaliptus Hybrid in Haryana. *Indian Forester,*(119): 232-237.

Tewari, V. P. & Gadow, K. V. 1999. Modelling the Relationship between Tree Diameters and Heights Using S Bb Distribution. *Forest Ecology and Management,*(119): 171-176.

Tewari, V. P. & Kumar, V. S. K. 1999. Above Ground Biomass Tables for Azadirachta Indica A. Juss. *International Forestry Review,*(1): 109-111.

Tewari, V. P. & Kumar, V. S. K. 2001. Construction and Validation of Tree Volume Functions for Dalbergia Sissoo Grown under Irrigated Conditions in the Hot Desert of India. *Journal of Tropical Forest Science,*(13): 503-511.

Tewari, V. P. & Kumar, V. S. K. 2002. Development of Top Height Model and Site Index Curves for Azadirachta Indica A . Juss. *Forest Ecology and Management,*(165): 67-73.

Tewari, V. P. & Kumar, V. S. K. 2003. Spacing Effect on the Height-Diameter Relationship of Irrigated Shelterbelt Plantations in Hot Desert. *Indian Forester,*(129): 349-356.

Tewari, V. P. & Kumar, V. S. K. 2003. Volume Equations and Their Validation for Irrigated Plantations of Eucalyptus Camaldulensis in the Hot Desert of India. *Journal of Tropical Forest Science,*(15): 136-146.

Tewari, V. P. & Kumar, V. S. K. 2005. Growth and Yield Functions for Dalbergia Sissoo Plantations in Hot Desert of India Grown under Irrigated Conditions. *Journal of Tropical Forest Science,*(17): 87-103.

Tewari, V. P. & Singh, B. 2001. Volume Equations for Eucalyptus Camaldulensis in Ignp Area. *Indian Forester,*(127): 1367-1370.

Tewari, V. P. & Singh, B. 2006. Provisional Equations for Estimating Total and Merchantable Wood Volume of Acacia Nilotica Trees in Gujarat State of India. *Forests, Trees and Livelihoods,*(16): 277-288.

Tewari, V. P. & Singh, B. 2006. Total and Merchantable Wood Volume Equations for Eucalyptus Hybrid Trees in Gujarat State, India. *Arid Land Research and Management,*(20): 147-159.

Tewari, V. P. & Singh, B. 2008. Potential Density and Basal Area Prediction Equations for Unthinned Eucalyptus Hybrid Plantations in the Gujarat State of India. *Bioresource Technology,*(99): 1642-9.

Tewari, V. P. & Singh, B. 2009. Site Index Model for Tecomella Undulata (Sm.) Seem. (Bignoniaceae) Plantations in a Hot Arid Region of India. *Journal of Arid Environments,*(73): 590-593.

Tewari, V. P. 1996. Developing Equations for Estimating Growth Parameters of Acacia Tortilis (Forsk.) Hayne. *Indian Forester,*(122): 1004-1009.

Tewari, V. P. 2004. Stem Number Development and Potential Stand Density in the Unthinned Even-Aged Azadirachta Indica Plantations in the Gujarat State of India. *International Forestry Review,*(6): 51-55.

Tewari, V. P. 2006. Generalised Diameter-Height Equations for Even-Aged Stands of Azadirachta Indica in Gujarat State of India. *Indian Forester,*(132): 79-90.

Tewari, V. P. 2007. Stand Density and Basal Area Prediction of Unthinned Irrigated Plantations of Eucalyptus Camaldulensis in the Hot Desert of India. *Bioresource Technology,*(98): 1106-1114.

Tewari, V. P. 2007. Total Wood Volume Equations and Their Validation for Tecomella Undulata Plantations in Hot Arid Region of India. *Indian Forester,*(133): 1648-1658.

Tewari, V. P. 2008. Predicting Potential Density and Basal Area Development in the Social Forestry Plantations of Acacia Nilotica in Gujarat State of India. *Journal of Sustainable Forestry,*(26): 284-300.

Tewari, V.P., chouhan, S.L & Kumar, V.S.K. 2001. Volume Equations for Dalbergia Sissoo in Ignp Area. *Annals of Forestry,*(9): 140-143.

Tewari, V. P., Mariswamy, K. M. & Arunkumar, A.N. 2013. Total and Merchantable Volume Equations for Tectona Grandis Linn. F. Plantations in Karnataka, India. *Journal of Sustainable Forestry,*(32): 213-229.

Thapa, H. B. & Gautam, S. K. 2005. Growth Performance of Tectona Grandis in the Western Terai of Nepal. *Banko Janakari,*(15): 6-12.

Thapa, H. B. & Gautam, S. K. 2007. Growth Performance of Tectona Grandis Linn F.Between Two Thinning Operations at Shankarnagar,Western Terai,Nepal. *Banko Janakari,*(17): 11-17.

Thapa, H. B. 1999. Prediction Models for above-Ground Wood of Some Fast Growing Trees of Nepal's Eastern Terai. *Banko Janakari,*(9): 27-35.

Thapa, H. B. 2000. Biomass Estimation of Some Fast Growing Trees in the Eastern Terai,Nepal. *Banko Janakari,*(10): 15-20.

Thapa, H. B. 2004. Early Growth,Thinning Yield and Estimated Biomass of Standing Tree of Dalbergia Latifolia Roxb. In the Eastern Terai,Nepal. *Banko Janakari,*(14): 31-40.

Thomson, E.F., Mirza, S.N. & Afzal, J. 2013. Technical Note : Predicting the Components of Aerial Biomass of Fourwing Saltbush from Shrub Height and Volume. *Journal of Range Management,*(51): 323-325.

Tiwari, A. K. 1992. Component-Wise Biomass Models for Trees: A Non-Harvest Technique. *Indian Forester,*(118): 404-410.

Tiwari, K. P. & Pandey, R. L. 1996. *Local Volume Tables for Teak,Sal and Other Species for Central Circle,Jabalpur (M.P).*

Toky,O.P.,Bisht.R.P.,Kumar,N. & Singh, R.R. 1994. Growth and Biomass of Populus Deltoides G3 Marsh Grown at Three Plant Spacing in Arid India. *Indian Journal of Forestry,*(17): 301-304.

Toky,O.P.,Riddell-Black,D.,Harris,P.J.C.,Vasudevan,P. & Davies, P.A. 2011. Biomass Production in Short Rotation Effluent-Irrigated Plantations in North-West India. *Journal of Scientific & Industrial Research,*(70): 601-609.

Tyagi, K., Sharma, S.D. & Tyagi, P. 2009. Development of Biomass and Productivity in Age Series of Dalbegia Sisoo Plantations in Sodic Lands of Uttar Pradesh. *Annals of Forestry,*(17): 219-233.

Unnikrishnan, K. P. & Singh, R. 1984. Construction of Volume Tables -a Generalised Approach. *Indian Forester,*(110): 561-576.

Uppal, R. & Khosla, P. K. 2002. Seed Germination,Seedling Growth and Biomass. Production of Six Multipurpose Shrubs under Nursery Conditions. *Annals of Forestry,*(10): 228-232.

Wangle, B. H. & Sharma, R. P. 2011. Modelling Height- Diameter Relationship for Pinus Wallichiana Trees for Lete and Kunjo of Mustang District. *Banko Janakari,*(21): 13-23.

Yekanthappa, K. & Rai, S. N. 1981. Local Volume Table for Dalbergia Latifolia Roxb.-Compiled through Stem Analysis. *My Forest,*(17): 15-40.

Zomer, R. & Menke, J. 1993. Site Index and Biomass Productivity Estimates for Himalayan Alder Large Cardamom Plantations :A Model Agroforestry System of the Middle Hills of Eastern Nepal. *Mountain Research and Development,*(13): 235-255.

9. Appendices

Appendix - 1.1. List of Contacts

Country	Last name	Name	Institution	e - mail
Bangladesh	Al-Amin	Mohammed	University of Chittagong	prof.alamin@yahoo.com
Bangladesh	Rahman	Md. Ahsanur	Bangladesh Forest Research institute	bappy43@yahoo.com
Bangladesh	Sayeam	M. Imran	University of Chittagong	imransayeam@gmail.com
Bangladesh	Das	Sharmila	Bangladesh Forest Research institute	sharmila_5348@yahoo.com
Bangladesh	Islam	Md. Rafiqul	Bangladesh Forest Research institute	bfri_fpd@ctpath.net
Bangladesh	Islam	Md. Zahirul	Bangladesh Forest Research institute	zahir.fid.bfri@gmail.com
Bangladesh	Islam	Ariful	University of Chittagong	shovon.ariful@gmail.com
Bangladesh	Islam	Syful	University of Chittagong	syful90@yahoo.com
Bangladesh	Nasreen	Shameema	Bangladesh Forest Research institute	shameema.bfri@yahoo.com
Bangladesh	Rahman	Md. Mokhlesur	Bangladesh Forest Research institute	director_bfri@ctpath.net
Bhutan	Katwal	Santosh	Department of Forest and Park Services	santoshkatwal@gmail.com
Bhutan	Lhamo	Kuenzang	Department of Forest and Park Services	lhakeen@gmail.com
Bhutan	Tshering	Kinley	Department of Forest and Park Services	kinleytshering@gmail.com
India	Ashraff	Javid	Forest Research Institute, Dehradun	jawaid@icfre.org
India	Chandra	Girish	Tropical Forest Research Institute, Jabalpur	gchandra23@yahoo.com
India	George	K.F.	Kerala Forest Research Institute	georgekfri@gmail.com
India	Hussain	K.H.	Kerala Forest Research Institute	hussain.rachana@gmail.com
India	Jain	Avinash	Tropical Forest Research Institute, Jabalpur	jainavi@yahoo.com
India	Kumar	Rajesh	Forest Survey of India	rajesh@fsi.nic.in
India	Nautiyal	Raman	Indian Council for Forestry Research and Education, Dehradun	nautiyalr@icfre.org
India	Prakash	Ram	State Forest Research Institute, Jabalpur	sdfri@rediffmail.com, dsfrimp@nic.in
Country	**Last name**	**Name**	**Institution**	**e - mail**
India	Sarojam	N	Kerala Forest Research Institute	sarojam@kfri.res.in

India	Seth	Richa	State Forest Research Institute, Jabalpur	richaseth1972@rediffmail.com
India	Sunil	Mukundan	Kerala Agricultural University	sunilmukundan@yahoo.co.in
India	Tewari	Vindhya P.	Institute of Wood Science and Technology, Bangalore	vptewari@icfre.org
India	Thomas	P. Thomas	Kerala Forest Research Institute	thomas.kfri@gmail.com
India	Vashishtha	H. B.	Forest Research Institute, Dehradun	vasisthahb@icfre.org
India	Verma	Kanhaiya L.	State Forest Research Institute, Jabalpur	klv_123@rediffmail.com
Nepal	Dangi	Resham	REDD Forestry and Climate Change Cell	reshamdangi@hotmail.com
Nepal	Kharal	Deepak Kumar	Department of Forests,Nepal	
Nepal	Gautam		Department of Forests,Nepal	
Nepal	Thapa	Hasta Bhadur	Department of Forests,Nepal	
Sri Lanka	Baiminiwatte	Shanthakumara	UN - REDD PMO, Sri Lanka	
Sri Lanka	Hitinayake	Gamini	Faculty of Agriculture, University of Peradeniya	gaminisbh@gmail.com
Sri Lanka	Nissanka	Sarath Premalal	Faculty of Agriculture, University of Peradeniya	nissankasp@yahoo.com
Sri Lanka	Pushpakumara	D.K.N.G.	Faculty of Agriculture, University of Peradeniya	ngpkumara@pdn.ac.lk
Sri Lanka	De Costa	W.A.J.M.	Faculty of Agriculture, University of Peradeniya	janendrad@yahoo.com
Sri Lanka	Edirisinghe	Nishantha	Forest Department, Sri Lanka	eapnishantha@yahoo.com
Sri Lanka	Kulathunga		Forest Department, Sri Lanka	skulatunga@yahoo.com
Sri Lanka	Lakshmi		Forest Department, Sri Lanka	
Sri Lanka	Munasinghe	Nalin	FAOLK	Nalin.Munasinghe@fao.org
Sri Lanka	Perera	Roshan	The Open University in Sri Lanka	
Sri Lanka	Premakantha		Forest Department, Sri Lanka	
Sri Lanka	Sathurusinghe	Anura	Forest Department, Sri Lanka	anura.sathurusinghe@gmail.com
Sri Lanka	Subasinghe	S.M.C.U.P.	University of Sri Jayewardenepura	
Sri Lanka	Thushara	Perera	FAOLK	thushara.perera@fao.org

Appendix - 1.2. List of Institutes/ Libraries that contributed documents to the database

Bangladesh Forest Research institute, GPO Box No. 273, Chittagong, Bangladesh
University of Chittagong, Chittagong - 4331, Bangladesh
Council for Renewable Natural Resources Research Centre, Bhutan
Department of Forests and Park Services, Thimpu, Bhutan
Forest Research Institute (FRI), Dehradun, Uttarakhand - 248006, India
Forest Survey of India (FSI), Dehradun, Uttarakhand - 248006, India
Indian Council for Forestry Research and Education (ICFRE), Dehradun, Uttarakhand, India
Institute of Wood Science and Technology, Bangalore, karnataka - 560012, India
Jawaharlal Nehru Tropical Botanical Garden Research Institute, Thiruvananthapuram, Kerala - 695562, India
Kerala Agricultural University, Thrissur, Kerala - 680656, India
Kerala Forest research institute, Thrissur, Kerala - 680653, India
State Forest Research Institute,Jabalpur, Madhya Pradesh 482008, India
Tropical Forest Research Institute, Jabalpur, Madhya Pradesh - 482 021, India
Department of Forests, Babarmahal, Kathmandu, Nepal
Forest Deparment, 82, Rajamalwatta Road, Battaramulla, Sri Lanka
The Open University in Sri Lanka, PO Box 21, Nugegoda, Sri Lanka
UN - REDD, FAO - PMO, Colombo, Sri Lanka
University of Peradeniya, Peradeniya 20400, Sri Lanka
University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka.

Appendix - 2. Species-wise distribution of different types of allometric equations available in the database

Plant Species	Volume equations		Biomass equations		BEF equations		Carbon equations		Others		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Eucalyptus camaldulensis	141	2.85	338	9.04	0	0.00	0	0.00	72	10.04	551	5.70
Dalbergia sissoo	197	3.97	74	1.98	14	24.14	0	0.00	59	8.23	344	3.56
Azadirachta indica	27	0.54	15	0.40	1	1.72	0	0.00	4	0.56	47	0.49
Acacia tortilis	4	0.08	0	0.00	0	0.00	0	0.00	3	0.42	7	0.07
Acacia nilotica	87	1.76	28	0.75	1	1.72	0	0.00	13	1.81	129	1.33
Eucalyptus hybrid	140	2.82	69	1.84	0	0.00	0	0.00	25	3.49	234	2.42
Tecomella undulate	4	0.08	0	0.00	0	0.00	0	0.00	1	0.14	5	0.05
Acacia mangium	108	2.18	47	1.26	0	0.00	3	1.49	48	6.69	203	2.10
Eucalptus grandis	62	1.25	32	0.86	0	0.00	0	0.00	3	0.42	97	1.00
Syzygium cumini	40	0.81	45	1.20	1	1.72	1	0.50	6	0.84	92	0.95
Dalbergia latifolia	19	0.38	15	0.40	1	1.72	0	0.00	1	0.14	36	0.37
Terminalia bellirica	47	0.95	4	0.11	0	0.00	2	0.99	0	0.00	51	0.53
Terminalia paniculata	12	0.24	8	0.21	0	0.00	0	0.00	1	0.14	21	0.22
Lagerstroemia lanceolata	10	0.20	8	0.21	0	0.00	0	0.00	1	0.14	19	0.20
Xylia xylocarpa	18	0.36	12	0.32	0	0.00	0	0.00	9	1.26	39	0.40
Careya arborea	8	0.16	12	0.32	0	0.00	0	0.00	0	0.00	20	0.21
Acacia auriculiformis	204	4.12	77	2.06	4	6.90	4	1.98	116	16.18	401	4.15
Toona cedrela	30	0.61	0	0.00	0	0.00	0	0.00	0	0.00	30	0.31
Bombax ceiba	67	1.35	0	0.00	1	1.72	2	0.99	2	0.28	70	0.72
Tectona grandis	300	6.05	89	2.38	2	3.45	29	14.36	45	6.28	436	4.51
Holoptelia integrifolia	13	0.26	2	0.05	0	0.00	0	0.00	0	0.00	15	0.16
Pinus wallichiana	104	2.10	3	0.08	0	0.00	0	0.00	6	0.84	113	1.17

Plant Species	Volume equations		Biomass equations		BEF equations		Carbon equations		Others		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Gmelina arborea	57	1.15	12	0.32	1	1.72	6	2.97	2	0.28	72	0.74
Shorea robusta	170	3.43	66	1.76	0	0.00	8	3.96	12	1.67	248	2.56
Cedrus deodara	15	0.30	6	0.16	0	0.00	0	0.00	2	0.28	23	0.24
Cryptomeria japonica	4	0.08	2	0.05	0	0.00	0	0.00	0	0.00	6	0.06
Calophyllum elatum	8	0.16	21	0.56	0	0.00	0	0.00	1	0.14	30	0.31
Dysoxylum malabaricum	5	0.10	0	0.00	0	0.00	0	0.00	0	0.00	5	0.05
Dipterocarpus turbinatus	63	1.27	2	0.05	0	0.00	3	1.49	10	1.39	75	0.78
Holigarna grahamii	5	0.10	37	0.99	0	0.00	0	0.00	1	0.14	43	0.44
Coronidium elatum	4	0.08	35	0.94	0	0.00	0	0.00	0	0.00	39	0.40
Canarium strictum	5	0.10	47	1.26	0	0.00	0	0.00	0	0.00	52	0.54
Carallia brachiata	5	0.10	25	0.67	0	0.00	0	0.00	0	0.00	30	0.31
Dillenia indica	0	0.00	15	0.40	0	0.00	0	0.00	0	0.00	15	0.16
Poa macrantha	0	0.00	15	0.40	0	0.00	0	0.00	0	0.00	15	0.16
Syzygium utilis	4	0.08	35	0.94	0	0.00	0	0.00	0	0.00	39	0.40
Garcinia cambogia	4	0.08	47	1.26	0	0.00	0	0.00	0	0.00	51	0.53
Garcinia indica	8	0.16	54	1.44	0	0.00	0	0.00	0	0.00	62	0.64
Lansium anamallayanum	4	0.08	39	1.04	0	0.00	0	0.00	0	0.00	43	0.44
Dimocarpus longana	0	0.00	15	0.40	0	0.00	0	0.00	0	0.00	15	0.16
Palaquium ellipticum	14	0.28	41	1.10	0	0.00	0	0.00	2	0.28	57	0.59
Eucalyptus globules	4	0.08	24	0.64	0	0.00	0	0.00	0	0.00	28	0.29
Populus deltoids	57	1.15	230	6.15	15	25.86	6	2.97	4	0.56	306	3.16
Pterocarpus dalbergioides	2	0.04	0	0.00	0	0.00	0	0.00	1	0.14	3	0.03
Dendrocalamus strictus	0	0.00	4	0.11	0	0.00	18	8.91	0	0.00	4	0.04
Acacia mearnsii	1	0.02	10	0.27	1	1.72	0	0.00	0	0.00	12	0.12
Bambusa tulda	0	0.00	5	0.13	0	0.00	6	2.97	0	0.00	5	0.05
Morus alba	2	0.04	0	0.00	0	0.00	0	0.00	7	0.98	9	0.09
Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**

Pinus caribaea	70	1.41	0	0.00	0	0.00	4	1.98	2	0.28	72	0.74
Pinus patula	6	0.12	3	0.08	0	0.00	0	0.00	1	0.14	10	0.10
Trewia nudiflora	19	0.38	4	0.11	0	0.00	0	0.00	0	0.00	23	0.24
Pterocarpus marsupium	59	1.19	30	0.80	0	0.00	0	0.00	0	0.00	89	0.92
Prosopis juliflora	18	0.36	42	1.12	0	0.00	0	0.00	2	0.28	62	0.64
Acacia farnesiana	0	0.00	6	0.16	0	0.00	0	0.00	0	0.00	6	0.06
Casuarina equisetifolia	1	0.02	64	1.71	1	1.72	0	0.00	2	0.28	68	0.70
Leucaena leucocephala	8	0.16	20	0.53	4	6.90	0	0.00	12	1.67	44	0.45
Cinnamomum camphora	0	0.00	12	0.32	0	0.00	0	0.00	0	0.00	12	0.12
Pinus roxburghii	58	1.17	31	0.83	0	0.00	0	0.00	20	2.79	109	1.13
Ailanthus excels	3	0.06	21	0.56	0	0.00	0	0.00	2	0.28	26	0.27
Dipterocarpus indicus	14	0.28	39	1.04	0	0.00	0	0.00	1	0.14	54	0.56
Alnus nepalensis	20	0.40	83	2.22	0	0.00	0	0.00	1	0.14	104	1.08
Broussonetia papyrifera	4	0.08	0	0.00	0	0.00	0	0.00	0	0.00	4	0.04
Acacia catechu	31	0.63	75	2.01	1	1.72	0	0.00	2	0.28	109	1.13
Lannea grandis	5	0.10	1	0.03	0	0.00	0	0.00	0	0.00	6	0.06
Melanorrhoea usitata	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Duabanga grandiflora	29	0.59	0	0.00	0	0.00	2	0.99	2	0.28	31	0.32
Amoora wallichii	7	0.14	4	0.11	0	0.00	0	0.00	0	0.00	11	0.11
Zanthoxylum rhetsa	4	0.08	0	0.00	0	0.00	0	0.00	0	0.00	4	0.04
Lagerstroemia parviflora	41	0.83	24	0.64	0	0.00	0	0.00	0	0.00	65	0.67
Tetrameles nudiflora	42	0.85	0	0.00	0	0.00	0	0.00	2	0.28	44	0.45
Pinus kesiya	15	0.30	0	0.00	0	0.00	0	0.00	0	0.00	15	0.16
Adina cordifolia	62	1.25	12	0.32	0	0.00	0	0.00	0	0.00	74	0.77
Lannea coromandelica	34	0.69	29	0.78	0	0.00	1	0.50	2	0.28	65	0.67
Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Albizia procera	31	0.63	18	0.48	0	0.00	2	0.99	8	1.12	57	0.59

Sonneratia apetala	128	2.58	0	0.00	0	0.00	0	0.00	2	0.28	130	1.34
Pterygota alata	4	0.08	0	0.00	0	0.00	0	0.00	0	0.00	4	0.04
Madhuca indica	3	0.06	18	0.48	0	0.00	0	0.00	0	0.00	21	0.22
Buchanania lanzan	14	0.28	18	0.48	0	0.00	0	0.00	2	0.28	34	0.35
Terminalia arjuna	54	1.09	7	0.19	0	0.00	1	0.50	0	0.00	61	0.63
Pongamia pinnata	0	0.00	8	0.21	1	1.72	0	0.00	0	0.00	9	0.09
Albizia lebbeck	7	0.14	13	0.35	1	1.72	2	0.99	3	0.42	24	0.25
Pithecellobium dulce	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Acacia latifolia	0	0.00	5	0.13	0	0.00	0	0.00	0	0.00	5	0.05
Terminalia tomentosa	80	1.61	52	1.39	0	0.00	0	0.00	4	0.56	136	1.41
Terminalia chebula	40	0.81	5	0.13	1	1.72	0	0.00	0	0.00	46	0.48
Mallotus philippensis	10	0.20	25	0.67	0	0.00	0	0.00	0	0.00	35	0.36
Eucalptus tereticornis	6	0.12	21	0.56	0	0.00	1	0.50	0	0.00	27	0.28
Artocarpus heterophyllus	5	0.10	8	0.21	0	0.00	5	2.48	0	0.00	13	0.13
Artocarpus hirsutus	6	0.12	4	0.11	0	0.00	0	0.00	1	0.14	11	0.11
Ailanthus triphysa	1	0.02	11	0.29	0	0.00	0	0.00	4	0.56	16	0.17
Mangifera indica	6	0.12	3	0.08	0	0.00	1	0.50	2	0.28	11	0.11
Paulownia fortunei	2	0.04	1	0.03	0	0.00	0	0.00	2	0.28	5	0.05
Bauhinia retusa	1	0.02	11	0.29	0	0.00	0	0.00	2	0.28	14	0.14
Stylosanthes humilis	0	0.00	1	0.03	1	1.72	0	0.00	2	0.28	4	0.04
Carpinus viminea	0	0.00	0	0.00	0	0.00	0	0.00	2	0.28	2	0.02
Celtis caucasica	0	0.00	0	0.00	0	0.00	0	0.00	2	0.28	2	0.02
Cordia vestita	0	0.00	0	0.00	0	0.00	0	0.00	2	0.28	2	0.02
Ficus cunia	0	0.00	8	0.21	0	0.00	0	0.00	2	0.28	10	0.10
Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Ficus roxburghii	0	0.00	0	0.00	0	0.00	0	0.00	2	0.28	2	0.02
Grewia elastica	0	0.00	0	0.00	0	0.00	0	0.00	2	0.28	2	0.02

Grewia optiva	0	0.00	0	0.00	0	0.00	0	0.00	2	0.28	2	0.02
Grewia vestila	0	0.00	4	0.11	0	0.00	0	0.00	2	0.28	6	0.06
Murraya exotica	0	0.00	0	0.00	0	0.00	0	0.00	2	0.28	2	0.02
Ougeinia oojeinensis	11	0.22	0	0.00	0	0.00	0	0.00	2	0.28	13	0.13
Trema politoria	0	0.00	0	0.00	0	0.00	0	0.00	2	0.28	2	0.02
Acacia melanoxylon	2	0.04	0	0.00	1	1.72	0	0.00	0	0.00	3	0.03
Grewia tiliaefolia	9	0.18	7	0.19	0	0.00	0	0.00	1	0.14	17	0.18
Bauhinia purpurea	2	0.04	0	0.00	0	0.00	0	0.00	2	0.28	4	0.04
Tsuga dumosa	14	0.28	0	0.00	0	0.00	0	0.00	3	0.42	17	0.18
Picea spinulosa	46	0.93	0	0.00	0	0.00	0	0.00	1	0.14	47	0.49
Abies densa	43	0.87	0	0.00	0	0.00	0	0.00	6	0.84	49	0.51
Betula utilis	33	0.67	0	0.00	0	0.00	0	0.00	3	0.42	36	0.37
Anogeissus latifolia	67	1.35	47	1.26	0	0.00	0	0.00	0	0.00	114	1.18
Diospyros melanoxylon	21	0.42	27	0.72	0	0.00	0	0.00	0	0.00	48	0.50
Poeciloneuron indicum	4	0.08	19	0.51	0	0.00	0	0.00	0	0.00	23	0.24
Mesua ferrea	7	0.14	19	0.51	0	0.00	0	0.00	0	0.00	26	0.27
Vateria indica	10	0.20	19	0.51	0	0.00	0	0.00	1	0.14	30	0.31
Cinnamomum zeylanicum	4	0.08	19	0.51	0	0.00	0	0.00	0	0.00	23	0.24
Drypetes elata	0	0.00	4	0.11	0	0.00	0	0.00	0	0.00	4	0.04
Diospyros ebenum	3	0.06	8	0.21	0	0.00	0	0.00	0	0.00	11	0.11
Humboldtia brunonis	0	0.00	4	0.11	0	0.00	0	0.00	0	0.00	4	0.04
Hardwickia pinnata	4	0.08	19	0.51	0	0.00	0	0.00	0	0.00	23	0.24
Nothopegia heyneana	4	0.08	19	0.51	0	0.00	0	0.00	0	0.00	23	0.24
Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Diospyros candolleana	4	0.08	19	0.51	0	0.00	0	0.00	0	0.00	23	0.24
Elaeocarpus tuberculatus	4	0.08	19	0.51	0	0.00	0	0.00	0	0.00	23	0.24
Myristica swamps	4	0.08	19	0.51	0	0.00	0	0.00	0	0.00	23	0.24

Melia azadirachta	4	0.08	13	0.35	0	0.00	0	0.00	4	0.56	21	0.22
Bambusa bambos	1	0.02	14	0.37	0	0.00	0	0.00	0	0.00	15	0.16
Fleminyia macrophylla	0	0.00	0	0.00	1	1.72	0	0.00	0	0.00	1	0.01
Chamaecytisus palmensis	0	0.00	0	0.00	1	1.72	0	0.00	0	0.00	1	0.01
Annona squamosa	0	0.00	0	0.00	0	0.00	0	0.00	1	0.14	1	0.01
Dalbergia paniculata	2	0.04	8	0.21	0	0.00	0	0.00	0	0.00	10	0.10
Boswellia serrata	39	0.79	16	0.43	0	0.00	0	0.00	0	0.00	55	0.57
Cleistanthus collinus	4	0.08	4	0.11	0	0.00	0	0.00	0	0.00	8	0.08
Emblica officinalis	5	0.10	11	0.29	0	0.00	0	0.00	0	0.00	16	0.17
Sterculia urens	0	0.00	4	0.11	0	0.00	0	0.00	0	0.00	4	0.04
Abies pindrow	7	0.14	12	0.32	0	0.00	0	0.00	2	0.28	21	0.22
Prosopis cineraria	3	0.06	4	0.11	0	0.00	0	0.00	3	0.42	10	0.10
Cassia siamea	43	0.87	41	1.10	0	0.00	0	0.00	2	0.28	86	0.89
Aphanamixis polystachya	29	0.59	0	0.00	0	0.00	3	1.49	2	0.28	31	0.32
Hardwickia binnata	2	0.04	10	0.27	1	1.72	0	0.00	0	0.00	13	0.13
Excoecaria agallocha	31	0.63	0	0.00	0	0.00	0	0.00	0	0.00	31	0.32
Paraserianthes falcataria	1	0.02	4	0.11	0	0.00	0	0.00	0	0.00	5	0.05
Acrocarpus fraxinifolius	4	0.08	2	0.05	0	0.00	0	0.00	0	0.00	6	0.06
Anthocephalus cadamba	4	0.08	0	0.00	0	0.00	0	0.00	0	0.00	4	0.04
Cedrela toona	10	0.20	2	0.05	0	0.00	0	0.00	0	0.00	12	0.12
Quercus lamellosa	1	0.02	1	0.03	0	0.00	0	0.00	0	0.00	2	0.02
Castanopsis tribuloides	10	0.20	4	0.11	0	0.00	0	0.00	2	0.28	16	0.17
Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Symplocos theaefolia	1	0.02	1	0.03	0	0.00	0	0.00	0	0.00	2	0.02
Eurya acuminata	0	0.00	7	0.19	0	0.00	0	0.00	0	0.00	7	0.07
Swietenia mahagoni	9	0.18	0	0.00	0	0.00	9	4.46	11	1.53	20	0.21
Sterculia alata	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01

Eugenia laetum	3	0.06	0	0.00	0	0.00	0	0.00	0	0.00	3	0.03
Michelia champaca	42	0.85	0	0.00	0	0.00	0	0.00	2	0.28	44	0.45
Michelia oblonga	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Phoebe goalparensis	19	0.38	0	0.00	0	0.00	0	0.00	0	0.00	19	0.20
Terminalia myriocarpa	17	0.34	0	0.00	0	0.00	0	0.00	2	0.28	19	0.20
Schima wallichii	38	0.77	13	0.35	0	0.00	0	0.00	5	0.70	56	0.58
Bambusa cupulata	0	0.00	5	0.13	0	0.00	0	0.00	0	0.00	5	0.05
Pseudotsuga menziesii	5	0.10	0	0.00	0	0.00	0	0.00	1	0.14	6	0.06
Quercus glauca	21	0.42	7	0.19	0	0.00	0	0.00	1	0.14	29	0.30
Samanea saman	6	0.12	0	0.00	0	0.00	0	0.00	4	0.56	10	0.10
Butea monosperma	7	0.14	51	1.36	0	0.00	0	0.00	0	0.00	58	0.60
Cupressus macrocarpa	32	0.65	197	5.27	0	0.00	0	0.00	4	0.56	233	2.41
Eucalyptus robusta	22	0.44	0	0.00	0	0.00	0	0.00	0	0.00	22	0.23
Eucalyptus microcorys	20	0.40	0	0.00	0	0.00	0	0.00	1	0.14	21	0.22
Cinnamomum tamala	2	0.04	15	0.40	0	0.00	0	0.00	0	0.00	17	0.18
Lophopetalum wightianum	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Euphoria longana	5	0.10	20	0.53	0	0.00	0	0.00	0	0.00	25	0.26
Bauhinia variegata	10	0.20	0	0.00	1	1.72	0	0.00	0	0.00	11	0.11
Wendalendia exserta	0	0.00	0	0.00	1	1.72	0	0.00	0	0.00	1	0.01
Lagerstroemia microcarpa	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Lagerstroemia reginae	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01

Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Dillenia pentagyna	3	0.06	0	0.00	0	0.00	1	0.50	0	0.00	3	0.03
Hopea parviflora	2	0.04	0	0.00	0	0.00	0	0.00	0	0.00	2	0.02
Persea macrantha	14	0.28	32	0.86	0	0.00	0	0.00	3	0.42	49	0.51
Terminalia ellaptica	12	0.24	0	0.00	0	0.00	0	0.00	0	0.00	12	0.12
Bombax malabaricum	1	0.02	8	0.21	0	0.00	0	0.00	0	0.00	9	0.09

Eugenia jambolana	2	0.04	0	0.00	0	0.00	0	0.00	0	0.00	2	0.02
Hymenodictyon excelsum	6	0.12	0	0.00	0	0.00	0	0.00	0	0.00	6	0.06
Garuga pinnata	8	0.16	12	0.32	0	0.00	0	0.00	0	0.00	20	0.21
Myrsina capitellata	4	0.08	18	0.48	0	0.00	0	0.00	0	0.00	22	0.23
Cassia fistula	7	0.14	12	0.32	0	0.00	0	0.00	0	0.00	19	0.20
Syzygium cerasoides	4	0.08	12	0.32	0	0.00	0	0.00	0	0.00	16	0.17
Holarrhena antidysenterica	6	0.12	25	0.67	0	0.00	0	0.00	0	0.00	31	0.32
Casearia graveolens	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Engelhardia spicata	20	0.40	5	0.13	0	0.00	0	0.00	2	0.28	27	0.28
Eugenia operculata	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Ficus lacor	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Ficus nerifolia	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Ficus semicordata	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Fraxinus floribunda	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Litsea monopetala	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Lyonia ovalifolia	2	0.04	19	0.51	0	0.00	0	0.00	0	0.00	21	0.22
Maesa macrophylla	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Melastoma malabathricum	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Myrica esculenta	0	0.00	4	0.11	0	0.00	0	0.00	0	0.00	4	0.04
Myrsina semiserrata	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03

Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Phyllanthus emblica	1	0.02	3	0.08	0	0.00	0	0.00	0	0.00	4	0.04
Pyrus pashia	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Quercus floribunda	9	0.18	13	0.35	0	0.00	0	0.00	3	0.42	25	0.26
Quercus lanuginosa	18	0.36	3	0.08	0	0.00	0	0.00	0	0.00	21	0.22
Quercus leucotrichophora	1	0.02	3	0.08	0	0.00	0	0.00	0	0.00	4	0.04
Rhododendron arboreum	16	0.32	23	0.61	0	0.00	0	0.00	2	0.28	41	0.42

Rhus wallichii	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Viburnum coriaceum	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Wendlandia coriacea	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Castanopsis indica	29	0.59	3	0.08	0	0.00	0	0.00	3	0.42	35	0.36
Sapium sebiferum	0	0.00	2	0.05	0	0.00	0	0.00	0	0.00	2	0.02
Rhus succedanea	0	0.00	2	0.05	0	0.00	0	0.00	0	0.00	2	0.02
Rhus javanica	0	0.00	2	0.05	0	0.00	0	0.00	0	0.00	2	0.02
Machilus thunbergii	10	0.20	11	0.29	0	0.00	0	0.00	0	0.00	21	0.22
Ficus nemoralis	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Michelia kisopa	2	0.04	3	0.08	0	0.00	0	0.00	1	0.14	6	0.06
Lithocarpus spicata	0	0.00	3	0.08	0	0.00	0	0.00	0	0.00	3	0.03
Dendrocalamus bookeri	0	0.00	5	0.13	0	0.00	0	0.00	0	0.00	5	0.05
Adhatoda vasica	0	0.00	4	0.11	0	0.00	0	0.00	0	0.00	4	0.04
Bambusa nutans	3	0.06	8	0.21	0	0.00	0	0.00	0	0.00	11	0.11
Schleichera trijuga	2	0.04	4	0.11	0	0.00	0	0.00	0	0.00	6	0.06
Hevea brasiliensis	65	1.31	5	0.13	0	0.00	1	0.50	3	0.42	73	0.75
Alstonia macrophylla	20	0.40	0	0.00	0	0.00	0	0.00	0	0.00	20	0.21
Bauhinia racemosa	1	0.02	1	0.03	0	0.00	0	0.00	0	0.00	2	0.02
Abies smithiana	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Acer barbatum	41	0.83	0	0.00	0	0.00	0	0.00	3	0.42	44	0.45
Quercus incana	1	0.02	4	0.11	0	0.00	0	0.00	0	0.00	5	0.05
Taxus baccata	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Acacia arabica	30	0.61	0	0.00	0	0.00	0	0.00	0	0.00	30	0.31
Callicarpa arborea	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Cynometra polyandra	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Dysoxylum binectariferum	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01

Jonesia asoca	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Stereospermum personatum	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Zigiphus xylopyra	0	0.00	1	0.03	0	0.00	0	0.00	0	0.00	1	0.01
Miliusa tomentosa	2	0.04	3	0.08	0	0.00	0	0.00	0	0.00	5	0.05
Avicennia officinalis	60	1.21	0	0.00	0	0.00	0	0.00	0	0.00	60	0.62
Ceriops decandra	6	0.12	0	0.00	0	0.00	0	0.00	5	0.70	11	0.11
Mitragyna parviflolia	32	0.65	4	0.11	0	0.00	0	0.00	0	0.00	36	0.37
Pometia pinnata	28	0.56	0	0.00	0	0.00	0	0.00	0	0.00	28	0.29
Zizyphus mauritiana	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Lagerstroemia spaciosa	10	0.20	4	0.11	0	0.00	8	3.96	12	1.67	26	0.27
Wrightia tomentosa	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Acacia ferruginea	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Acacia lenticularis	2	0.04	8	0.21	0	0.00	0	0.00	0	0.00	10	0.10
Manilkara achras	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Salvadora oleoides	1	0.02	4	0.11	0	0.00	0	0.00	0	0.00	5	0.05
Wrightia tinctoria	9	0.18	24	0.64	0	0.00	0	0.00	0	0.00	33	0.34
Chloroxylon swietenia	5	0.10	20	0.53	0	0.00	0	0.00	0	0.00	25	0.26
Falcourtia indica	1	0.02	4	0.11	0	0.00	0	0.00	0	0.00	5	0.05
Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Zizyphus xylopyrus	3	0.06	10	0.27	0	0.00	0	0.00	0	0.00	13	0.13
Gardenia resinifera	2	0.04	4	0.11	0	0.00	0	0.00	0	0.00	6	0.06
Memecylon edule	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Bridelia retusa	6	0.12	4	0.11	0	0.00	0	0.00	0	0.00	10	0.10
Aporosa lindleyana	1	0.02	4	0.11	0	0.00	0	0.00	0	0.00	5	0.05
Macaranga peltata	8	0.16	12	0.32	0	0.00	0	0.00	0	0.00	20	0.21
Olea dioica	5	0.10	4	0.11	0	0.00	0	0.00	0	0.00	9	0.09
Albizzia amara	2	0.04	10	0.27	0	0.00	0	0.00	0	0.00	12	0.12

Semecarpus anacardium	1	0.02	4	0.11	0	0.00	0	0.00	0	0.00	5	0.05
Quercus semecarpifolia	3	0.06	14	0.37	0	0.00	0	0.00	0	0.00	17	0.18
Myrica sapida	0	0.00	4	0.11	0	0.00	0	0.00	0	0.00	4	0.04
Eurya japonica	0	0.00	4	0.11	0	0.00	0	0.00	0	0.00	4	0.04
Anogeissus pendula	2	0.04	12	0.32	0	0.00	0	0.00	0	0.00	14	0.14
Cullenia excelsa	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Myristica malabarica	2	0.04	4	0.11	0	0.00	0	0.00	0	0.00	6	0.06
Protium caudatum	0	0.00	4	0.11	0	0.00	0	0.00	0	0.00	4	0.04
Memecylon angustifolium	0	0.00	4	0.11	0	0.00	0	0.00	0	0.00	4	0.04
Dolichandrone falcata	1	0.02	1	0.03	0	0.00	0	0.00	0	0.00	2	0.02
Acacia sundra	0	0.00	4	0.11	0	0.00	0	0.00	0	0.00	4	0.04
Juniperus communis	3	0.06	0	0.00	0	0.00	0	0.00	1	0.14	4	0.04
Ceiba pentandra	20	0.40	0	0.00	0	0.00	0	0.00	0	0.00	20	0.21
Ficus benghalensis	16	0.32	0	0.00	0	0.00	0	0.00	0	0.00	16	0.17
Madhuca latifolia	10	0.20	0	0.00	0	0.00	0	0.00	0	0.00	10	0.10
Ficus glomerata	2	0.04	0	0.00	0	0.00	0	0.00	2	0.28	4	0.04
Ficus religiosa	2	0.04	0	0.00	0	0.00	0	0.00	2	0.28	4	0.04
Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Ziziphus nummularia	2	0.04	0	0.00	0	0.00	0	0.00	2	0.28	4	0.04
Acacia leucophloea	2	0.04	0	0.00	0	0.00	0	0.00	0	0.00	2	0.02
Tsuga brunoniana	22	0.44	0	0.00	0	0.00	0	0.00	0	0.00	22	0.23
Larix griffithii	14	0.28	0	0.00	0	0.00	0	0.00	1	0.14	15	0.16
Alstonia scholaris	2	0.04	5	0.13	0	0.00	2	0.99	0	0.00	7	0.07
Albizia moluccana	1	0.02	4	0.11	0	0.00	0	0.00	0	0.00	5	0.05
Syzygium grande	49	0.99	0	0.00	0	0.00	3	1.49	0	0.00	49	0.51
Calophyllum inophyllum	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
kingeodendron pinnata	4	0.08	0	0.00	0	0.00	0	0.00	0	0.00	4	0.04

Amoora rohituka	12	0.24	0	0.00	0	0.00	0	0.00	0	0.00	12	0.12
Ailanthus grandis	10	0.20	0	0.00	0	0.00	0	0.00	0	0.00	10	0.10
Machilus macrantha	9	0.18	0	0.00	0	0.00	0	0.00	0	0.00	9	0.09
Symplocos spicata	28	0.56	0	0.00	0	0.00	0	0.00	3	0.42	31	0.32
Salmalia malabarica	11	0.22	0	0.00	0	0.00	0	0.00	0	0.00	11	0.11
Sterculia villosa	17	0.34	0	0.00	0	0.00	0	0.00	2	0.28	19	0.20
Engelhardtia spicata	8	0.16	0	0.00	0	0.00	0	0.00	1	0.14	9	0.09
Beilschmiedia obtusifolia	6	0.12	0	0.00	0	0.00	0	0.00	1	0.14	7	0.07
Abies lasiocarpa	13	0.26	0	0.00	0	0.00	0	0.00	0	0.00	13	0.13
Toona ciliata	2	0.04	0	0.00	0	0.00	0	0.00	0	0.00	2	0.02
Dipterocarpus zeylanicus	6	0.12	0	0.00	0	0.00	0	0.00	0	0.00	6	0.06
Picea glauca	2	0.04	0	0.00	0	0.00	0	0.00	1	0.14	3	0.03
Syzygium nervosum	6	0.12	0	0.00	0	0.00	0	0.00	0	0.00	6	0.06
Hopea odorata	3	0.06	1	0.03	0	0.00	4	1.98	2	0.28	6	0.06
Aleurites moluccana	3	0.06	0	0.00	0	0.00	0	0.00	4	0.56	7	0.07
Heritiera fomes	30	0.61	0	0.00	0	0.00	0	0.00	0	0.00	30	0.31
Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Dipterocarpus gracilis	17	0.34	0	0.00	0	0.00	0	0.00	0	0.00	17	0.18
Dipterocarpus costatus	15	0.30	0	0.00	0	0.00	1	0.50	0	0.00	15	0.16
Xylocarpus mekongensis	24	0.48	0	0.00	0	0.00	0	0.00	0	0.00	24	0.25
Palaquium polyanthum	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Quercus spicata	1	0.02	0	0.00	0	0.00	1	0.50	0	0.00	1	0.01
Hydnocarpus kuzii	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Artocarpus chaplasha	27	0.54	2	0.05	0	0.00	3	1.49	5	0.70	34	0.35
Callophyllum polyanthum	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Vitex peduncularis	1	0.02	0	0.00	0	0.00	1	0.50	0	0.00	1	0.01
Chukrasi valutina	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01

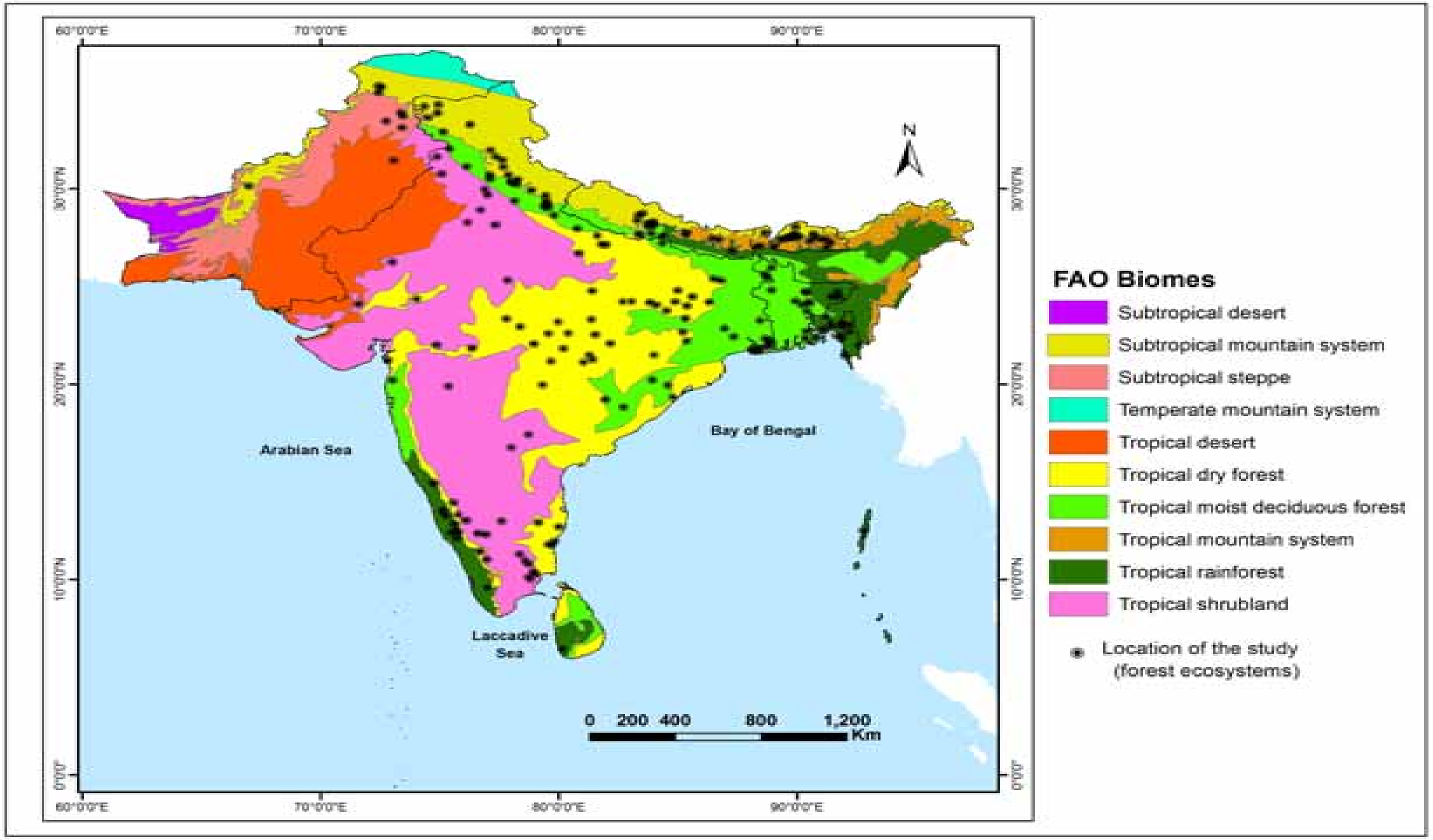
Plant Species	Volume equations		Biomass equations		BEF equations		Carbon equations		Others		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Mangifera sylvatica	19	0.38	0	0.00	0	0.00	1	0.50	0	0.00	19	0.20
Swintonia floribunda	21	0.42	0	0.00	0	0.00	5	2.48	0	0.00	21	0.22
Xylocarpus granatum	23	0.46	0	0.00	0	0.00	0	0.00	0	0.00	23	0.24
Bruguiera gymnorrhiza	25	0.50	0	0.00	0	0.00	5	2.48	0	0.00	25	0.26
Albizia stipulata	2	0.04	0	0.00	0	0.00	0	0.00	0	0.00	2	0.02
Eugenia cymosa	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Syzygium balsameum	0	0.00	0	0.00	0	0.00	1	0.50	0	0.00	0	0.00
Michelia montana	2	0.04	2	0.05	0	0.00	0	0.00	0	0.00	4	0.04
Olea ferruginea	1	0.02	10	0.27	0	0.00	0	0.00	2	0.28	13	0.13
Artocarpus lakoocha	3	0.06	0	0.00	0	0.00	2	0.99	0	0.00	3	0.03
Acacia modesta	0	0.00	4	0.11	0	0.00	0	0.00	2	0.28	6	0.06
Cinnamomum malabatrum	4	0.08	0	0.00	0	0.00	0	0.00	0	0.00	4	0.04
Erythrina indica	3	0.06	0	0.00	0	0.00	0	0.00	0	0.00	3	0.03
Acer acuminatum	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Aesculus indica	1	0.02	10	0.27	0	0.00	0	0.00	0	0.00	11	0.11
Bischofia javanica	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Terminalia crenulata	3	0.06	0	0.00	0	0.00	0	0.00	0	0.00	3	0.03
Albizia saman	0	0.00	0	0.00	0	0.00	3	1.49	0	0.00	0	0.00
Artocarpus lacucha	0	0.00	1	0.03	0	0.00	1	0.50	0	0.00	1	0.01
Quercus dilatata	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Acer Campbellii	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Erythrina suberosa	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Grewia microcos	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Bursera serrata	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Pinus oocarpa	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Araucaria heterophylla	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01

Acacia decurrens	2	0.04	0	0.00	0	0.00	0	0.00	0	0.00	2	0.02
myristica dactyloides	3	0.06	0	0.00	0	0.00	0	0.00	0	0.00	3	0.03
Cullenia ceylanica	3	0.06	0	0.00	0	0.00	0	0.00	0	0.00	3	0.03
Vitex pinnata	3	0.06	0	0.00	0	0.00	0	0.00	0	0.00	3	0.03
Cullenia rosayroana	3	0.06	0	0.00	0	0.00	0	0.00	0	0.00	3	0.03
Ehretia laevis	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Ailanthus integrepholia	6	0.12	0	0.00	0	0.00	0	0.00	2	0.28	8	0.08
Phoebe hainesiana	9	0.18	0	0.00	0	0.00	0	0.00	3	0.42	12	0.12
Alcimandra cathcartii	4	0.08	0	0.00	0	0.00	0	0.00	2	0.28	6	0.06
Terminalia alata	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Juniperus excelsa	0	0.00	0	0.00	0	0.00	0	0.00	4	0.56	4	0.04
Albizia falcataria	3	0.06	0	0.00	0	0.00	0	0.00	0	0.00	3	0.03
Eucalyptus brassiana	1	0.02	8	0.21	0	0.00	0	0.00	0	0.00	9	0.09
Anthocephalus chinensis	1	0.02	0	0.00	0	0.00	2	0.99	0	0.00	1	0.01
Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Albizia richardiana	13	0.26	0	0.00	0	0.00	0	0.00	0	0.00	13	0.13
Streblus asper	0	0.00	0	0.00	0	0.00	1	0.50	0	0.00	0	0.00
Melocanna baccifera	0	0.00	0	0.00	0	0.00	6	2.97	0	0.00	0	0.00
Podocarpus nerifolia	0	0.00	0	0.00	0	0.00	2	0.99	0	0.00	0	0.00
Dipterocarpus alatus	0	0.00	0	0.00	0	0.00	1	0.50	0	0.00	0	0.00
Elaeocarpus floribundus	0	0.00	0	0.00	0	0.00	1	0.50	0	0.00	0	0.00
Microcos paniculata	0	0.00	0	0.00	0	0.00	1	0.50	0	0.00	0	0.00
Pterospermum acerifolium	0	0.00	0	0.00	0	0.00	1	0.50	0	0.00	0	0.00
Syzygium fruticosum	0	0.00	0	0.00	0	0.00	1	0.50	0	0.00	0	0.00
Chukrasia tabularis	0	0.00	0	0.00	0	0.00	4	1.98	0	0.00	0	0.00
Albizia odoratissima	0	0.00	0	0.00	0	0.00	1	0.50	0	0.00	0	0.00
Lophopetalum fimbriatum	0	0.00	0	0.00	0	0.00	1	0.50	0	0.00	0	0.00

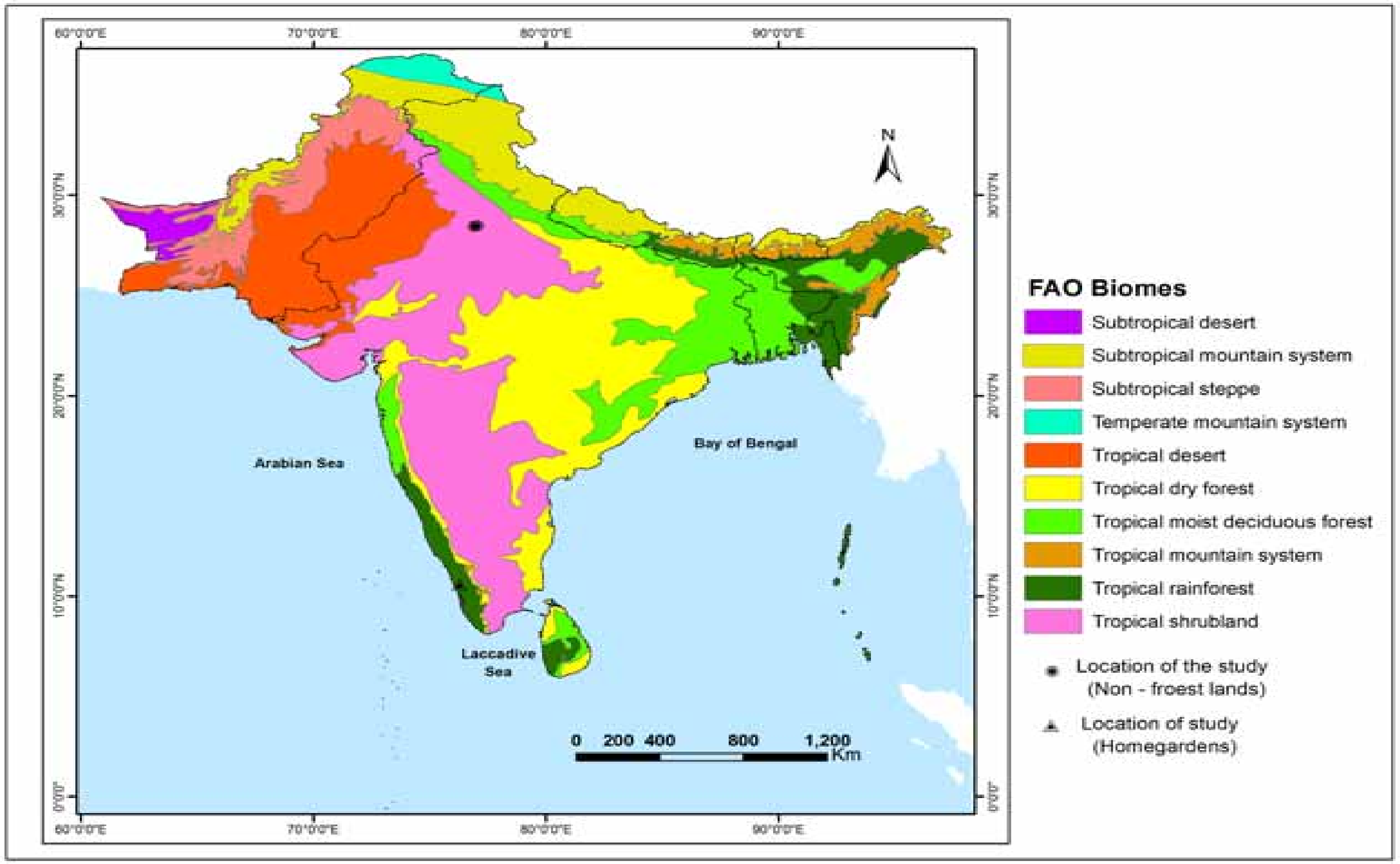
Swietenia macrophylla	2	0.04	6	0.16	0	0.00	0	0.00	10	1.39	18	0.19
Eucalyptus grandis	2	0.04	0	0.00	0	0.00	0	0.00	0	0.00	2	0.02
Persea fructifera	2	0.04	0	0.00	0	0.00	0	0.00	0	0.00	2	0.02
Echinocarpus decicarpus	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Elaeocarpus varuna	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Eurya cavinervis	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Evodia fraxinifolius	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Hovenia dulcis	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Morus macroura	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Nyssa javanica	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Sapium eugeniifolium	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Saurauja napaulensis	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Vitex heterophylla	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Plant Species	**Volume equations**		**Biomass equations**		**BEF equations**		**Carbon equations**		**Others**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Castanopsis hystrix	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Symplocos paniculata	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Tsuga canadensis	1	0.02	0	0.00	0	0.00	0	0.00	0	0.00	1	0.01
Juglans regia	0	0.00	10	0.27	0	0.00	0	0.00	0	0.00	10	0.10
Litsea umbrosa	0	0.00	10	0.27	0	0.00	0	0.00	0	0.00	10	0.10
Symplocos chinensis	0	0.00	10	0.27	0	0.00	0	0.00	0	0.00	10	0.10
Ilex dipyrena	0	0.00	10	0.27	0	0.00	0	0.00	0	0.00	10	0.10
Landea anamallyanum	0	0.00	12	0.32	0	0.00	0	0.00	0	0.00	12	0.12
Soymida febrifuga	0	0.00	0	0.00	0	0.00	0	0.00	2	0.28	2	0.02
Lumnitzera racemosa	0	0.00	0	0.00	0	0.00	5	2.48	0	0.00	0	0.00
Schima castanopsis	0	0.00	1	0.03	0	0.00	0	0.00	0	0.00	1	0.01

Appendix - 3

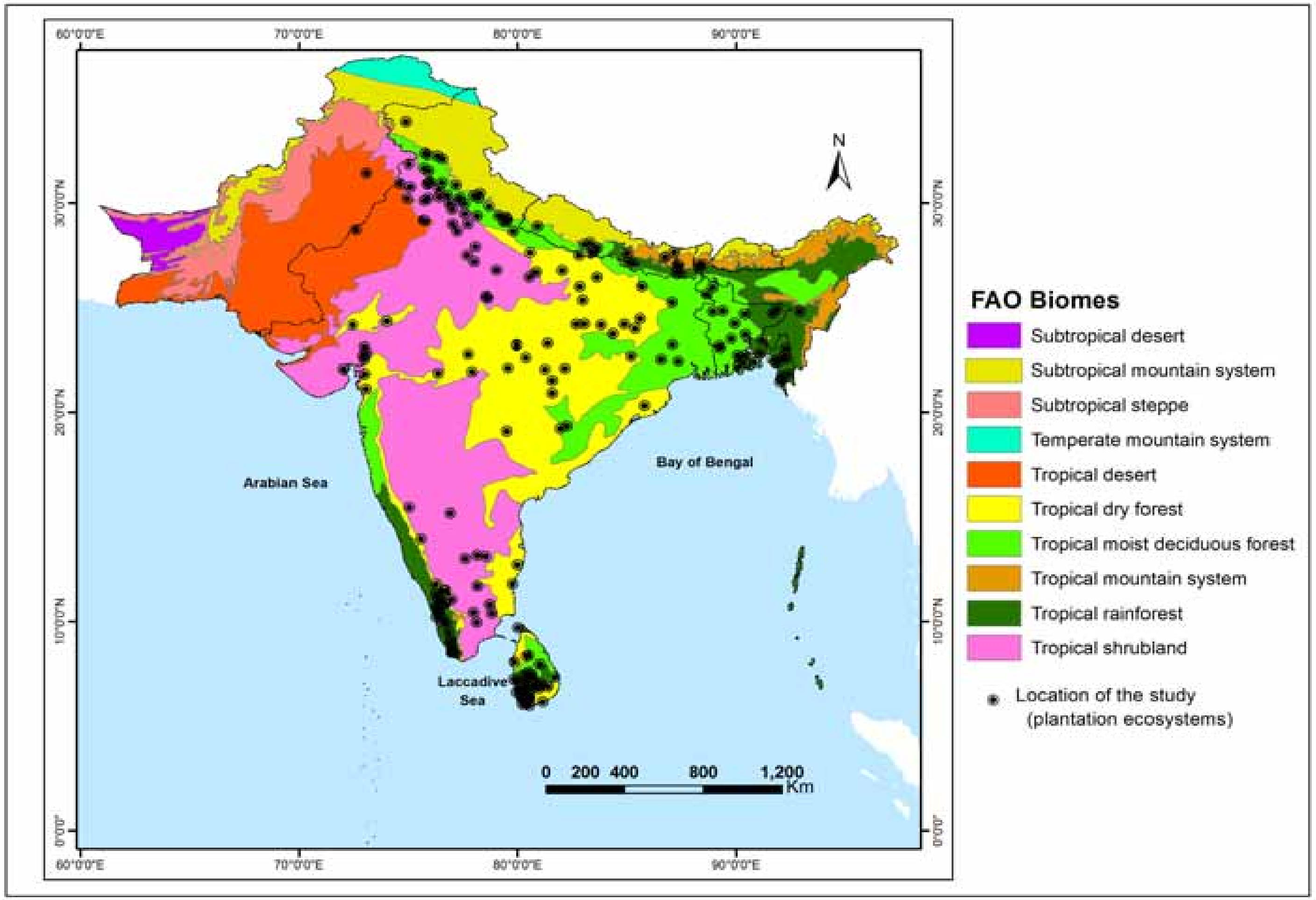
Appendix – 3.1 a. Geographical distribution of sample plots of forest ecosystems in FAO Biome systems of South Asia. The black dots represent the sites where equations were developed.



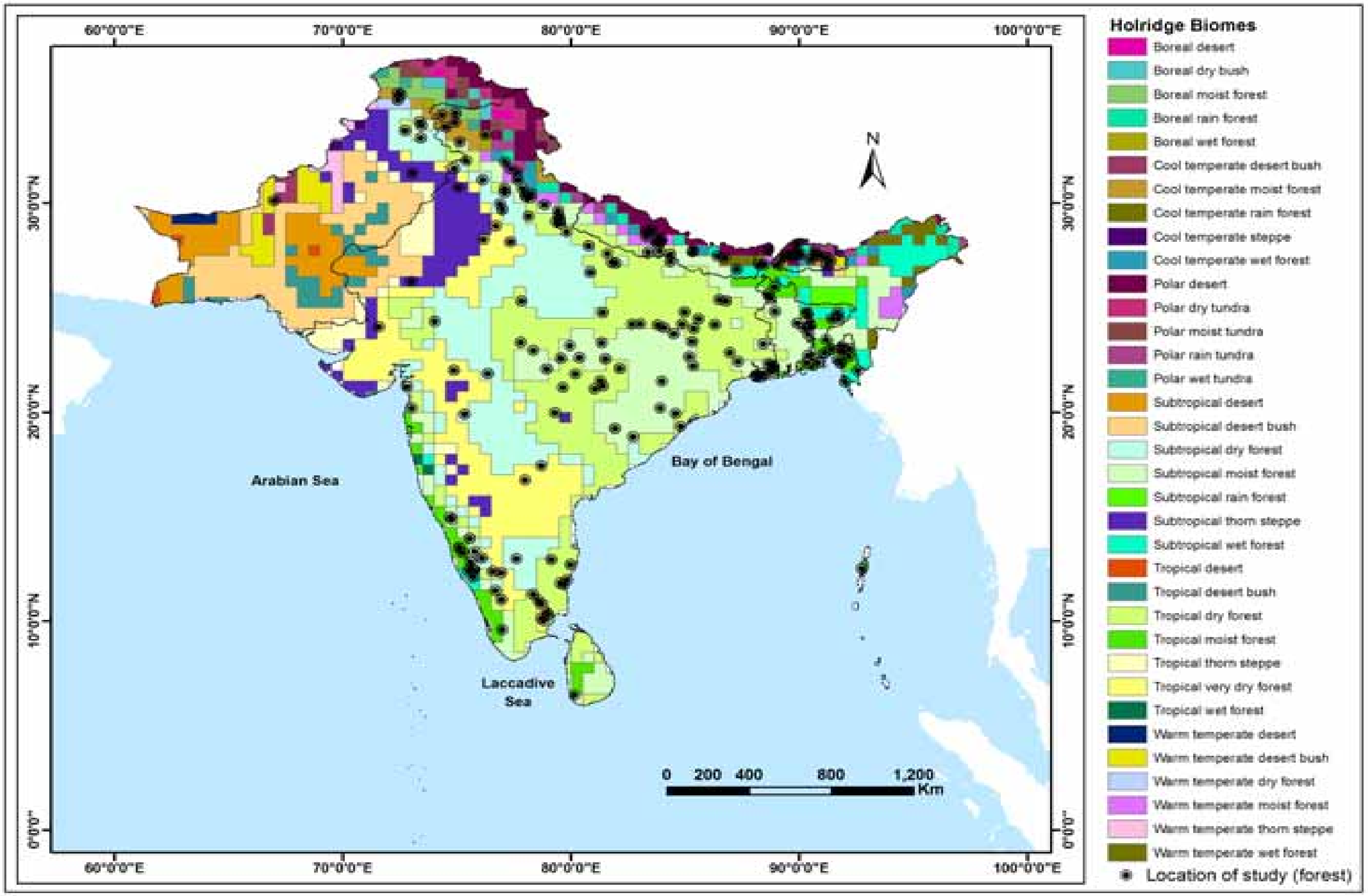
Appendix – 3.1 b. Geographical distribution of sample plots of non - forest ecosystems in FAO Biome systems of South Asia. The black dots represent the sites where equations were developed.



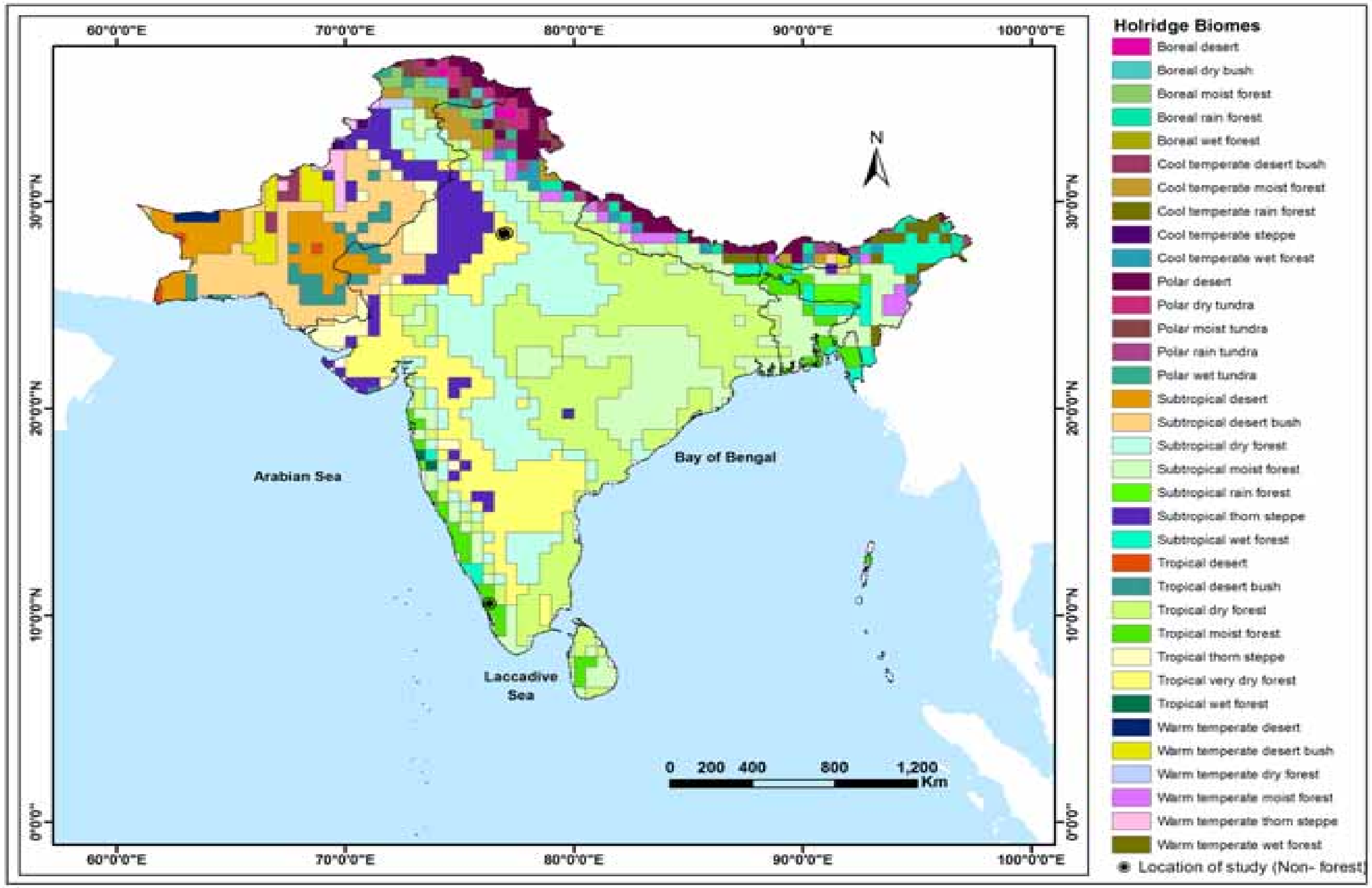
Appendix – 3.1 c. Geographical distribution of sample plots of plantation ecosystems in FAO Biome systems of South Asia. The black dots represent the sites where equations were developed.



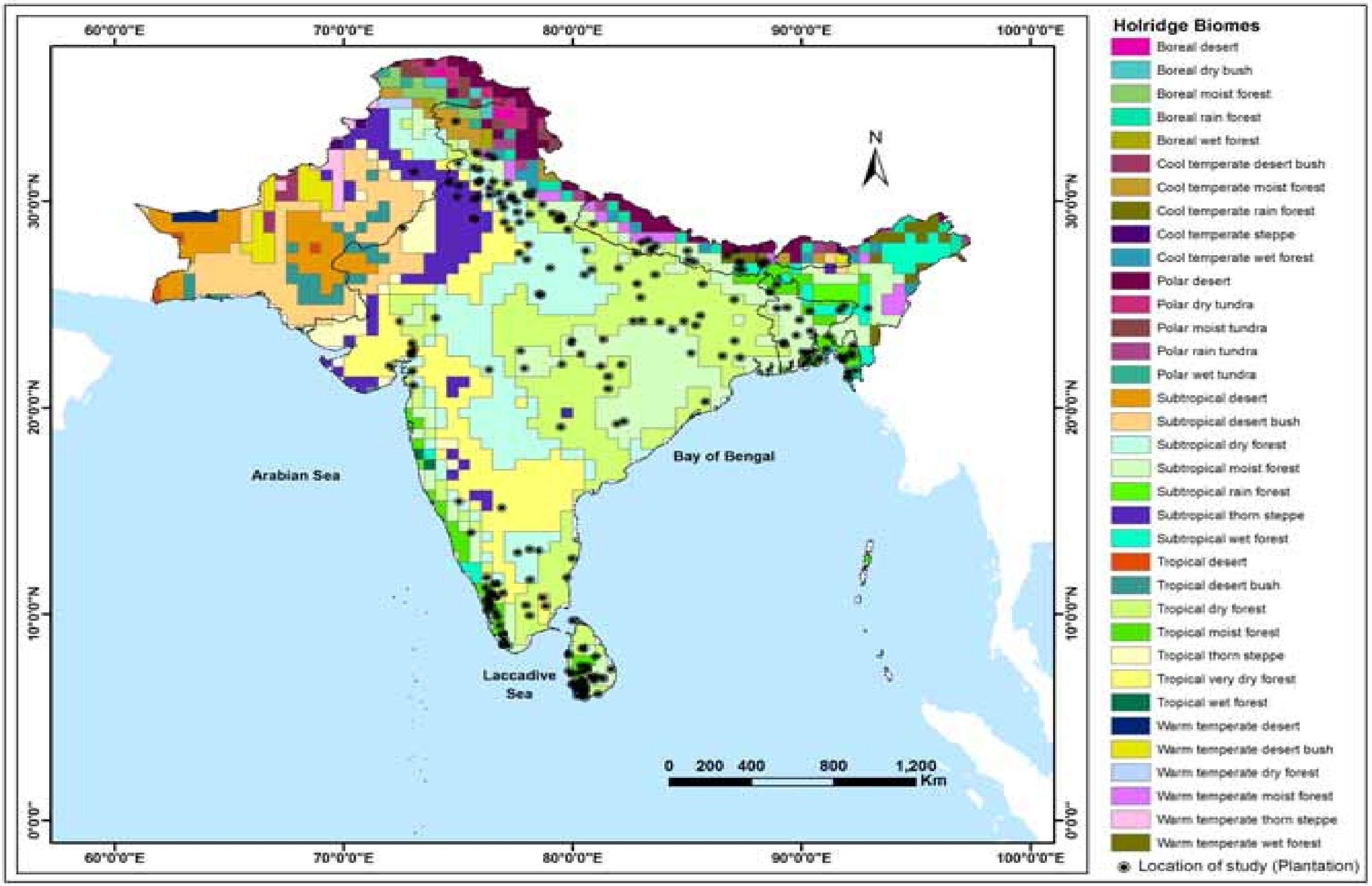
Appendix – 3.2 a. Geographical distribution of sample plots of forest ecosystems in Holridge Biome systems of South Asia. The black dots represent the sites where equations were developed.



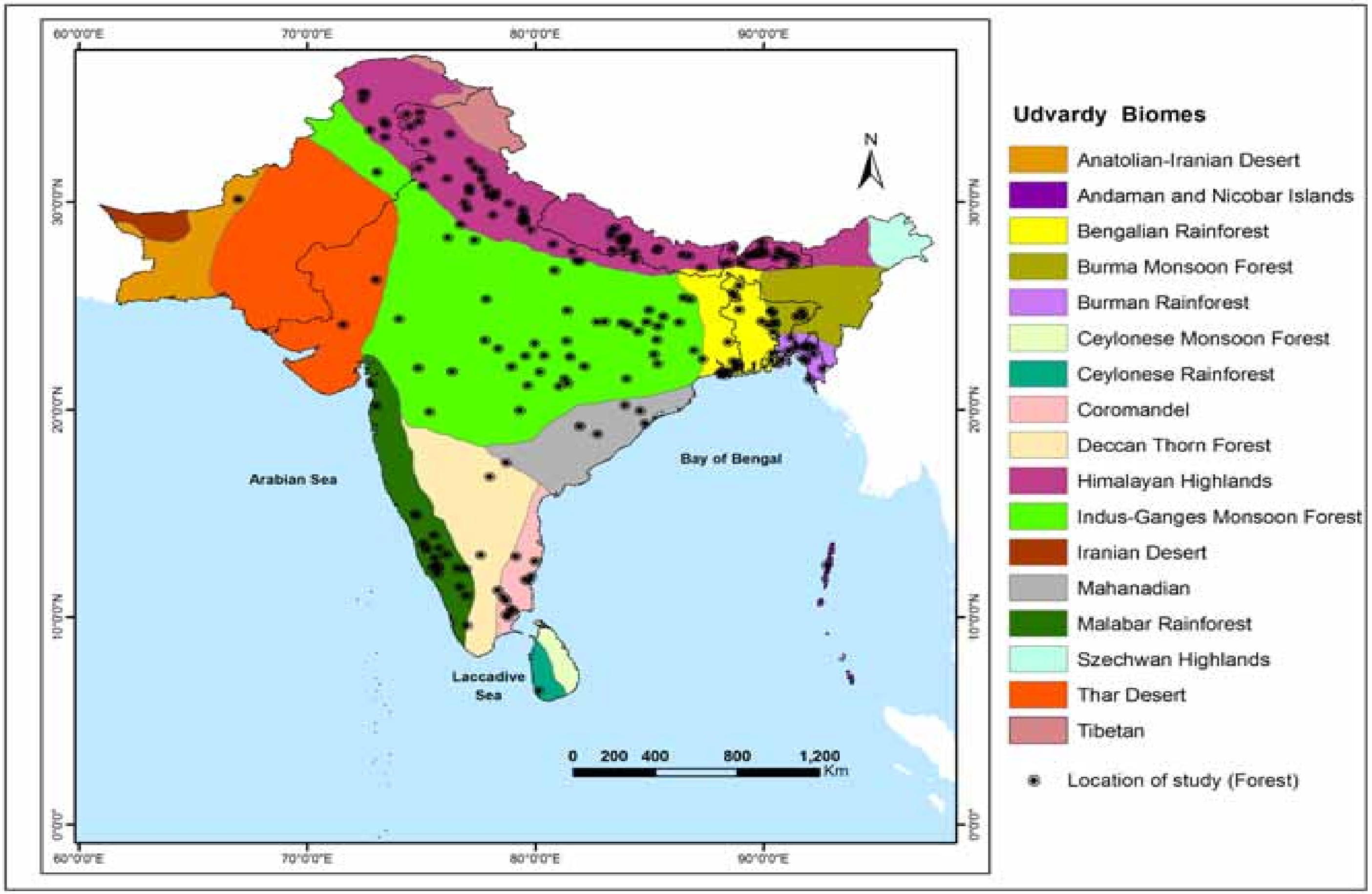
Appendix – 3.2 b. Geographical distribution of sample plots of non forest ecosystems in Holridge Biome systems of South Asia. The black dots represent the sites where equations were developed.



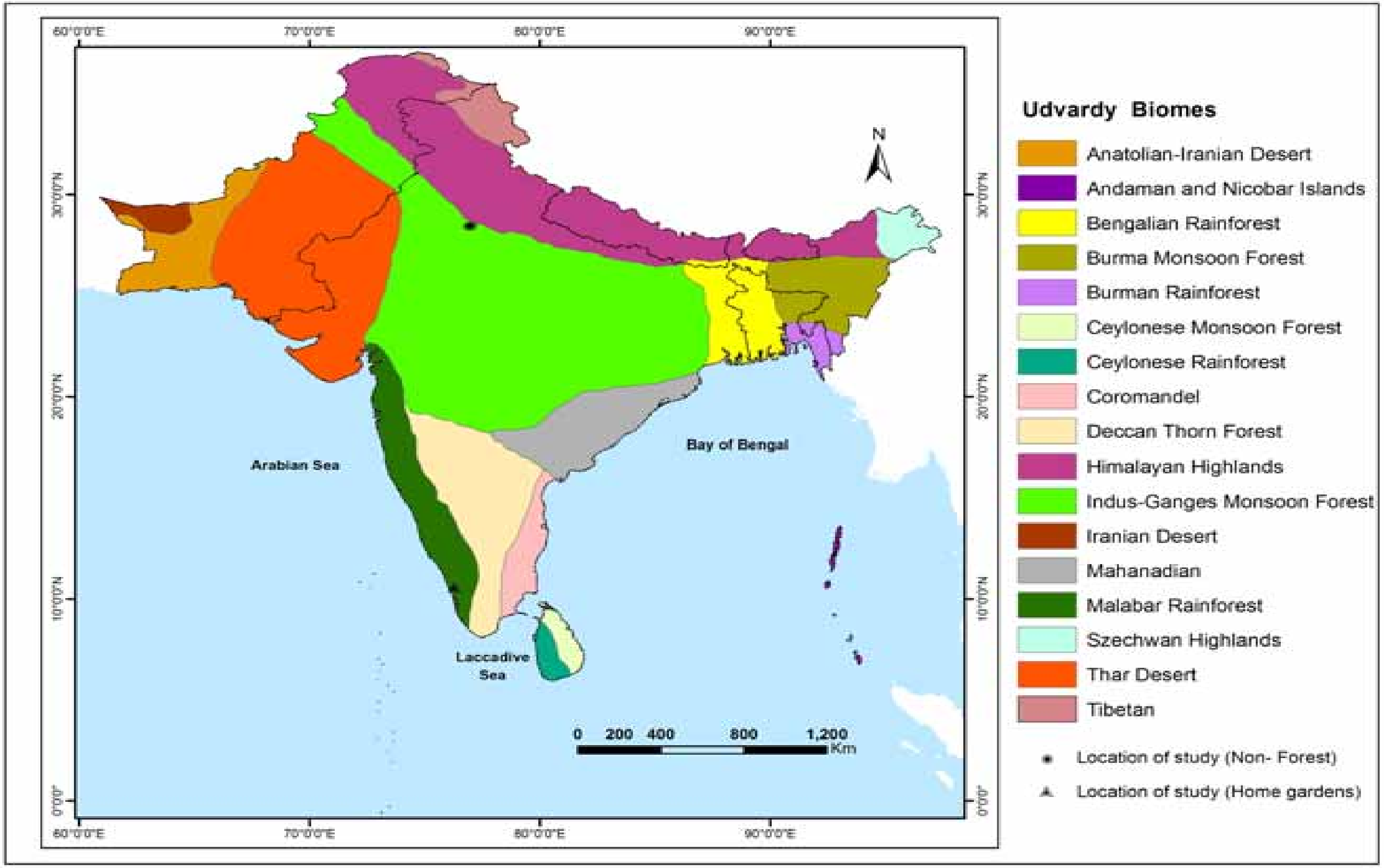
Appendix – 3.2 c. Geographical distribution of sample plots of plantation ecosystems in Holridge Biome systems of South Asia. The black dots represent the sites where equations were developed.



Appendix – 3.3 a. Geographical distribution of sample plots of forest ecosystems in Udvardy Biome systems of South Asia. The black dots represent the sites where equations were developed.



Appendix – 3.3 b. Geographical distribution of sample plots of non forest ecosystems in Udvardy Biome systems of South Asia. The black dots represent the sites where equations were developed



Appendix – 3.3 c. Geographical distribution of sample plots of plantation ecosystems in Udvardy Biome systems of South Asia. The black dots represent the sites where equations were developed