Proceedings on technical support for strengthening the data analysis and modeling using Bangladesh Forest Inventory data

Bangladesh Forest Department
02-06 April 2017

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

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

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

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

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Executive Summary

Five day (02-06 March 2017) workshop is organised on strengthening the data analysis and modelling capacities using field data collected under the Bangladesh Forest Inventory at Forest Department. Technical support was provided by FAO under a project titled "Strengthening National Forest Inventory and Satellite Land Monitoring System in support of REDD+ in Bangladesh". The objective of the workshop was to check the quality of data collected under Bangladesh Forest Inventory and facilitate

Field data collected under the Bangladesh forest Inventory was used during the workshop for (1) quality control, (2) data correction, (3) data analysis, (4) modelling and (5) reporting. Using the latest version of open source software and technical packages, the workshop aims at improving capacities for data analysis and modelling in forestry.

A total of 10 participants (9 male and one female) from Forest Department, Institute of Forestry and Environmental Science, Chittagong University; Forestry and Wood Technology Discipline, Khulna University, Department of Forestry and Environmental Science, Shahjalal University of Science and Technology and FAO has joined the workshop. This workshop contributed to strengthen the collaboration between national experts and universities.

Contents

1.   Introduction

Data collection on Bangladesh Forest Inventory has started in November 2016 under a project titled "Strengthening National Forest Inventory and Satellite Land Monitoring System in support of REDD+ in Bangladesh" of Forest Department. Data will be collected from a total of 1858 plots from the whole country. Till to date data has been collected from 640 plots from Sundarban, Coastal, Hill, Sal and village zone.

Open foris tool of FAO was used to collect the data from field. These data were used and free software "R" was used in the workshop. Manual checking was also done immediately after downloading the data from TAB. The Bangladesh Forest Inventory was used to identify/suggest the possible improvements and support the analysis of volume, biomass, C stock etc. on the other hand data collected for the development of Allometric Equation from sal zone was used for data quality checking during the workshop.

A workshop is designed to provide technical support to the BFI teams including Forest Department and Universities for the development of R scripts. A total of 10 participants from Forest Department, Institute of Forestry and Environmental Science, Chittagong University; Forestry and Wood Technology Discipline, Khulna University, Department of Forestry and Environmental Science, Shahjalal University of Science and Technology and FAO has joined the workshop.

2.   Objectives

The general objective of this training was to strengthen the national capacities in analysing and modelling the Bangladesh Forest Inventory data for supporting the decision.

The specific objectives were as follow:
-   Review the proposed allometric equation database and AE selection procedures
-   Contribute to improve the quality control routine developed on R
-   Establish calculation procedures for outputs such as volume, biomass and C stocks, for the different tree components, as far as possible (at least aboveground and belowground)
-   Provide recommendations to improve the data collection and QA/QC procedures

3. Summary of the training programme

3.1 BFI data checking

3.1.1 Questions for checking

Lists of questions were developed for quality control of the data. However within a week it was not possible to complete the development of R Scripts for checks and analysis. The teams are still working on the scripts to complete the analysis work. A list of questions has been developed for checking the data and considered for script developments in the workshop. But preliminary checks should be done manually. They are:

C1. `Data check in Open Foris after data receipt from the field teams`

C2. `Manual check after extraction from Open Foris`

> `# Match land feature size with land feature photograph`

> `# Land feature proportion with sketch`

Followings are the questions as considered for the development of script using "R" for checking the BFI data. During the workshop it was not possible to develop all the scripts. The script development is a continuous process.

`C3: Subplot and land feature`

> `C3.1: number of plot matching between plot and land feature`

> `C3.2: Consistency between land feature and land feature Object`

> `C3.3: Matching between land feature and tree presence`

> `C3.4: Matching between land feature and tree`

> `C3.5: Compare leaf coverage (subplot_info) with estimated crown cover (land feature)`

> `[leaf coverage by land feature is estimated by using the data from land feature_sub_prop]`

> `C3.6: Presence of Reference Point and consistency of distance between reference point and plot centre`

> `C3.7: To see consistency of distance between reference point and plot centre`

> `C3.6: Check location of the plots in terms of range, union and upazila`

`C3.8: Match lf owner and land feature legal status`

`C3.9: slope is greater than 5% but bearing of slope not taken`

C4: Tree, Sapling, Tree & Sapling

> C4.1: Number of tree dbh is NA

> C4.2: Number of tree height is NA

> C4.3: Number of trees smaller than 1 m height

C4.4: Tree measured outside its subplot

C4.5: Tree species is blank

C4.6: Number of trees with unknown species

C4.7: Height DBH relationship to see trees with abnormal height and diameter

C4.8: Check consistency between height of trees, saplings and seedlings using boxplot

C4.9: trees >10cm diameter and within 8 m and greater than 30 cm diameter in 19 m radius recorded as witness object but not measured in plot

C4.10: trees missing distance and bearing

C4.11: height of the dead standing trees and stumps whether in specified range or not

C4:12: check height and diameter range by species

C5: Seedling

C5.1: Number of trees bigger than 1 m height and > 2cm diameter

C6: Soil

C6.1: Check number of layers (3 from sundarbans and 2 from other zone) by forest zone

C6.2: Check humus depth by forest zone

C6.3: Soil labels written properly in core (manual)

C6.4: Number of soil samples from each plot

C6.5: Soil carbon concentrations by soil types

C7: Litter

C7.1: Samples are collected or not

C7.2: Whether bags of litter samples lebelled properly nor not?

C7.3: Consistency with lf object

C7.4: Weight of litter and carbon concentration by vegetation types (species)

C8: CWD & FWD

C8.1: consistency with land feaure and vegetation class

C8.2: fwd greater than 8cm diameter and cwd <8cm diameter

C8.3: classes of fwd whether they are measured in respective classes

C9: Bamboo

C9.1: Ht-diameter relationship by species to check consistency

3.1.2   Results from checking

Within five days period, it was not possible to develop scripts for all the questions. However partial checking was done for 640 plots. The outputs of the QA/QC checks revealed that, two plots i.e. plot id 230 and 1713 were not sampled due to restriction and pirates in the forests. Among the sampled plots 3 were missing "land feature object", on the other hand, trees were recorded in 4 plots of non-vegetated land feature object. Vegetation coverage of 35 plots seems inconsistent because there trees were recorded where maximum vegetation were shrub or herb. A total of 125 plots were associated with some sorts inconsistency between estimated crown cover and densitometer measured leaf coverage since in some plots the estimated maximum crown coverage is zero but leaf coverage is more than zero and estimated crown coverage is 100 but leaf coverage is 0. More surprisingly 12 plots were missing reference point which may be because of the absence of any object near the plot centre. Moreover, reference points of 23 plots were more than 200m away from the plot centers which also indicate possible inconsistency between locations of reference point and plot centre. In case of height and DBH it was found that for live trees 17 saplings were missing DBH and a total of 133 were missing heights. Location of the trees with reference to the plot centre indicated that 2 trees were measured outside of their associated subplots. Species names were missing in 28 saplings whereas unknown tree species were found in more than 25 plots. The checks also indicated a total of 196 outliers in height-diameter relationship of the trees in different sample plots. A comprehensive list of the QAQC output is given in the annex. BFI plots with problems and inconsistency were identified for cold checks.
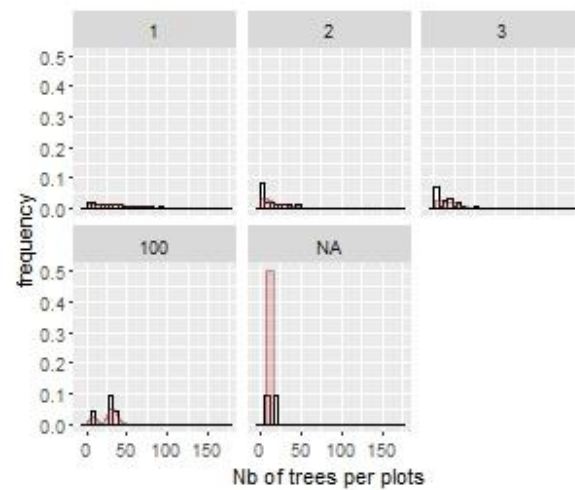
Some of the result graphs from the BFI data checking are shown below:

➢ Below graph is showing the number of trees per plot, median (blue line) and mean (red line) of number of trees
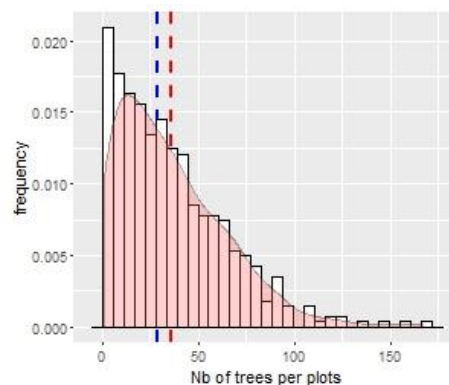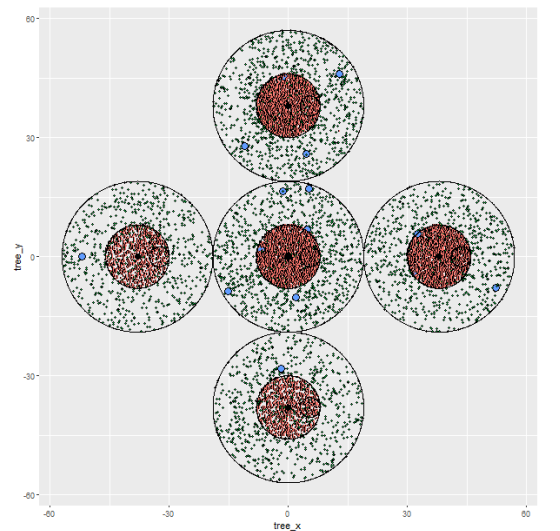
- Below graphs is showing the trees per plot by vegetation type (1= tree, 2=Shrub, 3=Herb, 100=other, NA= not available)

- Below graph is showing the location of recorded trees in subplots

- Belo graph showing two trees having diameter less than 30 cm measured outside the m plot
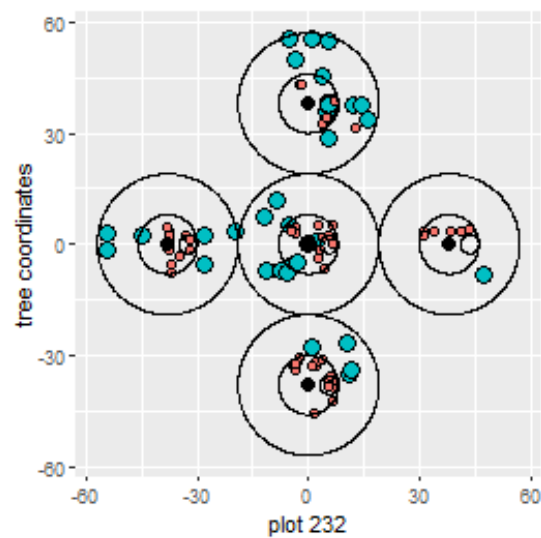
➢ Below graph is showing the outliers in DBH-Height relationship for trees

➢ Below graph is showing DBH-Height relationship for sapling

➢ Below graph is showing the outliers in DBH-Height relationship for saplings and trees

➢ Below graph is showing the extent of outliers in terms of fitted model for height diameter relationship

3.1.3   Data correction
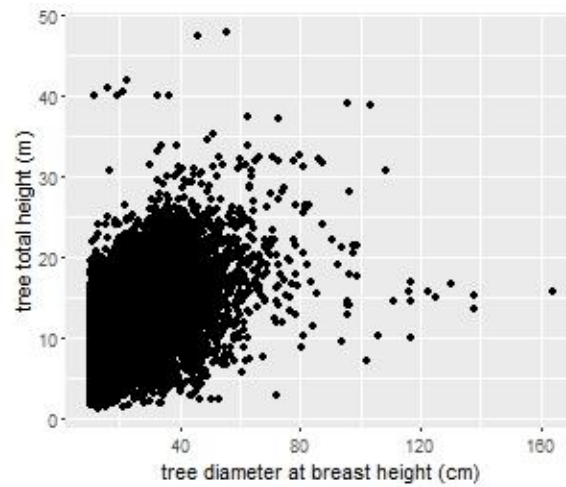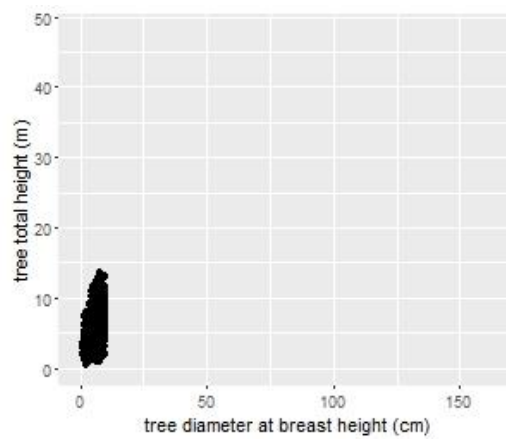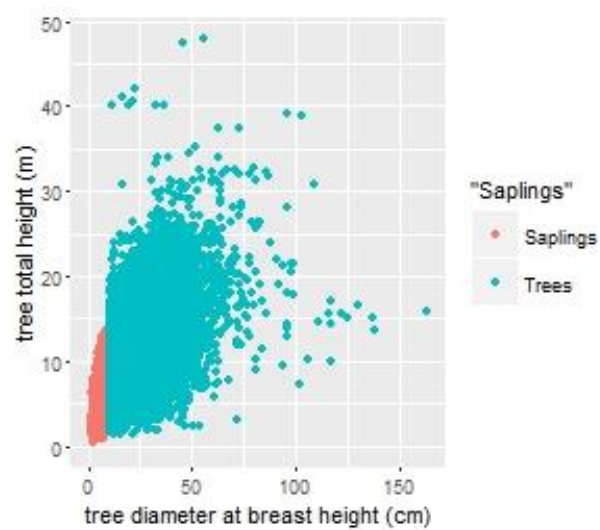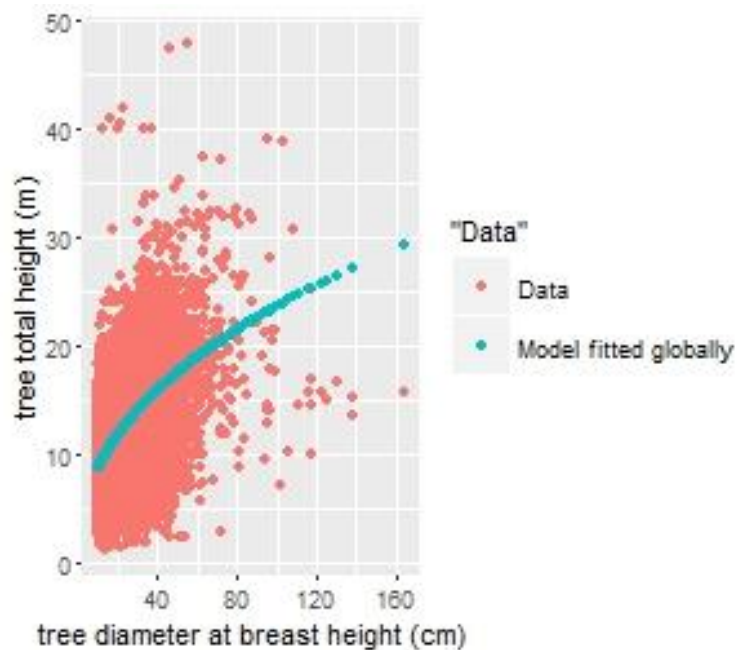
Procedures and script was also developed for the correction of data. Likewise the script development is not completed. Corrections of some checks were done in the database. Some of them are shown below:

C3.1 number of plot matching between plot and land feature

\# Correction procedure:

- Step 1: Be inform about the non-sample plots and Keep the plots in the database,
- Step 2: Take a new random plot in the corresponding hexagonal patch as new plot ID and measured them

C3.2: Consistency between land feature and land feature Object

\# Correction procedure:

- Step 1: plots should be checked at BFI HQ by checking land feature photograph and the sketch of the subplots

  \#   If successful see Step 3

  \#   If not successful

- Step 2: by cold check by revisiting the plot location
- Step 3: manual correction directly into OPENFORIS

  \# NOTE: The tables land features, land feature object (from the QAQC procedure) are required E

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Example Correction for plot 1142 (NOTE ARBITRARY DATA FILLING should be done in open foris)

3.2   Allometric Equation data checking

3.2.1   Questions for checking

The questions were designed for using them to develop R script for the checking of AE data. Some of the scripts were developed and some of them will be developed after giving further input in the database. The questions are as follows:

C1. Sampling

c1.1 Check for missing dbh and height

c1.2 Check for species with number (How many individuals per species) (information)

c1.3 Check for Dia class

C2 Tree

c2.1 Check for Dia and Ht. range (Ma. dia, Max. Ht.) (information)

c2.2 Species with unusual Dia and height

c2.3 Ht. Dia relation

c2.4 Check outliers in Stump Dia and DBH relation

c2.5 Bole Ht. vs Total Ht.

c2.6 Check for Merchantable and Bole Ht.

c2.7 Check for outliers in Total Ht and Ht. of the Crown length

c2.8 Consistency in Crown dia with crown length

c2.9 Consistency of Bole biomass with Branch biomass

c2.10 Merchantable Bole length equals sum of log volume

c2.11 Dia of 1st log equals Stump dia

c2.12 DBH should be within the value of 1st log and 2nd log

c2.13 Checks for outliers in Bole volume and bole biomass

c2.14 checks for outliers Bigger branch length vs bigger branch biomass

c2.15 Comparison of fresh and dry biomass among components

c2.16 Checks for moisture content in different components

C3 WD

c3.1 Check for WD

c3.2 Comparison with the World WD database

3.2.2   Results from checking

Data have been collected from the destructive samples of 101 trees from Sal Zone of Gazipur District for the development of AE. Those data has been checked during the workshop. Checking results can be found in below graphs to provide some idea about the data.

➢ Below graph is showing the relationship of stump Diameter with DBH for all samples
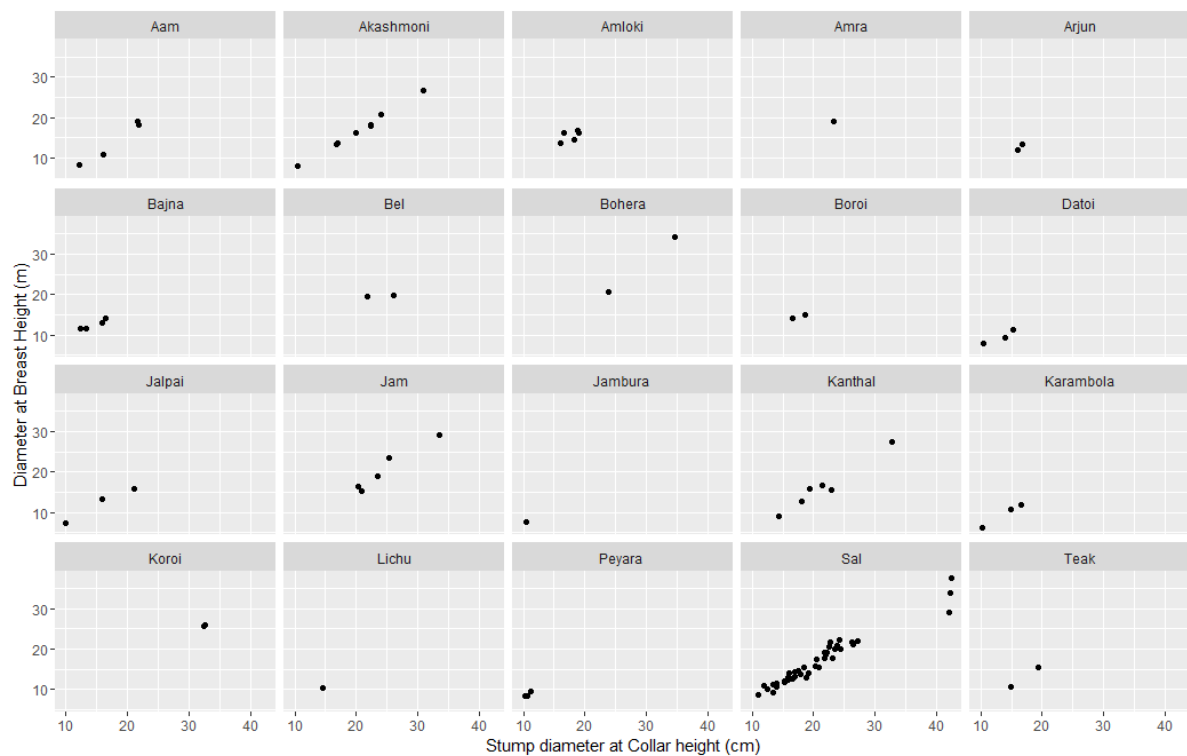
➢ Below graph is showing the check for merchantable Bole Length is >= Bole Length
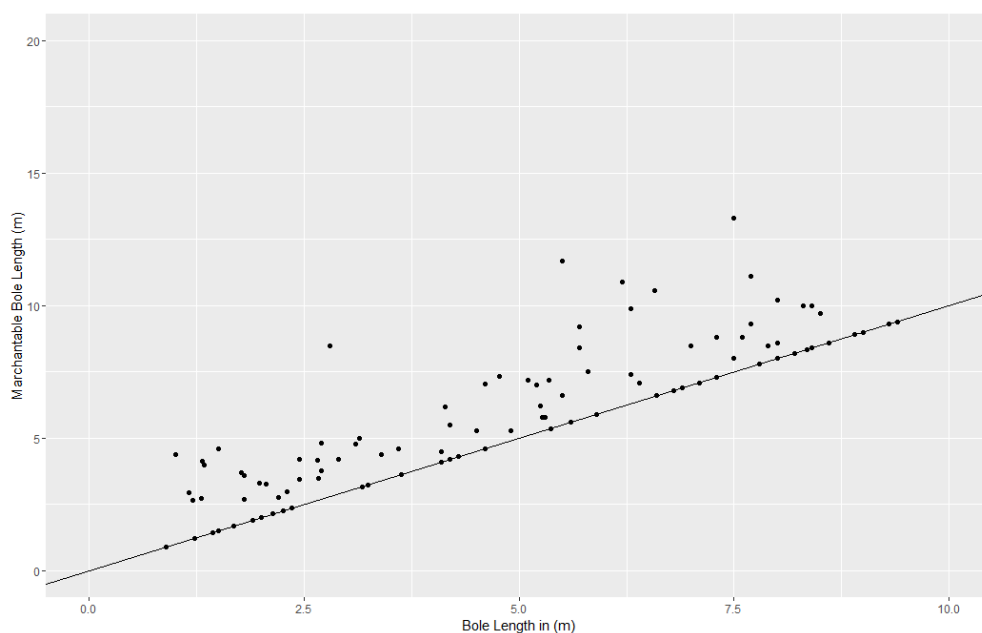
➢ Below graph is showing the relationship of stump –DBH for all samples
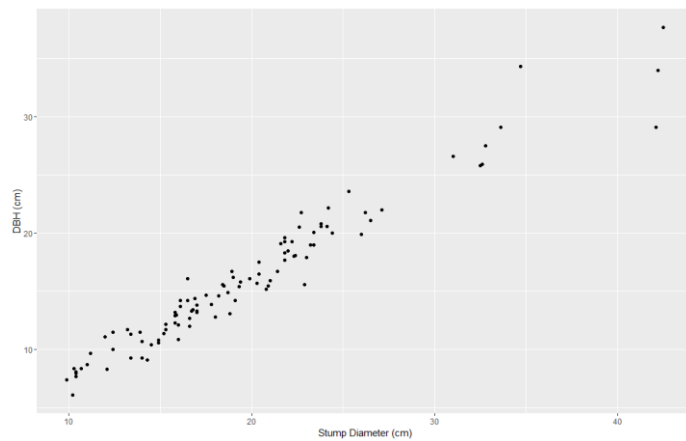
➢ Below graph is showing the checking result for the relationship of bole volume and bole biomass for all samples
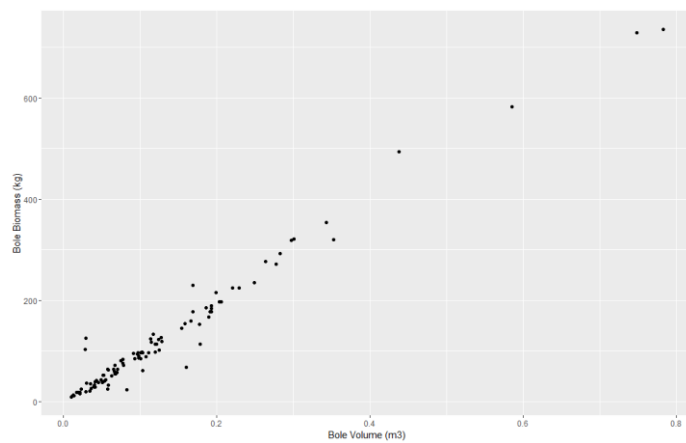
➢ Below graph is showing the checking result for comparing the bigger branch length vs bigger branch biomass
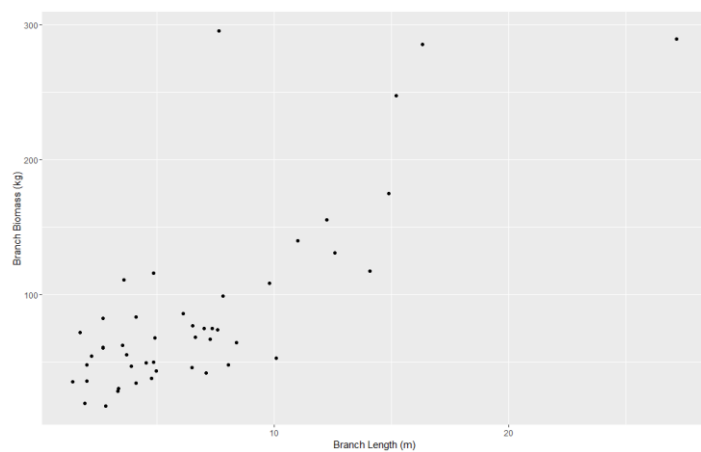
4. Recommendation and next steps

- Dorpbox is shared with data and documents with the participants
- Participants attended in the training will continue the development of R scripts and time to time will share the scripts for checking
- Complete the QA/QC script
- Complete the correction script
- Complete the data analysis script
- Preliminary results will be discussed for further improvement of QA/QC procedure
- A meeting will organised on 26th April 2016 at Dhaka in a small group to discuss about the next steps

Appendix 1.   Participant list

Name	Title	Institution	Contact
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Appendix 2. Agenda

Days	Topic	Participants
Day 1	Presentation of the BFI design and implementation process and data collection procedure	Zaheer Iqbal
	Overview of the status of the field data collected	Falgoonee Mondal
	Comments about the field data	Laurent Saint André
	Presentation of the alometric equation database	Rakibul Hassan Siddiqui
	Presentation of the new allometric equation data collected	Rakibul Hassan Siddiqui
	Identification of clear expected results from data analysis	All
Expected results at the end of the first day: - Full understanding of the process - Full understanding of the different sources of errors - Identification and documentation of the sources of errors		
Day 2	QA/QC procedure	Akhter Hossain
	Presentation of the QA/QC database and preliminary analysis	Gael Sola (Skype) and Akhter Hossain
	Identification of potential errors to be modified	Laurent Saint André
	Correction of data when possible	Falgoonee, Akhter Hossain, Tarik Aziz
	Preliminary results to be obtained	All
Expected result at the end of the second day: - revised database - preliminary results obtained		
Day 3	Review of the allometric equation database	Laurent Saint André
	Proposed process for the selection of allometric equation	Rakibul Hassan Siddiqui
	Preparation of a script of selection of allometric equations	Rakibul Hassan Siddiqui
	Overview of the field data collected for the allometric equation development	Rakibul Hassan Siddiqui
	Comments on the data collected	Laurent Saint-André
	Preparation of the data for the data analysis	Rakibul Hassan Siddiqui
	Preliminary models presented and obtained	All
Expected result at the end of the third day: - Procedure for the selection of allometric equation identified - Collected field data verified - Draft models prepared		
Day 4		
	Overview of the structure of the script for the data analysis	Laurent Saint-André
	Script preparation	All
Expected results at the end of the fourth day: - Script - Preliminary results		
Day 5		Laurent Saint-André
	Script preparation	
	Review of the results obtained	
	Identification of the next steps	
Expected results at the end of the fourth day: - Script - Preliminary results		

Appendix 3: Evaluation

		Frequency	Percentage
1	Gender Distribution		
	Male	3	75%
	Female	1	25%
2	Organization		
	Institute of Forestry and Environmental Sciences Chittagong University, Forestry and Environmental Science, Shahjalal University of Science and Technology ,BFD		
3	How often do you participate in training related to forest Inventory data analysis?		
	First time	0	0%
	1-3 every year	4	100%
	More than 3 per year	0	0%
	Regularly (approximately one per month)	0	0%
4	I would describe myself as?		
	A professor/academic	2	50%
	A student	1	25%
	Forest Department staff	1	25%
	Government staff (outside Forest Department)	0	0%
	NGO staff	0	0%
	Private consultant	0	0%
	Other	0	0%
5	My professional background relates most closely to:	TRUE	
	Forestry	3	75%
	GIS/RS	1	25%
	Statistics	0	0%
	Social survey/assessment	1	25%
	Economics	0	0%
	Natural Resource Management	1	25%
	Ecology	1	25%
	other	0	0%
6	My years of relevant experience is:		
	1-2 years	2	50%
	3-5 years	0	0%
	5-7 years	1	25%
	8-10 years	1	25%
	More than 10 years	0	0%

7	What was your skill level prior to training		
	No skill	0	0%
	Poor level of skill	1	25%
	moderate level of skill	3	75%
	Good level of skill	0	0%
	Excellent	0	0%
8	The training was relevant to my daily work		0%
	Strongly agree	3	75%
	Agree	1	25%
	Neutral	0	0%
	Disagree	0	0%
	Strongly disagree	0	0%
9	I had enough previous knowledge to understand the content of the event		0%
	Strongly agree	1	25%
	Agree	1	25%
	Neutral	2	50%
	Disagree	0	0%
	Strongly disagree	0	0%
10	The training met my expectations in terms of the content and learning outcomes		
	Strongly agree	0	0%
	Agree	4	100%
	Neutral	0	0%
	Disagree	0	0%
	Strongly disagree	0	0%
11	The learning resources provided were adequate and useful		
	Strongly agree	4	100%
	Agree	0	0%
	Neutral	0	0%
	Disagree	0	0%
	Strongly disagree	0	0%
12	The resource persons presented information in a way that was understandable and was easy to follow		
	Strongly agree	3	75%
	Agree	1	25%
	Neutral	0	0%
	Disagree	0	0%
	Strongly disagree	0	0%
13	The event was well organised and I was pleased with		

	the venue/snacks etc		
	Strongly agree	2	50%
	Agree	2	50%
	Neutral	0	0%
	Disagree	0	0%
	Strongly disagree	0	0%
14	Are there other people/agencies/organisations that you think should have been included in the next workshop?		
	BFRI		
15	Any other comments?		
	Not Applicable		
16	What are your recommendations for improving data analysis?		
	Share the parameters and methods in front of experts through a national workshop		
17	What are the constraints to take into account in order to ensure your implications in the short and long term in this process?		
	Time limitations and other jobs		