



Proceedings of training on sample-based estimations for the Bangladesh Forest Inventory



Bangladesh Forest Department
13 - 17 May 2018



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

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

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

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

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Disclaimer

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

Executive summary

The Forest Department in association with FAO and Silvacarbon organized a five day training program on sample-based estimation techniques for the Bangladesh Forest Inventory (BFI).

The objective of the training was to develop the mean and variance estimations necessary for reporting BFI data to national and international organizations. Another major objective was to train staff about the statistical background of sample-based estimations so that they can understand how to confidently report BFI statistics to stakeholders. Fifteen staff participated to the training which was conducted by Chip Scott from SilvaCarbon and Luca Birigazzi from FAO.

Different options were discussed for preparing reporting tables with SilvaMetricus, Evalidator or other software which will be useful for those who do not have R skills. Mr Scott developed spreadsheet which allowed calculations of basal area by BFI Zones and districts. Mr. Birigazzi developed an R code list for practicing calculation of tree basal area of rural settlement by zone with variance and confidence interval. The tool can be used for other variables and for reference in the future as participants continue to practice with BFI data. Total 17 participants (13 Male and 4 female) attended the training.

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1 INTRODUCTION

Field work of Bangladesh forest inventory started in November 2016 to collect data regarding forest resources, biomass measurement and the volume of wood available in the country. BFI is using latest technological advances in field of forest inventory. The entire country is divided into 5 different zones and 1858 plots have been selected by using pre-stratified systematic sampling.

The Bangladesh Forest Inventory (BFI) will provide estimations on a number of forest attributes (e.g. biomass, volume, soil carbon, etc.) to a variety of stakeholders. For example, BFD provides estimates for several forest resources characteristics including forest biomass and carbon stocks to national and international reporting frameworks. It is crucial that the estimations be robust and credible, following established probabilistic statistical techniques that are common in any national forest inventory.

The training was attended by 7 Forest Department officials, 8 FAO officials and 2 specialists sponsored by SilvaCarbon.

2 OBJECTIVES

1. To train staff on the statistical background of sample-based estimations in NFI's
2. To provide preliminary mean and variance estimates of basal area by country, BFI Zones, and Districts in MS Excel
3. To train staff on using R programming for calculating mean and variance estimates
4. To compare the estimates calculated in both MS Excel and R as a check on both approaches
5. To provide options on programs, software, and platforms for summarizing the data into tables for reporting purposes.

3 ACTIVITIES

3.1 1st Session: Introductory Session, 13 May 2018

This session included an overview of the status and progress of the BFI, including missing data in the CHT region. However, the main focus was on discussing the peculiarities of BFI plot data and how to accommodate them in the calculations. Mr Scott found some errors in the data that were reported as he was preparing materials for the training. Other major observations were:

- If post-stratification is desired, then it was decided to use level 3 of the LCCS classification system to experiment with first. This can be changed later.
- This workshop will focus on making basic tables of basal area by Country, Zone, and Division. However, a comprehensive list of all potential table needed (e.g. FRA indicators) would also be helpful.
- The “ratio-to-size” estimator is preferred for all variances with the exception of ratio estimates (e.g. basal area per area mangrove) across strata. The document “Estimation Using Ratio-to-Size Estimator Across Strata and Subpopulations” prepared by Mr Scott explains these nuances.

3.2 2nd Session: Training on sample-based statistics and use of the MS Excel spreadsheet tool, 14 May 2018

Major observations of this day:

- There is a mistake that some of the subplot areas are not correctly recorded. As a result, the total sum of area proportions does not add to 1. These should be fixed, which will also fix the problem of negative variances.
- To add another attribute to the tool, just insert a column into the Data table and Codes table under the Variables name.
- In the areas tab, and Cover Class table (level3) the areas are wrong. They should be updated by overlaying the land cover map on the zone map.
- The land cover class of the BFI data (nlcl) do not match those of the map.

3.3 3rd Session: Continued training, discussion on software options, 15 May 2018

On this day, the estimations of basal area were finalized. Some of these preliminary results are given in the table below. These are very useful to give an idea of how this process should work when providing official statistics to other countries. The day also included a discussion about options that could be used for forest managers to summarize data in tables without using R. Each of the options discussed requires some extra work to adapt the software to BFI data.

The options include:

- Silva Metricus
- Evalidator
- R with Shiny
- Open Foris Calc

						Sampling Error % (95	Sampling Error % (95	Sampling		
Total	Total	Total	None	Basal Area	4.97114	0.061336	0.940045	0.015039	5.288195	0.062027
Coastal	Total	Total	None	Basal Area	9.769043	0.196826	0.98747	0.011113	9.892999	0.198011
Hill	Total	Total	None	Basal Area	5.878788	0.095572	0.985479	0.006745	5.965413	0.095576
Sal	Total	Total	None	Basal Area	5.993107	0.158853	0.984469	0.014555	6.087652	0.15843
Sundarbar	Total	Total	None	Basal Area	23.07009	0.055403	0.997842	0.004204	23.11998	0.055206
Villages	Total	Total	None	Basal Area	3.32778	0.106147	0.923162	0.020651	3.604761	0.106286

3.4 4th Session: Programming statistics in R, 16-17 May 2018

These days were dedicated to training staff to program the statistics learned during the previous days in R. Mr. Birigazzi developed a R-script following the ratio-to-size estimators of Mr Scott for calculating the variance and confidence interval. Mr. Birigazzi explained the basic parameters and principles of calculations in the ratio-to-size estimators. Then the participants, with the given data, practiced variance and confidence interval calculations for basal area of Rural Settlement domain by village zone. More work is needed on the R-script for more automatization of the variance calculations in order to get variances for multiple strata in one table.

The session also included a discussion on status of existing allometric equations, decision tree and necessity of having R-program for applying the decision tree. It was decided to have a dedicated R-script only for selection of the potential allometric equations.

Table: A part of data used for practicing variance calculation in R

plot_plot_id	location_zone	y_h_i_d	x_h_i_d	a_h_i	p_h_i
1	Villages	0.412849257	0.453645979	0.453645979	1
2	Villages	1.352542153	0.209988471	0.340234484	0.6171875
3	Villages	2.316950753	0.141764368	0.453645979	0.3125
4	Villages	2.106840699	0.567057474	0.567057474	1
5	Villages	1.961381355	0.113411495	0.113411495	1

Table: A portion of code used for calculating variance for area of rural settlement domain of village zone in R

```
#-----#
# Estimate the variance and confidence interval for area #
# of RS in the villages zone #
#-----#
#and CONFIDENCE INTERVAL! 0.2346
sum(dataV$x_h_i_d)/sum(dataV$a_h_i)

#total area of RS in the villages #villages area = 10895454
0.2347*10895454 # 2557163 ha of villages are RS
n=nrow(dataV)
p_d=sum(dataV$x_h_i_d)/sum(dataV$a_h_i)
var=(n/(n-1))*
(sum(dataV$x_h_i_d^2)-2*p_d*sum(dataV$x_h_i_d*dataV$a_h_i)+
p_d^2*sum(dataV$a_h_i^2))/sum(dataV$a_h_i)^2
```

4 RECOMMENDATION FOR NEXT STEPS

Some final recommendations for follow up activities were given on the 13 May as follows:

1. Overlay level3 with zones to get areas and proportions
2. Redo the BFI estimation demo with updated level3 areas
3. Compare current BFI results with FRIED for variances, cost per plot and time on plot
4. Develop method for calculating at variables (e.g. litter, soils, leaf cover) at lf, subplot, or plot levels; leaf cover is at subplot level.
5. More RIMS training could be conducted in the future on statistics and R programming
6. Decide exactly what table outputs are needed and how to create them. Make a list of FRA indicators, IPCC, etc.
7. Check partially sampled subplots with imagery ... can we use them?
8. Create R scripts for 7 tables
9. Correct / clean data, e.g. some missing NLCL, x-walk NLCL with latest NLRS
10. For managers: Decide if we need to use spreadsheet, Evalidator, or Open Foris Calc
 - If modify EVALIDATOR (Chip)
 - if modify Silva Metricus (Asdrubal Calderon)
 - if Open Foris Calc (FAO training)

5 CONCLUSION

The visit from both Mr. Scott and Mr. Birigazzi was very useful to the BFI program. The excel spreadsheet is a practical tool for understanding estimations based on BFI data by Zone and Division over the whole country. The R programs developed followed this statistical approach consistently and can be easily adapted for other variables. The two training given together in the same week was especially effective.

Appendix 1. Agenda

Agenda for organizing a workshop on 13-17may 2018 at NFI meeting Room on the NFI data processing and planning

Days	Luca	Chip
13 may		
9am to 12pm	Support the review of sample-based estimations (i.e. mean, variance, SD, SE etc.) and uncertainty analysis of the NFI data and Socioeconomic data (with Akhter) in R	Training on design and estimation with Excel using NFI data to RIMS; estimations BY ZONE
1pm to 4pm		
14 may	Support the review of sample-based estimations (i.e. mean, variance, SD, SE etc.) and uncertainty analysis of the NFI data (with Akhter) in R BY ZONE AND DIVISION AND LANDCOVER	Training on design and estimation with Excel using NFI data to RIMS; estimations BY ZONE AND DIVISION AND LANDCOVER
9am to 4pm		Demonstration about SilviMetrica
15 may	Support the review of sample-based estimations (i.e. mean, variance, SD, SE etc.) and uncertainty analysis of the NFI data (with Akhter) in R BY ZONE AND DIVISION AND LANDCOVER	Training on design and estimation with Excel using NFI data to RIMS; estimations BY ZONE AND DIVISION AND LANDCOVER
9am to 12pm		
1 to 4pm	<ol style="list-style-type: none"> 1. Chip: Overall recommendations to BFI for improving sample-based estimations; approaches for dealing with incompletely and partially sampled plots (e.g. plots that cross international borders); Options for software. 2. Kris: Summary and follow up activities 	
16 may	Reviewing the existing decision tree and finally development of a set of tentative decision trees for allometric model selection	CHIP DEPARTS
17 may	Luca: Overall recommendations to BFI for improving sample-based estimations; approaches for sample based estimations BY DIVISION	

Appendix 2. List of Participants

Name	Gender	Organization	Designation
Mrs. Mariam Akhter	F	Forest Department	Forester
Mr. Tariq Aziz	M	Forest Department	Research Officer
Mr. Md. Babluzzaman	M	Forest Department	Forester
Mr. Touhidor Rahman	M	Forest Department	Forester
Ms. Afroza Begum	F	Forest Department	Research Officer
Mr. Zaheer Iqbal	M	Forest Department	DCF
Ms. Samima Begum Shewli	F	Forest Department	Research Officer
Mr. Luca Birigazzi	M	FAO	Consultant
Purnata Chakma	F	FAO	Intern
Mr. Matieu Henry	M	FAO	CTA
Mr. Akhter Hossain	M	FAO	Consultant
Mr. Mondal Falgoonee Kumar	M	FAO	Consultant
Mr. Rashed Jalal	M	FAO	Consultant
Mr. Kristofer Johnson	M	FAO	Consultant
Mr. Rajib Mahamud	M	FAO	Consultant
Mr. Chip Scott	M	SilvaCarbon	Contracted Consultant
Nathan Thomas	M	NASA	Scientist