Preliminary Analyses of Forest Inventory Data (2013) for Taungoo Forest Division

For

Estimation of Timber Volume, Forest Biomass, Forest Carbon, Number of Trees and Basal Area Distribution

Using

Forest Inventory Data (2013) of Oktwin and Yedashe Townships

And

Forest Cover Change Detection for Taungoo District

Reported by

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May 2015

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Executive Summary

This study estimates the above ground forest biomass, above ground forest carbon, timber volume, basal area and number of trees based on the National Forest Inventory data. The reliability of estimates such as percent margin of errors, percent standard errors and coefficient of variations are provided to the readers who would like to evaluate the quality and reliability of estimates.

This study reports that 1512 tons/ha above ground wood biomass and 756 tons/ha above ground forest carbon at the 5.14% Margin of Error in Taungoo Forest Division based on the Forest Inventory Data (2013) of Yedashe and Oktwin Townships.

This study also reports that 2379 m3/ha timber volume at 4.82% Margin of error and 22 trees/ha at 4.14% Margin of error in Taungoo Forest Division based on the Forest Inventory Data (2013) of Yedashe and Oktwin Townships.

This study recommends future research integrated studies such as Soil Carbon Sampling, Antithetic Sampling for Bole biomass Estimation, Randomized Branch Sampling for estimation branch, leaves twigs and fruit biomass, Allometric Biomass Equation Development for specific species and group of species using generalized linear models and High Carbon Stock (HCS) Vegetation Stratification using Landsat 8 - for reporting at the species level, group of species level and specific diameter class ranges within HCS strata which could be valuable quantitative information for sustainable forest management planning and working planning.

This study informed the detail calculation results as the Appendix for the readers who are interested in the detail result and quality and reliability of estimates.

This study also inform that 1.05 % of annual deforestation rate was occurred in Taungoo District based on the forest cover change detection on the landsat satellite imageries of year 2000, 2005, 2010 and 2014.

The authors would like to thank to the Forest Department for sharing the National Forest Inventory (2013) data for Oktwin and Yedashe Townships and Landsat satellite imageries.

1. Objectives

<u>Objectives</u>

(1) Estimate
- the number of trees specifically (1) trees per hectare, (2) trees per plot, and (3) trees per study area
- the Basal Area specifically (1) Basal Area per hectare, (2) Basal Area per plot, and (3) Basal Area per study area
- the Timber Volume specifically (1) Timber Volume per hectare, (2) Timber Volume per plot, and (3) Timber Volume per study area
- the Above Ground Wood Biomass specifically (1) Above Ground Wood Biomass per hectare, Above Ground Wood Biomass per plot, and (3) Above Ground Wood Biomass per study area
- the Above Ground Forest Carbon specifically (1) Above Ground Forest Carbon per hectare, Above Ground Forest Carbon per plot, (3) Above Ground Forest Carbon per study area
- the historical forest cover of Taungoo District based on Landsat Satellite imageries of year 2000, 2005, 2010 and 2014.

(2) **Provide** the reliability of estimates for each aforementioned estimate - such as % margin of error, % standard error, % coefficient of variation, sample variance and estimated variance for Oktwin Township, Yedarshe Township and combined Oktwin and Yedarshe Township.

2. Scope of the Study

Although the estimates could be derived at the individual species or group of species level, this study derived the estimates for ***all the species together*** in order to develop the methodology, algorithms and R Codes for estimation of resource quantity and reliability of estimates. Moreover, although the estimates could be derived at the reserved level, this study derived the estimates for the township level.

The unit of the study is metric units. The unit of the area is in hectare. The sample plot size is 50 meter radius circular plot which is equivalent to 1.9408 Acre or 0.7854 Ha. The area of Oktwin Township is estimated 164165 hectare. Based on the distribution of inventory plot within Oktwin Township, the study area within Oktwin Township is estimates as 114646 hectare. The area of Yedarshe Township is estimated as 279165 hectare. Based on the distribution of inventory plot within Yedarshe Township, the study area within Yedarshe Township is estimates as 194336 hectare. These areas could be modified using agreed areas from the REDD+ study team of Taungoo Division. This study followed the REDD+ report of Taungoo Study team as 384 Plots in Yedarshe, as 185 Plots in Oktwin, and 569 Plots in both Yedarshe and Oktwin. The total number of plot with Trees in Yedarshe is 315 Plots. Therefore, this study assumed that (384-315= 69) 69 plots in Yedarshe as no tree plots such as Agriculture area. The total number of plots with Trees in Oktwin is 125 plots. Therefore this study assumes that (185-125 = 60) 60 plots in Oktwin as no tree plots such as Agriculture Area. This study takes into account both Trees and No Trees Plots in order to avoid the Statistical Bias.

This study referred the "Tree Volume Equations for Myanmar by J.W.Leech, Aung Kyaw Myint, Shwe Kyaw and Htun Lynn, Yangon March 1990". Trees Volume Equations of Myanmar provided the polynomial regression parameters for estimation of timber volume (cubic meter) from Diameter at Breast Height (DBM in cm) for different group of species at different region of Myanmar. This studied applied the parameters for the Polynomial Regressions in Diameter for Bago Yoma Region. Although volume estimates could be improved including the height measurement, the available data does not contain the tree height information due to its Forest Inventory Field Measurements.

Forest cover change detection for Taungoo District was conducted based on Landsat satellite imageries of year 2000, 2005, 2010 and 2014.

3. Data for the Study

The Taungoo Inventory Data 2013-14 for the trees measurements for **both** below 20 cm (REDD-13-NF (19) and above 20 cm (REDD-13-NF (20cm +) DBH is applied. The records with DBH measurement values zero are removed. There are four records of unidentified species_529 which are recoded as 999 as All Other Species. The data is attached as the **"REDD-19-20plus-nozerodbh-wood-density-biomass-carbon-good-cpno.csv"** which contains 9900 trees in both Yedarshe and Oktwin Townships. Important attributes are as follow.

Attributes	Notes
PlotN	Cluster Plot Number
Township	Townships where the tree is located
DBHMM	DBH in mm
Source	Source of the records from REDD-13 (19) or REDD-13-NF (20cm plus)
EqnGrp	Species groups based on equation parameters (Group-1 to 10)
DBH	DBH in mm (duplicated column of DBHMM)
b0, b1, b2, b3, b4, b5	Parameters of polynomial equations
VOLM3	Volume in cubic meter based on polynomial equations
CPNO	Cluster Plot Number including "CP" text such as CP1 for Plot number 1 and township such as CP1_oktwin
Frequency	1 for each record in order to count the trees – 1 record as 1 tree
SPC	Species code
SPCNEW	Species code but unidentified species are recoded as 999
wd_gpercm3	Wood density gram per cubic cm based on literatures and available published wood density database
wd_kgperm3	Wood density kilogram per cubic meter
AGWB_Kg	Above Ground Wood Biomass in Kilogram
AGWB_Ton	Above Ground Wood Biomass in Metric Ton
AGC_Ton	Above Ground Carbon in Ton (50% of Wood Biomass)
Other attributes	Not important for the present analyses but included as explanatory purposes

The above data is queried by township for the dataset for Oktwin and Yedarshe Townships. The data is attached as **"REDD-19-20plus-nozerodbh-wood-density-biomass-carbon-good-cpno-oktwin.csv"** for Oktwin Township and **"REDD-19-20plus-nozerodbh-wood-density-biomass-carbon-good-cpno-yedashe.csv"** for Yedarshe Township.

Satellite imageries used for Forest Cover Change Detection for Taunggo District.

Satellite	Path/Row (132/47)	Acquisition Date	Path/Row (133/47)	Acquisition Date
Landsat-7	p132r047_7x19991223	December 23, 1999	p133r047_7x19991230	December 30, 1999
Landsat-7	L72132047_04720050206	February 6, 2005	L71133047_04720050213	February 13, 2005
Landsat-7	LE71320472009032EDC00	February 1, 2009	LE71330472009023SGS00	January 23, 2009
Landsat-8	LC81320472014086LGN00	March 27, 2014	LC81330472014045LGN00	February 14, 2014

4. Methodology

4.1 Sampling with Fixed Area Plots

According to the sampling with Fixed Area Plots, the following statistical proration are derived and implemented in R statistics. Sampling Strategies for Natural Resources and the Environment Page 207 to 246 (Gregoire, 2008) is an excellent reference for the following section.

"A" denotes the Area of study area such as a country, reserved forest, forest compartment or plantation etc. A contains m sample plots. The "**a"** denotes the area of a plot. The "y_i" denotes the measurement of individual quantity such as volume, biomass, and basal area of individual tree in the plot.

The population total T_y is derived as $\sum_{i=1}^{n}(yi)$ at the plot level.

The population mean per unit area is $\lambda_i = \sum_{i=1}^{n}(yi)/A$.

Inclusion probability (π) of a tree to a sample plot is derived as a/A. Inclusion zone has the same area of plot but orientation is different. The inclusion zone of circular plots and rectangular plots are straight forward. Therefore circular plots and rectangular plots are more common than other shapes like a star or an ell or a hexagon.

Each cluster plot can provide the independent estimate of population total T_y. Therefore, inclusion probability of individual tree is $\pi_i = a_i/A$.

For the Sth plot, the independent estimate of population could be denote as $\hat{T}_{y\pi s}$ and the estimator is

$$\hat{\tau}_{y\pi s} = \sum_{U_i \in s} \frac{y_i}{\pi_i}.$$

Substituting $\pi_i = a_i/A$ into $\hat{\tau}_{y\pi s}$ yields $\hat{\tau}_{y\pi s} = A \sum_{U_i \in s} \frac{y_i}{a_i}$, which,

barring edge trees, is identical to

$$\hat{\tau}_{y\pi s} = \frac{A}{a}\sum y_i = A\left(\frac{\text{plot total } y_i}{a}\right)$$

where the parenthesized term is the amount of the resource observed on the plot *prorated* to a per unit area (per acre, or per hectare, etc.) basis.

The $\hat{T}_{y\pi s}$ values varies from one plot to another provide the direct empirical evidence of how much the resource varies from one place to another with the study area A.

As there is m of these independent estimates $\hat{T}_{y\pi s}$ where s = 1,2,….m from m plots, average them together to get the unbiased estimator of T_y which will be denoted as $\hat{T}_{y\pi,rep.}$

$$\widehat{\mathcal{T}}_{y\pi,\text{rep}} = \frac{1}{m} \sum_{s=1}^{m} \widehat{\mathcal{T}}_{y\pi s}$$

Sample variance values among the $\widehat{\mathcal{T}}_{y\pi s}$ will be similar to the sample variance S^2_y of other context and it could be derived as follow.

$$s^2_y = \frac{1}{(m-1)} \sum_{s=1}^{m} (\widehat{\mathcal{T}}_{y\pi s} - \widehat{\mathcal{T}}_{y\pi,\text{rep}})^2$$

As the plots are allocated at the simple random sample framework or systematically sufficient far apart to each other that there is no correlation between neighboring plots, the systematic layouts of plots is essentially equivalent to simple random sampling of plots. Therefore unbiased estimator of variance is derived as follow.

$$\widehat{v}(\widehat{\mathcal{T}}_{y\pi,\text{rep}}) = \frac{s^2_y}{m} = \frac{1}{m(m-1)} \sum_{s=1}^{m} (\widehat{\mathcal{T}}_{y\pi s} - \widehat{\mathcal{T}}_{y\pi,\text{rep}})^2$$

For Per Unit Area (density) estimation λ_y, the amount of y per unit area is denoted and estimated as follow.

$$\widehat{\lambda}_{y\pi,\text{rep}} = \widehat{\mathcal{T}}_{y\pi,\text{rep}}/A$$

The variance is estimated as follow,

$$\widehat{v}(\widehat{\lambda}_{y\pi,\text{rep}}) = \frac{1}{A^2} \widehat{v}(\widehat{\mathcal{T}}_{y\pi,\text{rep}})$$

Then the usual statistics is applied to derive the percent coefficient of variation (%CV), standard error percent (SE%), percent coefficient of variation (CV%), upper limit estimate and lower limit estimate based on the $\widehat{\mathcal{T}}_{y\pi,\text{rep}}$, S^2_y, $\widehat{\lambda}_{y\pi,\text{rep}}$, $\widehat{V}(\widehat{\lambda}_{y\pi,\text{rep}})$ and $\widehat{V}(\widehat{\mathcal{T}}_{y\pi,\text{rep}})$. R statistics package is applied to implement the plot sampling statistics for National Forest Inventory and Forest Resources Assessment.

The aforementioned plot sampling theory is implemented using R Statistics to generate the estimates on number trees, basal area and volume. Moreover, this study provided the reliability of estimates.

4.2 Forest Biomass Estimation

The biomass of a tree equals the product of the volume and the density (Ketterings et al., 2001). The volume of the tree is derived using the regression parameters provided by "Tree Volume Equations for Myanmar by J.W.Leech, Aung Kyaw Myint, Shwe Kyaw and Htun Lynn, Yangon March 1990".

The wood density in gram per cm^3 for each individual species is referenced to the available wood density databases from FAO and Wood Density of Tropical Trees Species by Gisel Reyes and Sandra Brown 1992. If a species is found globally, India, China and South East Asia, average wood density at the global, Asia, India and South East Asia level is calculated. Then wood density value to a species is assigned based on the following order of precedence South East Asia, Asia, India and global level.

There are 190 species found at Taungoo 2013 Inventory data. Unfortunately, the wood density data of 8 species are not available through the literature research. The average wood density on Brown (1997) data set is 0.71 gm per cm^3 (Kettering et al., 2001). Brown and Lugo (1984) reported the value of wood density 0.62 gm per cm^3 as the global average for the tropical forests. Brown (1997) (with the data from Reyes et al., 1992) reported an arithmetic mean of 0.57 gm per cm^3 and a range of 0.40 to 0.69 gm per cm^3 based on 428 species in Asia. The average wood density of available species (182 species) in Taungoo Inventory data is 0.5935 gm per cm^3 with the range of (0.57 to 0.62 gm per cm^3) at 95% confidence interval. The average wood density value of 0.5935 gm per cm^3 is assigned to all 8 species which wood density data is unavailable. The average wood density values 0.5935 gm per cm^3 is within the average wood density value range of 428 species of Asia and lower than the global average reported by Brown 1997. The final wood density table is provided as the excel table with references and important reference papers.

The above ground wood dry biomass is calculated by multiplying the volume and wood density. The above ground forest carbon is estimated as the 50% of above ground dry biomass.

4.3 Forest Cover Change Detection

Supervised classification was conducted with Maximum Likelihood classification algorithms. Forest cover change detection was conducted by comparing two time series of satellite images (Year 2000 and 2005, 2005 and 2010, 2010 and 2014). Flow chart of image processing was shown in the flow diagram.
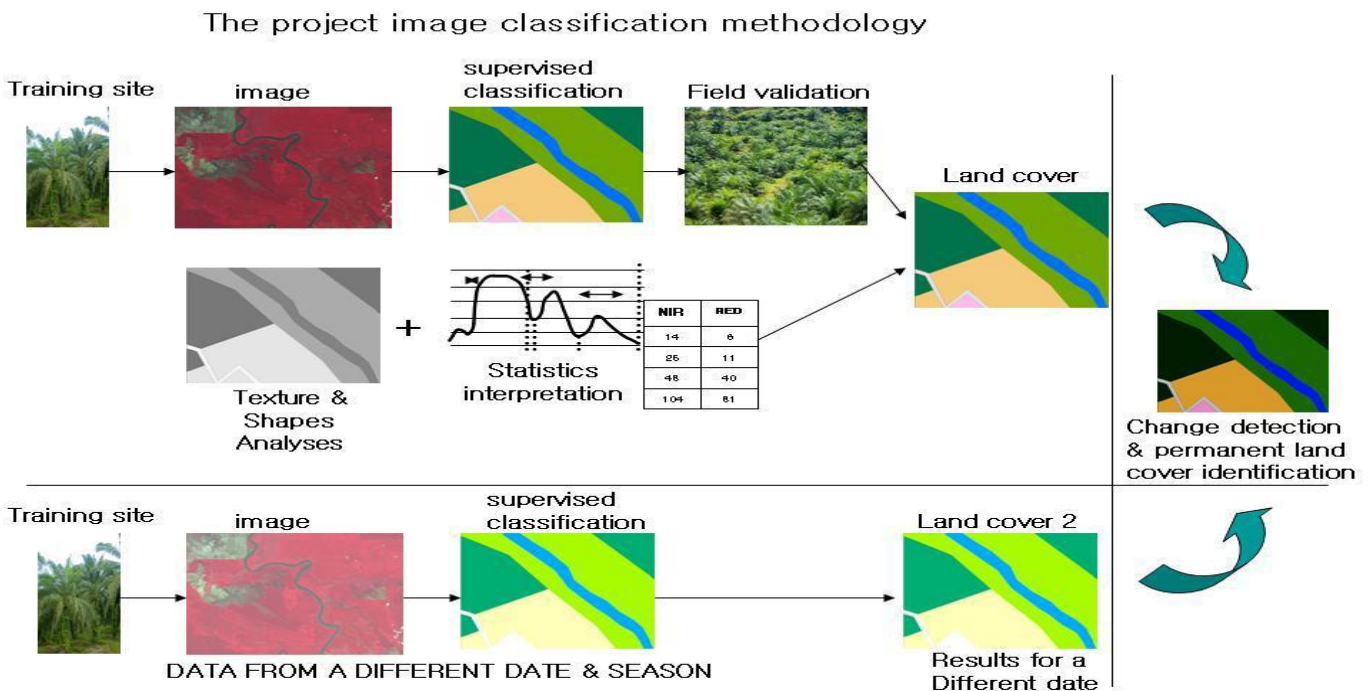
5. Important Summary Result

The following table summarizes the important results - the Timber Volume per Hectare, Basal Area per Hectare, Number of Trees per Hectare, Above Ground Forest Biomass (Metric Tons) per Hectare and Above Ground Forest Carbon (Metric Tons) of resources in Oktwin Township, Yedarshe Township and Combined Oktwin-Yedarshe Township for forest management planning and REDD+ reporting based on Taungoo Forest Inventory 2013 data.

	Lower Limit Volume (m3/ha)	Mean Volume (m3/ha)	Upper Limit Volume (m3/ha)	%MgErr	SE%	CV%
Oktwin	2019	2265	2512	10.89	6.59	89.6
Yedarshe	2309	2433	2558	5.11	3.10	60.73
Oktwin-Yedarshe	2264	2379	2495	4.82	2.93	69.79
	Lower Limit Basal Area (m2/ha)	Mean Basal Area (m2/ha)	Upper Limit Basal Area (m3/ha)	%MgErr	SE%	CV%
Oktwin	1.5	1.71	1.92	12.20	7.38	100.41
Yedarshe	1.39	1.5	1.61	7.14	4.33	84.63
Oktwin-Yedarshe	1.47	1.57	1.67	6.37	3.87	92.25
	Lower Limit Trees/ha	Mean Trees/ha	Upper Limit Trees/ha	%MgErr	SE%	CV%
Oktwin	16	18	20	10.54	6.37	86.68
Yedarshe	23	24	25	4.24	2.57	50.38
Oktwin-Yedarshe	21	22	23	4.14	2.51	59.94
	Lower Limit Above Ground Biomass (Tons/Ha)	Mean Above Ground Biomass (Tons/Ha)	Upper Limit Above Ground Biomass (Tons/Ha)	%MgErr	SE%	CV%
Oktwin	1297.86	1469.45	1641.03	11.68	7.06	96.07
Yedarshe	1450.154	1532.481	1614.807	5.37	3.25	63.85
Oktwin-Yedarshe	1434.25	1511.987	1589.725	**5.14**	3.12	74.44
	Lower Limit Above Ground Carbon (Tons/Ha)	Mean Above Ground Carbon (Tons/Ha)	Upper Limit Above Ground Carbon (Tons/Ha)	%MgErr	SE%	CV%
Oktwin	648.93	734.72	820.52	11.68	7.06	96.07
Yedarshe	725.08	766.24	807.40	5.37	3.25	63.85
Oktwin-Yedarshe	717.12	755.99	794.86	**5.14**	3.12	74.44

The % Margin of error for volume per hectare estimate and trees per hectare estimate for combined Oktwin-Yedarshe Townships is **below 5%.** It is very good measurement for volume estimation assuming that the volume equations are accurate. The 2379 Cubic meter per hectare timber volume and 22 trees per hectare total trees could be safely applied to multiply in order to estimate the timber volume and number of trees estimates within Taungoo Forest Division or similar ecosystem, forest cover and land cover condition.

The % Margin of error for above ground biomass (metric tons per hectare) estimate and above ground forest carbon (metric tons per hectare) estimate for combined Oktwin-Yedarshe Townships is **slightly above the 5%** margin of error at 5.14%. It is very good measurement for above ground forest biomass

and above ground forest carbon estimation assuming that the volume equations are accurate. The 1512 tons per hectare above ground forest biomass and 756 tons per hectare above ground forest carbon could be safely applied to multiply in order to estimate the above ground forest biomass and forest carbon within Taungoo Forest Division or similar ecosystem, forest cover and land cover condition.

The detail calculations results for estimations of resources such as trees, basal area, timber volume, above ground forest biomass and above ground forest carbon for the plot level, per hectare level and study area level are reported as the Appendix-A: Detail Calculation Summary Results. The Appendix-A could be quantitative tables for the readers who are interested in detail calculation results and quality of calculation.

1.05% of annual deforestation rate was occurred in Taungoo District between years 2000 to 2014. This historical data can be used in future research of REDD+ project. 2.2% of annual defor rate was occurred between 2000 and 2005. 0.79% of annual defor rate was occurred between 2005 and 2010. 1.66% of annual defor rate was occurred between 2010 and 2014.

6. Recommendation

6.1 Tree Height Measurement

Volume equations applied diameter as the predictor variable to estimate the volume as the response variable without using the tree bole height because neither bole heights nor total heights had been recorded for all the trees on each inventory plot in Taungoo 2013 data. For the future inventory, the total height, the height to the lowest branch, the merchantable height should be measured.

6.2 Height Diameter Relationship

Moreover, the height and diameter relationships for species or group of species should be developed.

6.3 Antithetic Sampling and Randomized Branch Sampling (RBS)

Although wood density data from global database and reference literatures could be derived for estimation of biomass, it is only accounted biomass of wood or timber. It does not account the biomass of branches, twigs, leaves and fruits. Randomized Branch Sampling and Antithetic Sampling is recommended for more accurate estimation of biomass of bole, branches, twigs, leaves and fruits. Minimum 30~50 trees per species should be sampled using antithetic sampling and RBS sampling. Diameter and height relationship, diameter, height and volume relationship, diameter, height and biomass relationship, volume and biomass relationship, and biomass and carbon relationship should be created using the generalized linear regression models.

6.4 High Carbon Stock (HCS) vegetation Stratification

The vegetation should be stratified based on the High Carbon Stock (HCS) vegetation strategies using Landsat 8 remote sensing data within the study area. The following HCS stratification is recommended to derive from the Landsat 8 remotely sensed satellite data.

HCS	HCS Definition by HCS Forest Study
HK3	Remnant forest or advanced secondary forest close to primary condition

HK2	Remnant forest but more disturbed than High Density Forest
HK1	Appears to be remnant forest but highly disturbed and recovering (may contain plantation/mixed garden)
BT	Mostly young re-growth forest, but with occasional patches of older forest within the stratum
BM	Recently cleared areas, some woody re-growth and grass-like ground cover
LT	Very recently cleared land with mostly grass or crops, few woody plants

The forest biomass and forest carbon could be estimated based on the sample plots that fall to each HCS strata.

6.5 Species, Group of Species and Diameter Classes

The present study focused all species and all diameter classes as a single entity for estimation for the plot level, per hectare level and study area level such as township or combined townships.

The estimation for each species or group of species within a series of diameter classes within HCS strata could be estimated and it is recommended to do so for sustainable forest management planning and REDD+ MRV reporting using the same data set. The local and standard volume table, forest biomass tables and forest carbon tables could be constructed for the forest management planning and REDD+ Reporting.

6.6 Soil Carbon

The soil Auger or Profile sampling should be considered for estimation of soil carbon in the future Forest Inventory and REDD+ data collection

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8. Appendix-A: Detail Calculation Summary Results

8. 1 Above Ground Wood Biomass Estimates for Oktwin Township

The following table reports the above ground biomass (metric tons) estimate in Oktwin Township at the plot level, per hectare level and Oktwin Township study area level.

Plot Level Biomass Estimate for Oktwin Township	Definition_biomass_plot	Estimates_biomass_plot
T_cap_y_pi_rep_tot_biomass_par_plot	Estimated total biomass per plot	1154.10
s_square_y_tot_biomass_par_plot	Sample variance of total biomass among plots	1229325.25
v_cap_T_cap_y_pi_rep_tot_biomass_par_plot	Estimated variance of total biomass based on the plots	6645.00
mg_err_percent_tot_biomass_par_plot	Margin of error (%) of total biomass at plot level	11.68
min_tot_biomass_par_plot	Lower limit of estimate at 95 % confidence interval	1019.34
max_tot_biomass_par_plot	Upper limit of estimate at 95 % confidence interval	1288.87
cv_percent_tot_biomass_par_plot	Percent coefficient of variation	96.07
std_err_percent_tot_biomass_par_plot	Standard error percent	7.06
Biomass Per Ha Estimate for Oktwin Township	**Definition_biomass_per_hec**	**Estimates_biomass_per_hec**
Lamda_cap_y_pi_rep_tot_biomass_per_hec	Estimated total biomass per hectare	1469.45
s_square_y_lamda_cap_y_pi_rep_tot_biomass_per_he	Sample variance of total biomass per hectare	1992897.72
v_cap_lamda_cap_y_pi_rep_tot_biomass_per_hec	Estimated variance of total biomass per hectare	10772.42
mg_err_percent_tot_biomass_per_hec	Margin of error (%) of total biomass per hectare	11.68
lower_tot_biomass_per_hec_lamda	lower limit of biomass per hectare	1297.86
upper_tot_biomass_per_hec_lamda	upper limit of biomass per hectare	1641.03
cv_percent_tot_biomass_per_hac	Percent coefficient of variation	96.07
std_err_percent_tot_biomass_per_hec	Standard error percent	7.06
Total Biomass Estimate for Oktwin Township	**Definition_biomass_prorate_to_Big_A**	**Estimates_biomass_prorate_to_Big_A**
T_cap_y_pi_rep_tot_biomass_prorate_to_Big_A	Estimated total biomass proration to Big A	168466392.72
s_square_y_tot_biomass_prorate_to_Big_A	Sample variance of total biomass of trees among Big A pr	26194060323960100.00
v_cap_T_cap_y_pi_rep_tot_biomass_prorate_to_Big_A	Estimated variance of total biomass based on Big A prora	141589515264650.00
mg_err_percent_tot_biomass_prorate_to_Big_A	Margin of error (%) of total biomass at Big A proration plo	11.68
min_tot_biomass_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	148795008.33
max_tot_biomass_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	188137777.12
cv_percent_tot_biomass_prorate_to_Big_A	Percent coefficient of variation	96.07
std_err_percent_tot_biomass_prorate_to_Big_A	Standard error percent	7.06

8.2 Above Ground Wood Biomass Estimates for Yedarshe Township

The following table reports the above ground biomass (metric tons) estimate in Yedashe Township at the plot level, per hectare level and Yedashe Township study area level.

Plot Level Biomass Estimate of Yedashe Township	Definition_biomass_plot	Estimates_biomass_plot
T_cap_y_pi_rep_tot_biomass_par_plot	Estimated total biomass per plot	1203.61
s_square_y_tot_biomass_par_plot	Sample variance of total biomass among plots	590515.00
v_cap_T_cap_y_pi_rep_tot_biomass_par_plot	Estimated variance of total biomass based on the plots	1537.80
mg_err_percent_tot_biomass_par_plot	Margin of error (%) of total biomass at plot level	5.37
min_tot_biomass_par_plot	Lower limit of estimate at 95 % confidence interval	1138.95
max_tot_biomass_par_plot	Upper limit of estimate at 95 % confidence interval	1268.27
cv_percent_tot_biomass_par_plot	Percent coefficient of variation	63.85
std_err_percent_tot_biomass_par_plot	Standard error percent	3.26
Biomass Per Ha Estimate of Yedashe Township	Definition_biomass_per_hec	Estimates_biomass_per_hec
Lamda_cap_y_pi_rep_tot_biomass_per_hec	Estimated total biomass per hectare	1532.48
s_square_y_lamda_cap_y_pi_rep_tot_biomass_per_he	Sample variance of total biomass per hectare	957302.38
v_cap_lamda_cap_y_pi_rep_tot_biomass_per_hec	Estimated variance of total biomass per hectare	2492.97
mg_err_percent_tot_biomass_per_hec	Margin of error (%) of total biomass per hectare	5.37
lower_tot_biomass_per_hec_lamda	lower limit of biomass per hectare	1450.15
upper_tot_biomass_per_hec_lamda	upper limit of biomass per hectare	1614.81
cv_percent_tot_biomass_per_hac	Percent coefficient of variation	63.85
std_err_percent_tot_biomass_per_hec	Standard error percent	3.26
Total Biomass Estimate for Yedarshe Township	Definition_biomass_prorate_to_Big_A	Estimates_biomass_prorate_to_Big_A
T_cap_y_pi_rep_tot_biomass_prorate_to_Big_A	Estimated total biomass proration to Big A	297816138.12
s_square_y_tot_biomass_prorate_to_Big_A	Sample variance of total biomass of trees among Big A pr	36153941898491300.00
v_cap_T_cap_y_pi_rep_tot_biomass_prorate_to_Big_A	Estimated variance of total biomass based on Big A prorat	94150890360654.50
mg_err_percent_tot_biomass_prorate_to_Big_A	Margin of error (%) of total biomass at Big A proration plo	5.37
min_tot_biomass_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	281817197.97
max_tot_biomass_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	313815078.28
cv_percent_tot_biomass_prorate_to_Big_A	Percent coefficient of variation	63.85
std_err_percent_tot_biomass_prorate_to_Big_A	Standard error percent	3.26

8.3 Above Ground Wood Biomass Estimates for Combined Yedarshe and Oktwin Townships

The following table reports the above ground biomass (metric tons) estimate in combined Oktwin and Yedashe Townships at the plot level, per hectare level and combined Oktwin Yedashe Townships study area level.

Plot level Biomass Estimate for Yedarshe and Oktwin Townships	Definition_biomass_plot	Estimates_biomass_plot
T_cap_y_pi_rep_tot_biomass_par_plot	Estimated total biomass per plot	1187.51
s_square_y_tot_biomass_par_plot	Sample variance of total biomass among plots	781429.93
v_cap_T_cap_y_pi_rep_tot_biomass_par_plot	Estimated variance of total biomass based on the plots	1373.34
mg_err_percent_tot_biomass_par_plot	Margin of error (%) of total biomass at plot level	5.14
min_tot_biomass_par_plot	Lower limit of estimate at 95 % confidence interval	1126.46
max_tot_biomass_par_plot	Upper limit of estimate at 95 % confidence interval	1248.57
cv_percent_tot_biomass_par_plot	Percent coefficient of variation	74.44
std_err_percent_tot_biomass_par_plot	Standard error percent	3.12
Biomass Per Ha Estimate for Yedashe and Oktwin Townships	**Definition_biomass_per_hec**	**Estimates_biomass_per_hec**
Lamda_cap_y_pi_rep_tot_biomass_per_hec	Estimated total biomass per hectare	1511.99
s_square_y_lamda_cap_y_pi_rep_tot_biomass_per_hec	Sample variance of total biomass per hectare	1266800.56
v_cap_lamda_cap_y_pi_rep_tot_biomass_per_hec	Estimated variance of total biomass per hectare	2226.36
mg_err_percent_tot_biomass_per_hec	Margin of error (%) of total biomass per hectare	5.14
lower_tot_biomass_per_hec_lamda	lower limit of biomass per hectare	1434.25
upper_tot_biomass_per_hec_lamda	upper limit of biomass per hectare	1589.72
cv_percent_tot_biomass_per_hac	Percent coefficient of variation	74.44
std_err_percent_tot_biomass_per_hec	Standard error percent	3.12
Total Biomass Estimate for Yedashe and Oktwin Townships	**Definition_biomass_prorate_to_Big_A**	**Estimates_biomass_prorate_to_Big_A**
T_cap_y_pi_rep_tot_biomass_prorate_to_Big_A	Estimated total biomass proration to Big A	467176711.11
s_square_y_tot_biomass_prorate_to_Big_A	Sample variance of total biomass of trees among Big A pr	120941293224053000.00
v_cap_T_cap_y_pi_rep_tot_biomass_prorate_to_Big_A	Estimated variance of total biomass based on Big A prorat	212550603205719.00
mg_err_percent_tot_biomass_prorate_to_Big_A	Margin of error (%) of total biomass at Big A proration plo	5.14
min_tot_biomass_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	443157024.88
max_tot_biomass_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	491196397.34
cv_percent_tot_biomass_prorate_to_Big_A	Percent coefficient of variation	74.44
std_err_percent_tot_biomass_prorate_to_Big_A	Standard error percent	3.12

8.4 Above Ground Forest Carbon Estimates for Oktwin Township

The following table reports the above ground forest carbon (metric tons) estimate in Oktwin Township at the plot level, per hectare level and Oktwin Township study area level.

Plot Level Above Ground Forest Carbon Estimate for Oktwin	Definition_carbon_plot	Estimates_carbon_plot
T_cap_y_pi_rep_tot_carbon_par_plot	Estimated total carbon per plot	577.0524259
s_square_y_tot_carbon_par_plot	Sample variance of total carbon among plots	307331.3137
v_cap_T_cap_y_pi_rep_tot_carbon_par_plot	Estimated variance of total carbon based on the plots	1661.250344
mg_err_percent_tot_carbon_par_plot	Margin of error (%) of total carbon at plot level	11.67674103
min_tot_carbon_par_plot	Lower limit of estimate at 95 % confidence interval	509.6715086
max_tot_carbon_par_plot	Upper limit of estimate at 95 % confidence interval	644.4333433
cv_percent_tot_carbon_par_plot	Percent coefficient of variation	96.07007617
std_err_percent_tot_carbon_par_plot	Standard error percent	7.063212474
Above ground Forest Carbon Per Ha Estimate for Oktwin	Definition_carbon_per_hec	Estimates_carbon_per_hec
Lamda_cap_y_pi_rep_tot_carbon_per_hec	Estimated total carbon per hectare	734.72425
s_square_y_lamda_cap_y_pi_rep_tot_carbon_per_hec	Sample variance of total carbon per hectare	498224.4294
v_cap_lamda_cap_y_pi_rep_tot_carbon_per_hec	Estimated variance of total carbon per hectare	2693.105024
mg_err_percent_tot_carbon_per_hec	Margin of error (%) of total carbon per hectare	11.67674103
lower_tot_carbon_per_hec_lamda	lower limit of carbon per hectare	648.932402
upper_tot_carbon_per_hec_lamda	upper limit of carbon per hectare	820.5160979
cv_percent_tot_carbon_per_hac	Percent coefficient of variation	96.07007617
std_err_percent_tot_carbon_per_hec	Standard error percent	7.063212474
Total Above Ground Forest Carbon for Oktwin	Definition_carbon_prorate_to_Big_A	Estimates_carbon_prorate_to_Big_A
T_cap_y_pi_rep_tot_carbon_prorate_to_Big_A	Estimated total carbon proration to Big A	84233196.36
s_square_y_tot_carbon_prorate_to_Big_A	Sample variance of total carbon of trees among Big A pr	6.54852E+15
v_cap_T_cap_y_pi_rep_tot_carbon_prorate_to_Big_A	Estimated variance of total carbon based on Big A prorat	3.53974E+13
mg_err_percent_tot_carbon_prorate_to_Big_A	Margin of error (%) of total carbon at Big A proration plc	11.67674103
min_tot_carbon_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	74397504.16
max_tot_carbon_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	94068888.56
cv_percent_tot_carbon_prorate_to_Big_A	Percent coefficient of variation	96.07007617
std_err_percent_tot_carbon_prorate_to_Big_A	Standard error percent	7.063212474

8.5 Above Ground Forest Carbon Estimates for Yedashe Township

The following table reports the above ground forest carbon (metric tons) estimate in Yedarshe Township at the plot level, per hectare level and Yedashe Township study area level.

Plot Level Above Ground Forest carbon Estimate for Yedashe	Definition_carbon_plot	Estimates_carbon_plot
T_cap_y_pi_rep_tot_carbon_par_plot	Estimated total carbon per plot	601.81
s_square_y_tot_carbon_par_plot	Sample variance of total carbon among plots	147628.75
v_cap_T_cap_y_pi_rep_tot_carbon_par_plot	Estimated variance of total carbon based on the plots	384.45
mg_err_percent_tot_carbon_par_plot	Margin of error (%) of total carbon at plot level	5.37
min_tot_carbon_par_plot	Lower limit of estimate at 95 % confidence interval	569.48
max_tot_carbon_par_plot	Upper limit of estimate at 95 % confidence interval	634.13
cv_percent_tot_carbon_par_plot	Percent coefficient of variation	63.85
std_err_percent_tot_carbon_par_plot	Standard error percent	3.26
Above Ground Forest Carbon Per Ha for Yedashe	**Definition_carbon_per_hec**	**Estimates_carbon_per_hec**
Lamda_cap_y_pi_rep_tot_carbon_per_hec	Estimated total carbon per hectare	766.24
s_square_y_lamda_cap_y_pi_rep_tot_carbon_per_hec	Sample variance of total carbon per hectare	239325.59
v_cap_lamda_cap_y_pi_rep_tot_carbon_per_hec	Estimated variance of total carbon per hectare	623.24
mg_err_percent_tot_carbon_per_hec	Margin of error (%) of total carbon per hectare	5.37
lower_tot_carbon_per_hec_lamda	lower limit of carbon per hectare	725.08
upper_tot_carbon_per_hec_lamda	upper limit of carbon per hectare	807.40
cv_percent_tot_carbon_per_hac	Percent coefficient of variation	63.85
std_err_percent_tot_carbon_per_hec	Standard error percent	3.26
Total Above Ground Forest Carbon Estimate for Yedashe	**Definition_carbon_prorate_to_Big_A**	**Estimates_carbon_prorate_to_Big_A**
T_cap_y_pi_rep_tot_carbon_prorate_to_Big_A	Estimated total carbon proration to Big A	148908069.06
s_square_y_tot_carbon_prorate_to_Big_A	Sample variance of total carbon of trees among Big A proration plots	9038485474622830.00
v_cap_T_cap_y_pi_rep_tot_carbon_prorate_to_Big_A	Estimated variance of total carbon based on Big A proration plots	23537722590163.60
mg_err_percent_tot_carbon_prorate_to_Big_A	Margin of error (%) of total carbon at Big A proration plots	5.37
min_tot_carbon_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	140908598.99
max_tot_carbon_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	156907539.14
cv_percent_tot_carbon_prorate_to_Big_A	Percent coefficient of variation	63.85
std_err_percent_tot_carbon_prorate_to_Big_A	Standard error percent	3.26

8.6 Above Ground Forest Carbon Estimates for Combined Yedarshe and Oktwin Townships

The following table reports the above ground forest carbon (metric tons) estimate in combined Oktwin and Yedashe Townships at the plot level, per hectare level and combined Oktwin Yedashe Townships study area level.

Plot Level Above Ground Forest Carbon Estimate for Oktwin and Yedashe Townships	Definition_carbon_plot	Estimates_carbon_plot
T_cap_y_pi_rep_tot_carbon_par_plot	Estimated total carbon per plot	593.76
s_square_y_tot_carbon_par_plot	Sample variance of total carbon among plots	195357.48
v_cap_T_cap_y_pi_rep_tot_carbon_par_plot	Estimated variance of total carbon based on the plots	343.33
mg_err_percent_tot_carbon_par_plot	Margin of error (%) of total carbon at plot level	5.14
min_tot_carbon_par_plot	Lower limit of estimate at 95 % confidence interval	563.23
max_tot_carbon_par_plot	Upper limit of estimate at 95 % confidence interval	624.28
cv_percent_tot_carbon_par_plot	Percent coefficient of variation	74.44
std_err_percent_tot_carbon_par_plot	Standard error percent	3.12
Above Ground Forest Carbon Per Ha Estimate for Oktwin and Yedashe Townships	Definition_carbon_per_hec	Estimates_carbon_per_hec
Lamda_cap_y_pi_rep_tot_carbon_per_hec	Estimated total carbon per hectare	755.99
s_square_y_lamda_cap_y_pi_rep_tot_carbon_per_hec	Sample variance of total carbon per hectare	316700.14
v_cap_lamda_cap_y_pi_rep_tot_carbon_per_hec	Estimated variance of total carbon per hectare	556.59
mg_err_percent_tot_carbon_per_hec	Margin of error (%) of total carbon per hectare	5.14
lower_tot_carbon_per_hec_lamda	lower limit of carbon per hectare	717.12
upper_tot_carbon_per_hec_lamda	upper limit of carbon per hectare	794.86
cv_percent_tot_carbon_per_hac	Percent coefficient of variation	74.44
std_err_percent_tot_carbon_per_hec	Standard error percent	3.12
Total Above Ground Forest Carbon Estimate for Oktwin and Yedarshe Townships	Definition_carbon_prorate_to_Big_A	Estimates_carbon_prorate_to_Big_A
T_cap_y_pi_rep_tot_carbon_prorate_to_Big_A	Estimated total carbon proration to Big A	233588355.56
s_square_y_tot_carbon_prorate_to_Big_A	Sample variance of total carbon of trees among Big A pr	30235323306013400.00
v_cap_T_cap_y_pi_rep_tot_carbon_prorate_to_Big_A	Estimated variance of total carbon based on Big A prora	53137650801429.60
mg_err_percent_tot_carbon_prorate_to_Big_A	Margin of error (%) of total carbon at Big A proration plo	5.14
min_tot_carbon_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	221578512.44
max_tot_carbon_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	245598198.67
cv_percent_tot_carbon_prorate_to_Big_A	Percent coefficient of variation	74.44
std_err_percent_tot_carbon_prorate_to_Big_A	Standard error percent	3.12

8.7 Number of Tree Estimates for Oktwin Township

The following table reports the number of trees estimate in Oktwin Township at the plot level, per hectare level and Oktwin Township study area level.

Plot Level Estimates for Oktwin Township		
Symbol_numtree_plot	Definition_numtree_plot	Estimates_numtree_plot
T_cap_y_pi_rep_tot_numtree_par_plot	Estimated total number of trees per plot	14.14
s_square_y_tot_numtree_par_plot	Sample variance of total number of trees among plots	150.12
v_cap_T_cap_y_pi_rep_tot_numtree_par_plot	Estimated variance of total number of trees based on the plots	0.81
mg_err_percent_tot_numtree_par_plot	Margin of error (%) of total number of trees at plot level	10.54
min_tot_numtree_par_plot	Lower limit of estimate at 95 % confidence interval	12.65
max_tot_numtree_par_plot	Upper limit of estimate at 95 % confidence interval	15.62
cv_percent_tot_numtree_par_plot	Percent coefficient of variation	86.68
std_err_percent_tot_numtree_par_plot	Standard error percent	6.37
Per Hecater Estimates for Oktwin Township		
Symbol_numtree_per_hec	Definition_numtree_per_hec	Estimates_numtree_per_hec
Lamda_cap_y_pi_rep_tot_numtree_per_hec	Estimated number of trees per hectare	18.00
s_square_y_lamda_cap_y_pi_rep_tot_numtree_per_hec	Sample variance of total number of trees per hectare	243.37
v_cap_lamda_cap_y_pi_rep_tot_numtree_per_hec	Estimated variance of total number of trees per hectare	1.32
mg_err_percent_tot_numtree_per_hec	Margin of error (%) of total number of trees per hectare	10.54
lower_tot_numtree_per_hec_lamda	lower limit of number of trees per hectare	16.10
upper_tot_numtree_per_hec_lamda	upper limit of number of trees per hectare	19.89
cv_percent_tot_numtree_per_hac	Percent coefficient of variation	86.68
std_err_percent_tot_numtree_per_hec	Standard error percent	6.37
Symbol_numtree_BigA for Oktwin Township	Definition_numtree_BigA	Estimates_numtree_BigA
T_cap_y_pi_rep_tot_numtree_prorate_to_Big_A	Estimated total number of trees proration to Big A	2063326.59
s_square_y_tot_numtree_prorate_to_Big_A	Sample variance of total number of trees among Big A proration plots	3198762832433.97
v_cap_T_cap_y_pi_rep_tot_numtree_prorate_to_Big_A	Estimated variance of total number of trees based on Big A proration plots	17290609905.05
mg_err_percent_tot_numtree_prorate_to_Big_A	Margin of error (%) of total number of trees at Big A proration plots	10.54
min_tot_numtree_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	1845944.11
max_tot_numtree_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	2280709.07
cv_percent_tot_numtree_prorate_to_Big_A	Percent coefficient of variation	86.68
std_err_percent_tot_numtree_prorate_to_Big_A	Standard error percent	6.37

Based on this table, we could estimate or expect 14 trees (lower limit 12, upper limit 16 trees) at plot level in Oktwin, 18 trees per hectare (lower limit 16, upper limit 20) in Oktwin and total 2063327 trees (lower limit 1845944, upper limit 2280709) within Oktwin Study Area at 95% Confidence Interval. The reliability of estimates - the % standard error is 6.37% and % Margin of error is 10.54% throughout the Plot Level, Per Hectare Level and Study Area Township level consistently. The % Coefficient Variation is 86.68% which could be very useful for future designing for REDD+ data collection at the National Scale. The reliability of estimates for number of trees is very high and indicating high quality data.

8.8 Number of Tree Estimates for Yedarshe Township

The following table reports the number of trees estimate in Yedarshe Township at the plot level, per hectare level and Oktwin Township study area level.

Symbol_numtree_plot for Yedarshe Township	Definition_numtree_plot	Estimates_numtree_plot
T_cap_y_pi_rep_tot_numtree_par_plot	Estimated total number of trees per plot	18.97
s_square_y_tot_numtree_par_plot	Sample variance of total number of trees among plots	91.37
v_cap_T_cap_y_pi_rep_tot_numtree_par_plot	Estimated variance of total number of trees based on the plots	0.24
mg_err_percent_tot_numtree_par_plot	Margin of error (%) of total number of trees at plot level	4.24
min_tot_numtree_par_plot	Lower limit of estimate at 95 % confidence interval	18.17
max_tot_numtree_par_plot	Upper limit of estimate at 95 % confidence interval	19.78
cv_percent_tot_numtree_par_plot	Percent coefficient of variation	50.38
std_err_percent_tot_numtree_par_plot	Standard error percent	2.57
Symbol_numtree_per_hec for Yedarshe Township	Definition_numtree_per_hec	Estimates_numtree_per_hec
Lamda_cap_y_pi_rep_tot_numtree_per_hec	Estimated number of trees per hectare	24.16
s_square_y_lamda_cap_y_pi_rep_tot_numtree_per_hec	Sample variance of total number of trees per hectare	148.12
v_cap_lamda_cap_y_pi_rep_tot_numtree_per_hec	Estimated variance of total number of trees per hectare	0.39
mg_err_percent_tot_numtree_per_hec	Margin of error (%) of total number of trees per hectare	4.24
lower_tot_numtree_per_hec_lamda	lower limit of number of trees per hectare	23.13
upper_tot_numtree_per_hec_lamda	upper limit of number of trees per hectare	25.18
cv_percent_tot_numtree_per_hac	Percent coefficient of variation	50.38
std_err_percent_tot_numtree_per_hec	Standard error percent	2.57
Symbol_numtree_BigA for Yedarshe Township	Definition_numtree_BigA	Estimates_numtree_BigA
T_cap_y_pi_rep_tot_numtree_prorate_to_Big_A	Estimated total number of trees proration to Big A	4694190.33
s_square_y_tot_numtree_prorate_to_Big_A	Sample variance of total number of trees among Big A proration plots	5593830286623.82
v_cap_T_cap_y_pi_rep_tot_numtree_prorate_to_Big_A	Estimated variance of total number of trees based on Big A proration plots	14567266371.42
mg_err_percent_tot_numtree_prorate_to_Big_A	Margin of error (%) of total number of trees at Big A proration plots	4.24
min_tot_numtree_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	4495183.48
max_tot_numtree_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	4893197.18
cv_percent_tot_numtree_prorate_to_Big_A	Percent coefficient of variation	50.38
std_err_percent_tot_numtree_prorate_to_Big_A	Standard error percent	2.57

Based on this table, we could estimate or expect 19 trees (lower limit 18, upper limit 20 trees) at plot level in Yedarshe, 24 trees per hectare (lower limit 23, upper limit 25) in Yedarshe and total 4694190 trees (lower limit 4491583, upper limit 4893189) within Yedarshe Study Area at 95% Confidence Interval. The reliability of estimates - the % standard error is 2.57% and % Margin of error is 4.24% throughout the Plot Level, Per Hectare Level and Study Area Township level consistently. The % Coefficient Variation is 50.38% which could be very useful for future designing for REDD+ data collection at the National Scale. The reliability of estimates for number of trees is very high and indicating high quality data.

8.9 Number of Tree Estimates for Combined Oktwin and Yedarshe Townships

The following table reports the number of trees estimate in Combined Oktwin and Yedarshe Townships at the plot level, per hectare level and Oktwin and Yedarshe Townships study area level. This result could be applied for estimation of Taungoo District.

Symbol_numtree_plot for Oktwin_Yedarshe Combined	Definition_numtree_plot	Estimates_numtree_plot
T_cap_y_pi_rep_tot_numtree_par_plot	Estimated total number of trees per plot	17.40
s_square_y_tot_numtree_par_plot	Sample variance of total number of trees among plots	108.75
v_cap_T_cap_y_pi_rep_tot_numtree_par_plot	Estimated variance of total number of trees based on the plots	0.19
mg_err_percent_tot_numtree_par_plot	Margin of error (%) of total number of trees at plot level	4.14
min_tot_numtree_par_plot	Lower limit of estimate at 95 % confidence interval	16.68
max_tot_numtree_par_plot	Upper limit of estimate at 95 % confidence interval	18.12
cv_percent_tot_numtree_par_plot	Percent coefficient of variation	59.94
std_err_percent_tot_numtree_par_plot	Standard error percent	2.51
Symbol_numtree_per_hec for Oktwin_Yedarshe Combined	Definition_numtree_per_hec	Estimates_numtree_per_hec
Lamda_cap_y_pi_rep_tot_numtree_per_hec	Estimated number of trees per hectare	22.15
s_square_y_lamda_cap_y_pi_rep_tot_numtree_per_hec	Sample variance of total number of trees per hectare	176.29
v_cap_lamda_cap_y_pi_rep_tot_numtree_per_hec	Estimated variance of total number of trees per hectare	0.31
mg_err_percent_tot_numtree_per_hec	Margin of error (%) of total number of trees per hectare	4.14
lower_tot_numtree_per_hec_lamda	lower limit of number of trees per hectare	21.24
upper_tot_numtree_per_hec_lamda	upper limit of number of trees per hectare	23.07
cv_percent_tot_numtree_per_hac	Percent coefficient of variation	59.94
std_err_percent_tot_numtree_per_hec	Standard error percent	2.51
Symbol_numtree_BigA for Oktwin_Yedarshe Combined	Definition_numtree_BigA	Estimates_numtree_BigA
T_cap_y_pi_rep_tot_numtree_prorate_to_Big_A	Estimated total number of trees proration to Big A	6844870.11
s_square_y_tot_numtree_prorate_to_Big_A	Sample variance of total number of trees among Big A proration plots	16830710912106.50
v_cap_T_cap_y_pi_rep_tot_numtree_prorate_to_Big_A	Estimated variance of total number of trees based on Big A proration plots	29579456787.53
mg_err_percent_tot_numtree_prorate_to_Big_A	Margin of error (%) of total number of trees at Big A proration plots	4.14
min_tot_numtree_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	6561514.86
max_tot_numtree_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	7128225.35
cv_percent_tot_numtree_prorate_to_Big_A	Percent coefficient of variation	59.94
std_err_percent_tot_numtree_prorate_to_Big_A	Standard error percent	2.51

Based on this table, we could estimate or expect 17 trees (lower limit 16, upper limit 18 trees) at plot level in Oktwin-Yedarshe (Taungoo Division), 22 trees per hectare (lower limit 21, upper limit 23) in Oktwin-Yedarshe (Taungoo Division) and total 6844870 trees (lower limit 6561515, upper limit 7128225) within Oktwin-Yedarshe (Taungoo Division) Study Area at 95% Confidence Interval. The reliability of estimates - the % standard error is 2.51% and % Margin of error is 4.14% throughout the Plot Level, Per Hectare Level and Study Area Township level consistently. The % Coefficient Variation is 59.94% which could be very useful for future designing for REDD+ data collection at the National Scale. The reliability of estimates for number of trees is very high and indicating high quality data.

8.10 Basal Area Estimates for Oktwin Township

The following table reports the basal area (meter square) estimate in Oktwin Township at the plot level, per hectare level and Oktwin Township study area level.

Symbol_ba_plot for Oktwin Township	Definition_ba_plot	Estimates_ba_plot
T_cap_y_pi_rep_tot_ba_par_plot	Estimated total number of basel area per plot	1.34
s_square_y_tot_ba_par_plot	Sample variance of total number of basel area among plots	1.82
v_cap_T_cap_y_pi_rep_tot_ba_par_plot	Estimated variance of total number of basel area based on the plots	0.01
mg_err_percent_tot_ba_par_plot	Margin of error (%) of total number of basel area at plot level	12.20
min_tot_ba_par_plot	Lower limit of estimate at 95 % confidence interval	1.18
max_tot_ba_par_plot	Upper limit of estimate at 95 % confidence interval	1.51
cv_percent_tot_ba_par_plot	Percent coefficient of variation	100.41
std_err_percent_tot_ba_par_plot	Standard error percent	7.38
Symbol_ba_per_hec for Oktwin Township	Definition_ba_per_hec	Estimates_ba_per_hec
Lamda_cap_y_pi_rep_tot_ba_per_hec	Estimated basel area of trees per hectare	1.71
s_square_y_lamda_cap_y_pi_rep_tot_ba_per_hec	Sample variance of total basel area of trees per hectare	2.96
v_cap_lamda_cap_y_pi_rep_tot_ba_per_hec	Estimated variance of total basel area of trees per hectare	0.02
mg_err_percent_tot_ba_per_hec	Margin of error (%) of total basel area of trees per hectare	12.20
lower_tot_ba_per_hec_lamda	lower limit of basel area of trees per hectare	1.50
upper_tot_ba_per_hec_lamda	upper limit of basel area of trees per hectare	1.92
cv_percent_tot_ba_per_hac	Percent coefficient of variation	100.41
std_err_percent_tot_ba_per_hec	Standard error percent	7.38
Symbol_ba_prorate_to_Big_A for Oktwin Township	Definition_ba_prorate_to_Big_A	Estimates_ba_prorate_to_Big_A
T_cap_y_pi_rep_tot_ba_prorate_to_Big_A	Estimated total number of basel area proration to Big A	196315.83
s_square_y_tot_ba_prorate_to_Big_A	Sample variance of total basel area of trees among Big A proration plots	38853216097.87
v_cap_T_cap_y_pi_rep_tot_ba_prorate_to_Big_A	Estimated variance of total basel area of trees based on Big A proration plots	210017384.31
mg_err_percent_tot_ba_prorate_to_Big_A	Margin of error (%) of total basel area of trees at Big A proration plots	12.20
min_tot_ba_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	172358.03
max_tot_ba_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	220273.64
cv_percent_tot_ba_prorate_to_Big_A	Percent coefficient of variation	100.41
std_err_percent_tot_ba_prorate_to_Big_A	Standard error percent	7.38

Based on this table, we could estimate or expect basal area 1.34 m^2 (lower limit 1.18, upper limit 1.51 m^2) at plot level in Oktwin, 1.71 m^2 per hectare (lower limit 1.5, upper limit 1.92 m^2 /ha) in Oktwin and total 196315 m^2 (lower limit 172358, upper limit 220273 m^2) within Oktwin Study Area at 95% Confidence Interval. The reliability of estimates - the % standard error is 7.38% and % Margin of error is 12.20% throughout the Plot Level, Per Hectare Level and Study Area Township level consistently. The % Coefficient Variation is 100.41% which could be very useful for future designing for REDD+ data collection at the National Scale. The reliability of estimates for number of trees is very high and indicating high quality data.

8.11 Basal Area Estimates for Yedarshe Township

The following table reports the number of Basal Area estimate in Yedarshe Township at the plot level, per hectare level and Oktwin Township study area level.

Symbol_ba_plot for Yedarshe Township	Definition_ba_plot	Estimates_ba_plot
T_cap_y_pi_rep_tot_ba_par_plot	Estimated total number of basel area per plot	1.18
s_square_y_tot_ba_par_plot	Sample variance of total number of basel area among plots	1.00
v_cap_T_cap_y_pi_rep_tot_ba_par_plot	Estimated variance of total number of basel area based on the plots	0.00
mg_err_percent_tot_ba_par_plot	Margin of error (%) of total number of basel area at plot level	7.14
min_tot_ba_par_plot	Lower limit of estimate at 95 % confidence interval	1.09
max_tot_ba_par_plot	Upper limit of estimate at 95 % confidence interval	1.26
cv_percent_tot_ba_par_plot	Percent coefficient of variation	84.83
std_err_percent_tot_ba_par_plot	Standard error percent	4.33
Symbol_ba_per_hec for Yedarshe Township	Definition_ba_per_hec	Estimates_ba_per_hec
Lamda_cap_y_pi_rep_tot_ba_per_hec	Estimated basel area of trees per hectare	1.50
s_square_y_lamda_cap_y_pi_rep_tot_ba_per_hec	Sample variance of total basel area of trees per hectare	1.62
v_cap_lamda_cap_y_pi_rep_tot_ba_per_hec	Estimated variance of total basel area of trees per hectare	0.00
mg_err_percent_tot_ba_per_hec	Margin of error (%) of total basel area of trees per hectare	7.14
lower_tot_ba_per_hec_lamda	lower limit of basel area of trees per hectare	1.39
upper_tot_ba_per_hec_lamda	upper limit of basel area of trees per hectare	1.61
cv_percent_tot_ba_per_hac	Percent coefficient of variation	84.83
std_err_percent_tot_ba_per_hec	Standard error percent	4.33
Symbol_ba_prorate_to_Big_A for Yedarshe Township	Definition_ba_prorate_to_Big_A	Estimates_ba_prorate_to_Big_A
T_cap_y_pi_rep_tot_ba_prorate_to_Big_A	Estimated total number of basel area proration to Big A	291279.89
s_square_y_tot_ba_prorate_to_Big_A	Sample variance of total basel area of trees among Big A proration plots	61055026110.63
v_cap_T_cap_y_pi_rep_tot_ba_prorate_to_Big_A	Estimated variance of total basel area of trees based on Big A proration plots	158997463.83
mg_err_percent_tot_ba_prorate_to_Big_A	Margin of error (%) of total basel area of trees at Big A proration plots	7.14
min_tot_ba_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	270488.95
max_tot_ba_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	312070.82
cv_percent_tot_ba_prorate_to_Big_A	Percent coefficient of variation	84.83
std_err_percent_tot_ba_prorate_to_Big_A	Standard error percent	4.33

Based on this table, we could estimate or expect basal area 1.18 m^2 (lower limit 1.09, upper limit 1.62 m^2) at plot level in Yedarshe, 1.0 m^2 per hectare (lower limit 1.39, upper limit 1.61 m^2/Ha) in Yedarshe and total 291280 m^2 (lower limit 270489, upper limit 312071 m^2) within Yedarshe Study Area at 95% Confidence Interval. The reliability of estimates - the % standard error is 4.33% and % Margin of error is 7.14% throughout the Plot Level, Per Hectare Level and Study Area Township level consistently. The % Coefficient Variation is 84.83% which could be very useful for future designing for REDD+ data collection at the National Scale. The reliability of estimates for number of trees is very high and indicating high quality data.

8.12 Basal Area Estimates for Combined Oktwin and Yedarshe Townships

The following table reports the Basal Area estimate in Combined Oktwin and Yedarshe Townships at the plot level, per hectare level and Oktwin and Yedarshe Townships study area level. This result could be applied for estimation of Taungoo District.

Symbol_ba_plot for Combined Oktwin-Yedarshe Townships	Definition_ba_plot	Estimates_ba_plot
T_cap_y_pi_rep_tot_ba_par_plot	Estimated total number of basel area per plot	1.23
s_square_y_tot_ba_par_plot	Sample variance of total number of basel area among plots	1.29
v_cap_T_cap_y_pi_rep_tot_ba_par_plot	Estimated variance of total number of basel area based on the plots	0.00
mg_err_percent_tot_ba_par_plot	Margin of error (%) of total number of basel area at plot level	6.37
min_tot_ba_par_plot	Lower limit of estimate at 95 % confidence interval	1.15
max_tot_ba_par_plot	Upper limit of estimate at 95 % confidence interval	1.31
cv_percent_tot_ba_par_plot	Percent coefficient of variation	92.25
std_err_percent_tot_ba_par_plot	Standard error percent	3.87
Symbol_ba_per_hec for Combined Oktwin-Yedarshe Townships	Definition_ba_per_hec	Estimates_ba_per_hec
Lamda_cap_y_pi_rep_tot_ba_per_hec	Estimated basel area of trees per hectare	1.57
s_square_y_lamda_cap_y_pi_rep_tot_ba_per_hec	Sample variance of total basel area of trees per hectare	2.09
v_cap_lamda_cap_y_pi_rep_tot_ba_per_hec	Estimated variance of total basel area of trees per hectare	0.00
mg_err_percent_tot_ba_per_hec	Margin of error (%) of total basel area of trees per hectare	6.37
lower_tot_ba_per_hec_lamda	lower limit of basel area of trees per hectare	1.47
upper_tot_ba_per_hec_lamda	upper limit of basel area of trees per hectare	1.67
cv_percent_tot_ba_per_hac	Percent coefficient of variation	92.25
std_err_percent_tot_ba_per_hec	Standard error percent	3.87
Symbol_ba_prorate_to_Big_A for Combined Oktwin-Yedarshe Townships	Definition_ba_prorate_to_Big_A	Estimates_ba_prorate_to_Big_A
T_cap_y_pi_rep_tot_ba_prorate_to_Big_A	Estimated total number of basel area proration to Big A	484566.72
s_square_y_tot_ba_prorate_to_Big_A	Sample variance of total basel area of trees among Big A proration plots	199839263265.20
v_cap_T_cap_y_pi_rep_tot_ba_prorate_to_Big_A	Estimated variance of total basel area of trees based on Big A proration plots	351211358.99
mg_err_percent_tot_ba_prorate_to_Big_A	Margin of error (%) of total basel area of trees at Big A proration plots	6.37
min_tot_ba_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	453690.76
max_tot_ba_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	515442.68
cv_percent_tot_ba_prorate_to_Big_A	Percent coefficient of variation	92.25
std_err_percent_tot_ba_prorate_to_Big_A	Standard error percent	3.87

Based on this table, we could estimate or expect basal area 1.23 m^2 (lower limit 1.15, upper limit 1.31 m^2) at plot level in Oktwin-Yedarshe (Taungoo Division), 1.57 m^2 per hectare (lower limit 1.47, upper limit 1.67 m^2/Ha) in Oktwin-Yedarshe (Taungoo Division) and total 484567 m^2 (lower limit 453691, upper limit 515443 m^2) within Oktwin-Yedarshe (Taungoo Division) Study Area at 95% Confidence Interval. The reliability of estimates - the % standard error is 3.87% and % Margin of error is 6.37% throughout the Plot Level, Per Hectare Level and Study Area Township level consistently. The % Coefficient Variation is 92.25% which could be very useful for future designing for REDD+ data collection at the National Scale. The reliability of estimates for number of trees is very high and indicating high quality data.

8.13 Volume Estimates for Oktwin Township

The following table reports the volume (cubic meter) estimate in Oktwin Township at the plot level, per hectare level and Oktwin Township study area level.

Symbol_volume_plot for Oktwin Township	Definition_volume_plot	Estimates_volume_plot
T_cap_y_pi_rep_tot_volume_par_plot	Estimated total volume per plot	1779.33
s_square_y_tot_volume_par_plot	Sample variance of total volume among plots	2541758.56
v_cap_T_cap_y_pi_rep_tot_volume_par_plot	Estimated variance of total volume based on the plots	13739.24
mg_err_percent_tot_volume_par_plot	Margin of error (%) of total volume at plot level	10.89
min_tot_volume_par_plot	Lower limit of estimate at 95 % confidence interval	1585.56
max_tot_volume_par_plot	Upper limit of estimate at 95 % confidence interval	1973.11
cv_percent_tot_volume_par_plot	Percent coefficient of variation	89.60
std_err_percent_tot_volume_par_plot	Standard error percent	6.59
Symbol_volume_per_hec for Oktwin Township	Definition_volume_per_hec	Estimates_volume_per_hec
Lamda_cap_y_pi_rep_tot_volume_per_hec	Estimated total volume per hectare	2265.51
s_square_y_lamda_cap_y_pi_rep_tot_volume_per_hec	Sample variance of total volume per hectare	4120524.50
v_cap_lamda_cap_y_pi_rep_tot_volume_per_hec	Estimated variance of total volume per hectare	22273.11
mg_err_percent_tot_volume_per_hec	Margin of error (%) of total volume per hectare	10.89
lower_tot_volume_per_hec_lamda	lower limit of volume per hectare	2018.79
upper_tot_volume_per_hec_lamda	upper limit of volume per hectare	2512.24
cv_percent_tot_volume_per_hac	Percent coefficient of variation	89.60
std_err_percent_tot_volume_per_hec	Standard error percent	6.59
Symbol_volume_prorate_to_Big_A for Oktwin Township	Definition_volume_prorate_to_Big_A	Estimates_volume_prorate_to_Big_A
T_cap_y_pi_rep_tot_volume_prorate_to_Big_A	Estimated total volume proration to Big A	259732146.07
s_square_y_tot_volume_prorate_to_Big_A	Sample variance of total volume of trees among Big A proration plots	54158959802924600.00
v_cap_T_cap_y_pi_rep_tot_volume_prorate_to_Big_A	Estimated variance of total volume based on Big A proration plots	292751134069863.00
mg_err_percent_tot_volume_prorate_to_Big_A	Margin of error (%) of total volume at Big A proration plots	10.89
min_tot_volume_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	231446332.76
max_tot_volume_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	288017959.37
cv_percent_tot_volume_prorate_to_Big_A	Percent coefficient of variation	89.60
std_err_percent_tot_volume_prorate_to_Big_A	Standard error percent	6.59

Based on this table, we could estimate or expect timber volume 1779 m^3 (lower limit 1586, upper limit 1973 m^3) at plot level in Oktwin, 2266 m^3 per hectare (lower limit 2019, upper limit 2512 m^3/Ha) in Oktwin and total 259732146 m^3 (lower limit 231446333, upper limit 288017959 m^3) within Oktwin Study Area at 95% Confidence Interval. The reliability of estimates - the % standard error is 6.59% and % Margin of error is 10.89% throughout the Plot Level, Per Hectare Level and Study Area Township level consistently. The % Coefficient Variation is 89.6% which could be very useful for future designing for REDD+ data collection at the National Scale. The reliability of estimates for number of trees is very high and indicating high quality data.

8.14 Volume Estimates for Yedarshe Township

The following table reports the volume (cubic meter) estimate in Yedarshe Township at the plot level, per hectare level and Oktwin Township study area level.

Symbol_volume_plot for Yedarshe Township	Definition_volume_plot	Estimates_volume_plot
T_cap_y_pi_rep_tot_volume_par_plot	Estimated total volume per plot	1911.16
s_square_y_tot_volume_par_plot	Sample variance of total volume among plots	1347178.75
v_cap_T_cap_y_pi_rep_tot_volume_par_plot	Estimated variance of total volume based on the plots	3508.28
mg_err_percent_tot_volume_par_plot	Margin of error (%) of total volume at plot level	5.11
min_tot_volume_par_plot	Lower limit of estimate at 95 % confidence interval	1813.50
max_tot_volume_par_plot	Upper limit of estimate at 95 % confidence interval	2008.82
cv_percent_tot_volume_par_plot	Percent coefficient of variation	60.73
std_err_percent_tot_volume_par_plot	Standard error percent	3.10
Symbol_volume_per_hec for Yedatshe Township	Definition_volume_per_hec	Estimates_volume_per_hec
Lamda_cap_y_pi_rep_tot_volume_per_hec	Estimated total volume per hectare	2433.36
s_square_y_lamda_cap_y_pi_rep_tot_volume_per_hec	Sample variance of total volume per hectare	2183953.71
v_cap_lamda_cap_y_pi_rep_tot_volume_per_hec	Estimated variance of total volume per hectare	5687.38
mg_err_percent_tot_volume_per_hec	Margin of error (%) of total volume per hectare	5.11
lower_tot_volume_per_hec_lamda	lower limit of volume per hectare	2309.01
upper_tot_volume_per_hec_lamda	upper limit of volume per hectare	2557.71
cv_percent_tot_volume_per_hac	Percent coefficient of variation	60.73
std_err_percent_tot_volume_per_hec	Standard error percent	3.10
Symbol_volume_prorate_to_Big_A for Yedarshe Township	Definition_volume_prorate_to_Big_A	Estimates_volume_prorate_to_Big_A
T_cap_y_pi_rep_tot_volume_prorate_to_Big_A	Estimated total volume proration to Big A	472889407.72
s_square_y_tot_volume_prorate_to_Big_A	Sample variance of total volume of trees among Big A proration plots	82480246004728300.00
v_cap_T_cap_y_pi_rep_tot_volume_prorate_to_Big_A	Estimated variance of total volume based on Big A proration plots	214792307303980.00
mg_err_percent_tot_volume_prorate_to_Big_A	Margin of error (%) of total volume at Big A proration plots	5.11
min_tot_volume_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	448724320.90
max_tot_volume_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	497054494.54
cv_percent_tot_volume_prorate_to_Big_A	Percent coefficient of variation	60.73
std_err_percent_tot_volume_prorate_to_Big_A	Standard error percent	3.10

Based on this table, we could estimate or expect timber volume 1911 m^3 (lower limit 1814, upper limit 2009 m^3) at plot level in Yedarshe, 2433 m^3 Per Hectare (lower limit 2309, upper limit 2558 m^3/Ha) in Yedarshe and total 472889408 m^3 (lower limit 448724321, upper limit 497054495 m^3) within Yedarshe Study Area at 95% Confidence Interval. The reliability of estimates - the % standard error is 3.10% and % Margin of error is 5.11% throughout the Plot Level, Per Hectare Level and Study Area Township level consistently. The % Coefficient Variation is 60.73% which could be very useful for future designing for REDD+ data collection at the National Scale. The reliability of estimates for number of trees is very high and indicating high quality data.

8.15 Volume Estimates for Combined Oktwin and Yedarshe Townships

The following table reports the volume estimate in Combined Oktwin and Yedarshe Townships at the plot level, per hectare level and Oktwin and Yedarshe Townships study area level. This result could be applied for estimation of Taungoo District.

Symbol_volume_plot for Combined Oktwin-Yedarshe Townships	Definition_volume_plot	Estimates_volume_plot
T_cap_y_pi_rep_tot_volume_par_plot	Estimated total volume per plot	1868.30
s_square_y_tot_volume_par_plot	Sample variance of total volume among plots	1700322.75
v_cap_T_cap_y_pi_rep_tot_volume_par_plot	Estimated variance of total volume based on the plots	2988.26
mg_err_percent_tot_volume_par_plot	Margin of error (%) of total volume at plot level	4.82
min_tot_volume_par_plot	Lower limit of estimate at 95 % confidence interval	1778.24
max_tot_volume_par_plot	Upper limit of estimate at 95 % confidence interval	1958.36
cv_percent_tot_volume_par_plot	Percent coefficient of variation	69.79
std_err_percent_tot_volume_par_plot	Standard error percent	2.93
Symbol_volume_per_hec for Combined Oktwin-Yedarshe Townships	Definition_volume_per_hec	Estimates_volume_per_hec
Lamda_cap_y_pi_rep_tot_volume_per_hec	Estimated total volume per hectare	2378.79
s_square_y_lamda_cap_y_pi_rep_tot_volume_per_hec	Sample variance of total volume per hectare	2756446.53
v_cap_lamda_cap_y_pi_rep_tot_volume_per_hec	Estimated variance of total volume per hectare	4844.37
mg_err_percent_tot_volume_per_hec	Margin of error (%) of total volume per hectare	4.82
lower_tot_volume_per_hec_lamda	lower limit of volume per hectare	2264.12
upper_tot_volume_per_hec_lamda	upper limit of volume per hectare	2493.46
cv_percent_tot_volume_per_hac	Percent coefficient of variation	69.79
std_err_percent_tot_volume_per_hec	Standard error percent	2.93
Symbol_volume_prorate_to_Big_A for Combined Oktwin-Yedarshe Townships	Definition_volume_prorate_to_Big_A	Estimates_volume_prorate_to_Big_A
T_cap_y_pi_rep_tot_volume_prorate_to_Big_A	Estimated total volume proration to Big A	735002631.31
s_square_y_tot_volume_prorate_to_Big_A	Sample variance of total volume of trees among Big A proration plots	2631576608997463000.00
v_cap_T_cap_y_pi_rep_tot_volume_prorate_to_Big_A	Estimated variance of total volume based on Big A proration plots	462491404213468.00
mg_err_percent_tot_volume_prorate_to_Big_A	Margin of error (%) of total volume at Big A proration plots	4.82
min_tot_volume_prorate_to_Big_A	Lower limit of estimate at 95 % confidence interval	699571257.52
max_tot_volume_prorate_to_Big_A	Upper limit of estimate at 95 % confidence interval	770434005.10
cv_percent_tot_volume_prorate_to_Big_A	Percent coefficient of variation	69.79
std_err_percent_tot_volume_prorate_to_Big_A	Standard error percent	2.93

Based on this table, we could estimate or expect timber volume 1868 m^3 (lower limit 1778, upper limit 1958 m^3) at plot level in Oktwin-Yedarshe (Taungoo Division), 2379 m^3 Per Hectare (lower limit 2264, upper limit 2493 m^3/Ha) in Oktwin-Yedarshe (Taungoo Division) and total 735002631 m^3 (lower limit 699571258, upper limit 770434005 m^3) within Oktwin-Yedarshe (Taungoo Division) Study Area at 95% Confidence Interval. The reliability of estimates - the % standard error is 2.93% and % Margin of error is 4.82% throughout the Plot Level, Per Hectare Level and Study Area Township level consistently. The % Coefficient Variation is 69.79% which could be very useful for future designing for REDD+ data collection at the National Scale. The reliability of estimates for number of trees is very high and indicating high quality data.

8.16 Historical Forest Cover in Taungoo District
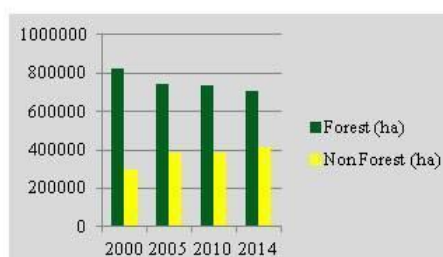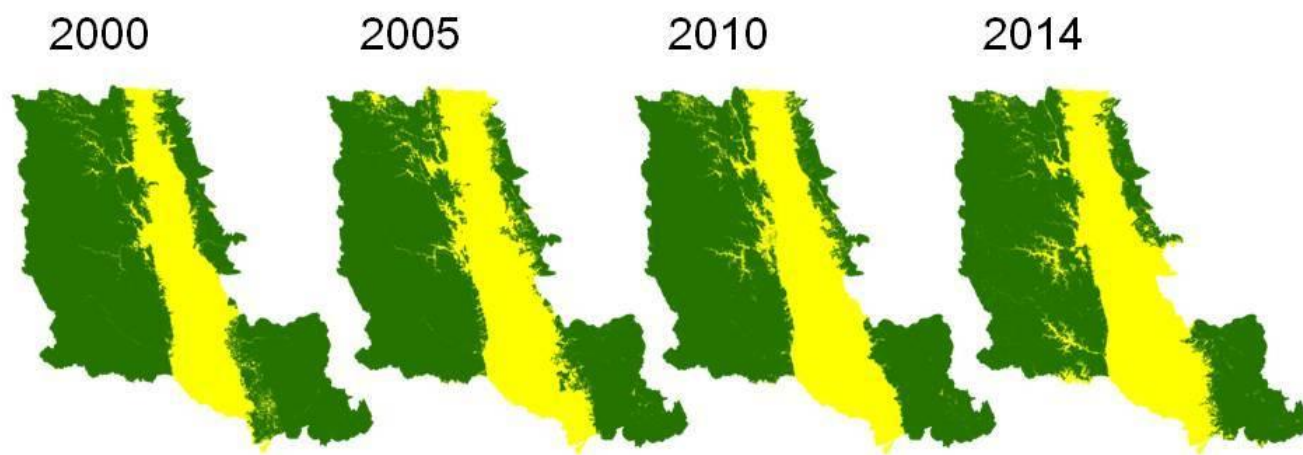
Year	Forest (Ha)		Non Forest (Ha)		Total
2000	826702.92	73.53 %	297604.53	26.47 %	100%
2005	742165.29	66.01 %	382165.29	33.99 %	100%
2010	740147.76	65.83%	384185.61	34.17 %	100%
2014	711119.25	63.25 %	413188.65	36.75 %	100%

8.17 Annual Deforestation Rate in Taungoo District

Years	Type	Hectares	Area%	Defor rate %	Annual rate %
2000-2005	Forest	735681	65.45		
	Non-Forest to Forest	6245	0.56		
	Forest to Non-Forest	90759	8.07		
	Non-Forest	291271	25.91		
	Taungoo District	**1123957**	**100.00**	**10.98**	**2.20**
2005-2010	Forest	712498	63.39		
	Non-Forest to Forest	27352	2.43		
	Forest to Non-Forest	29363	2.61		
	Non-Forest	354744	31.56		
	Taungoo District	**1123957**	**100.00**	**3.96**	**0.79**
2010-2014	Forest	690675	61.45		
	Non-Forest to Forest	20221	1.80		
	Forest to Non-Forest	49227	4.38		
	Non-Forest	363834	32.37		
	Taungoo District	**1123957**	**100.00**	**6.65**	**1.66**
2000-2014	Forest	705217	62.74		
	Non-Forest to Forest	5700	0.51		
	Forest to Non-Forest	121201	10.78		
	Non-Forest	291839	25.97		
	Taungoo District	**1123957**	**100.00**	**14.66**	**1.05**