DEVELOPMENT OF CARBON MONITORING METHODOLOGY FOR REDD+ IN MALAYSIA

Forest Inventory Method For Biomass Estimation

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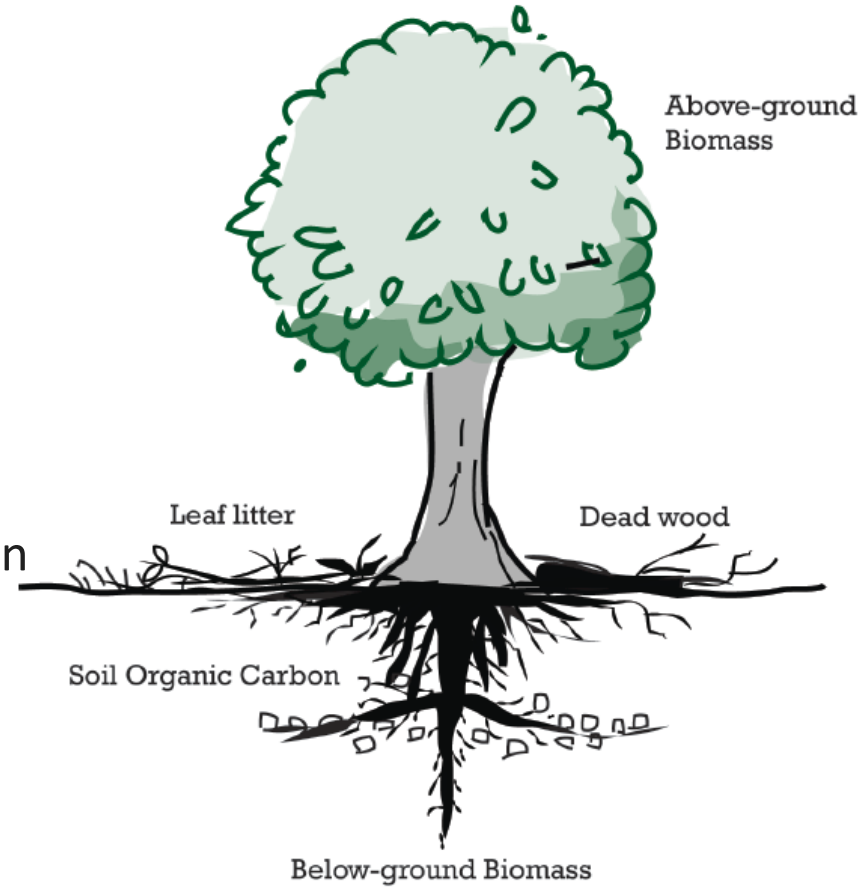
PRESENTATION OUTLINES

1. INTRODUCTION
2. OBJECTIVE OF THE BIOMASS COMPONENT
3. COMPONENT ACTIVITIES
    1. Developing standard procedure & ground measurement
    2. Biomass calculation
5. CONCLUSION

Forest Carbon Pools

Forest carbon is stored in five pools within and around vegetation

1. **Above-ground biomass**: stems, bark, leaves, etc.
2. **Below-ground biomass**: roots of all sizes
3. **Dead wood** or dead organic matter in dead wood
4. **Litter** or dead organic matter in litter
5. **Soil organic carbon** (SOC)



THE COMPONENT'S OBJECTIVE

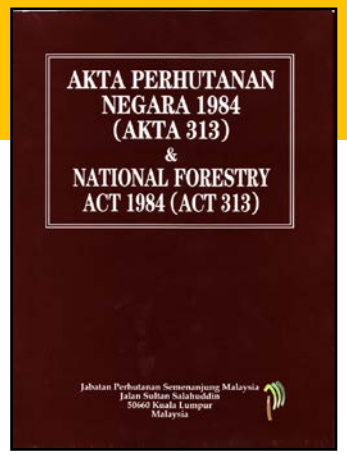
To determine biomass and estimate carbon stock in the forest by different forest type and disturbances

Lowland forest
(< 300m asl)

Disturbed forest

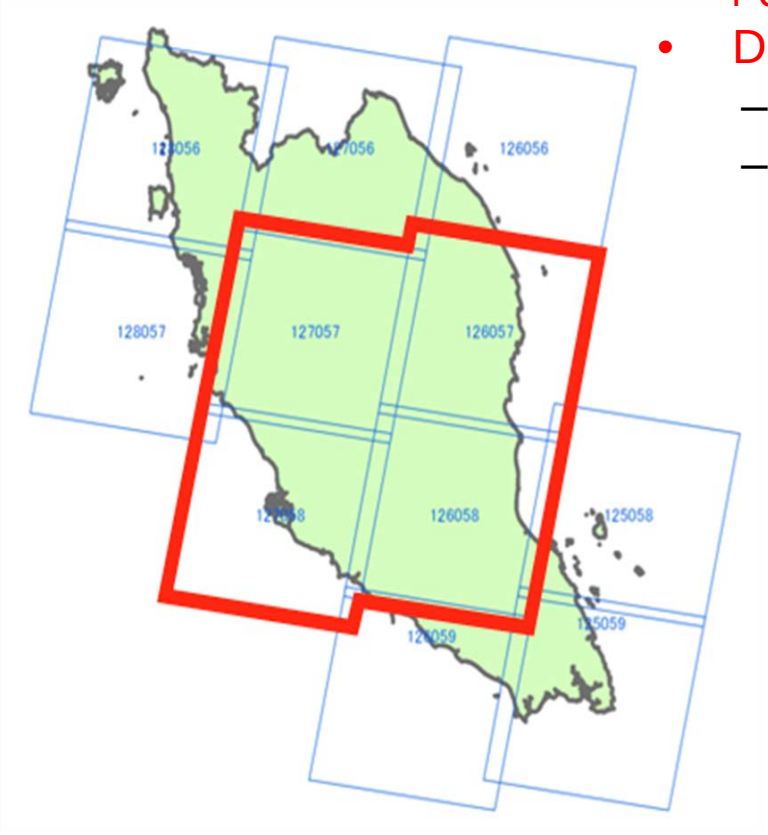
Hill forest
(≥ 300m asl)

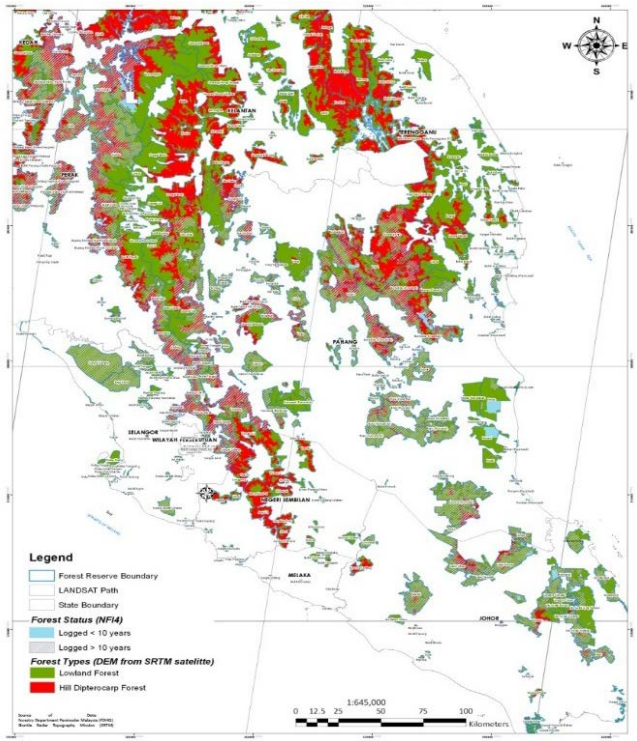
STUDY SITES



Stratification by:

- Forest type : Hill / Lowland
- Disturbance categories :
  - Undisturbed (VJR)
  - Disturbed
    a. ≤ 10 years
    b. > 10 years





96 plots distributed randomly and equally within four selected LANDSAT satellite images.

MAIN ACTIVITIES

1. Detailed ground measurement of biomass
2. Development of standard procedures of biomass ground inventory for carbon stock estimation
3. Average carbon value for each category identified



ACTIVITY 1 & 2

DEVELOPMENT OF STANDARD PROCEDURES OF BIOMASS GROUND INVENTORY FOR CARBON STOCK ESTIMATION & GROUND MEASUREMENT

BrandLaureate
Best Brand Awards

ISO 9001-2008 Certified

5S

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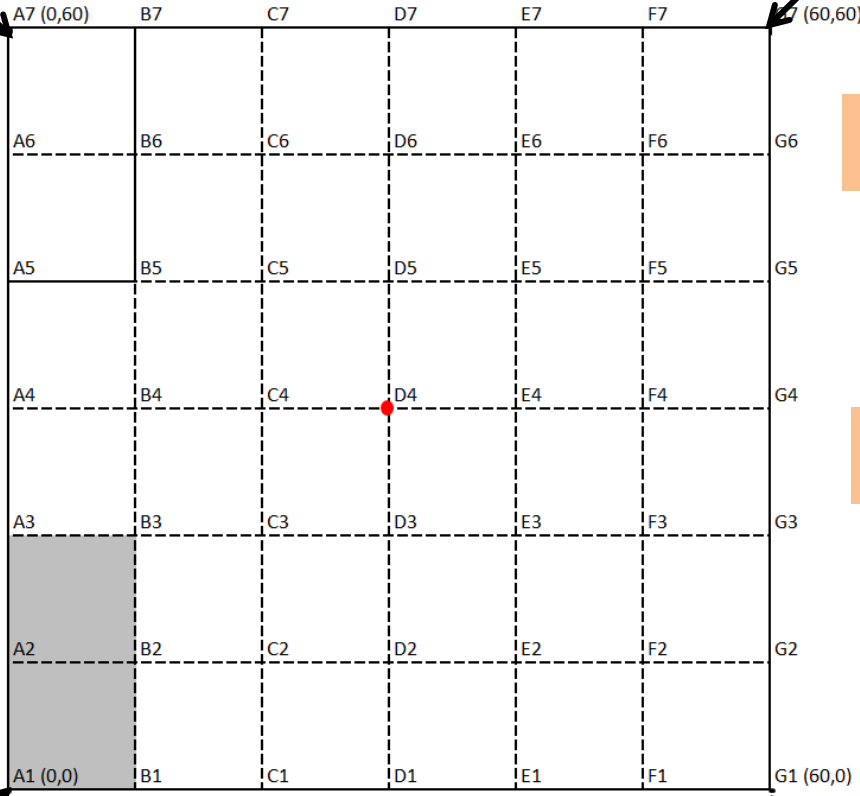
FOREST RESEARCH INSTITUTE MALAYSIA
http://www.frim.gov.my

Inventory Procedures

(Non-destructive Method)



Main plot 60 x 60 m : trees > 10 cm dbh

Subplot 10 x 20 m : trees 5 - 10 cm dbh

Quadrate 10x 10 m

PLOT

- Altitude
- Slope
- Bearing
- Coordinates – main corners & center
- Bench marks – Main corners
- Photographs
- Time

TREE

- Diameter at breast height, dbh (cm)
- Total height – first 5 trees in each dbh class : (1) 5-10cm, (2) 10-30cm, (3) 30-50cm, (4) 50-70 cm, (5) 70-90 cm and (6) ≥ 90cm
- Tree identification

Equipments

Laser range finders – Digital Camera – Diameter tape – Reflector & pole – Distance tape – Suunto Compass – GPS – Altimeter – Clinometer – Binocular – Flagging tape – Tree tag (plastic) – Rainproof bag – Aluminium plate (for quadrate corner label) – Data sheet – PVC pole (quadrate corners post) – Aluminium pole (main plot corners post) –Herbarium specimen (Plant press, Plastic specimen bag, Paper specimen labels, old newspaper, lastik) – Walkie talkie

Field Form 1 – Plot Survey

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PLOT SURVEY

Sheet No. 1

Team Leader :

State :

Forest Reserve :

Compartment No :

Plot No :

Date of survey	Start time	Finish time

Category

Hill		Unlogged forest / VJR	
Lowland		Logged forest > 10 years	
		Logged forest < 10 years	

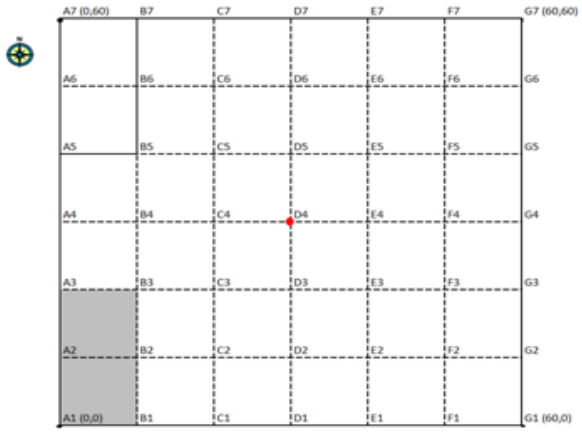
Point	Coordinate (RSO)		Slope	Bearing *	Photo #	Permanent Benchmark					
						Benchmark	Coordinate (RSO)		Bearing #	Photo #	Distance
0,0											
0,60											
60,60											
60,0											

* from (0,0) to (0,60) ; (0,60) to (60,60); (60,60) to (60,0); (60,0) to (0,0)

from corner to benchmark

Coordinate D4		
Altitude D4		

Overall forest conditions



Field Form 2 – Tree Census

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TREE CENSUS

Sheet No [ ]

Date of survey :
Recorder :
State : Plot No :
Forest Reserve : Compartment No :
Category
Hill forest [ ] Unlogged forest / VJR [ ]
Lowland forest [ ] Logged forest > 10 years [ ]
Logged forest < 10 years [ ]

Quadrate *	Tree No.	Tree Identification	Dbh (cm)	Height (m) ^	Remarks

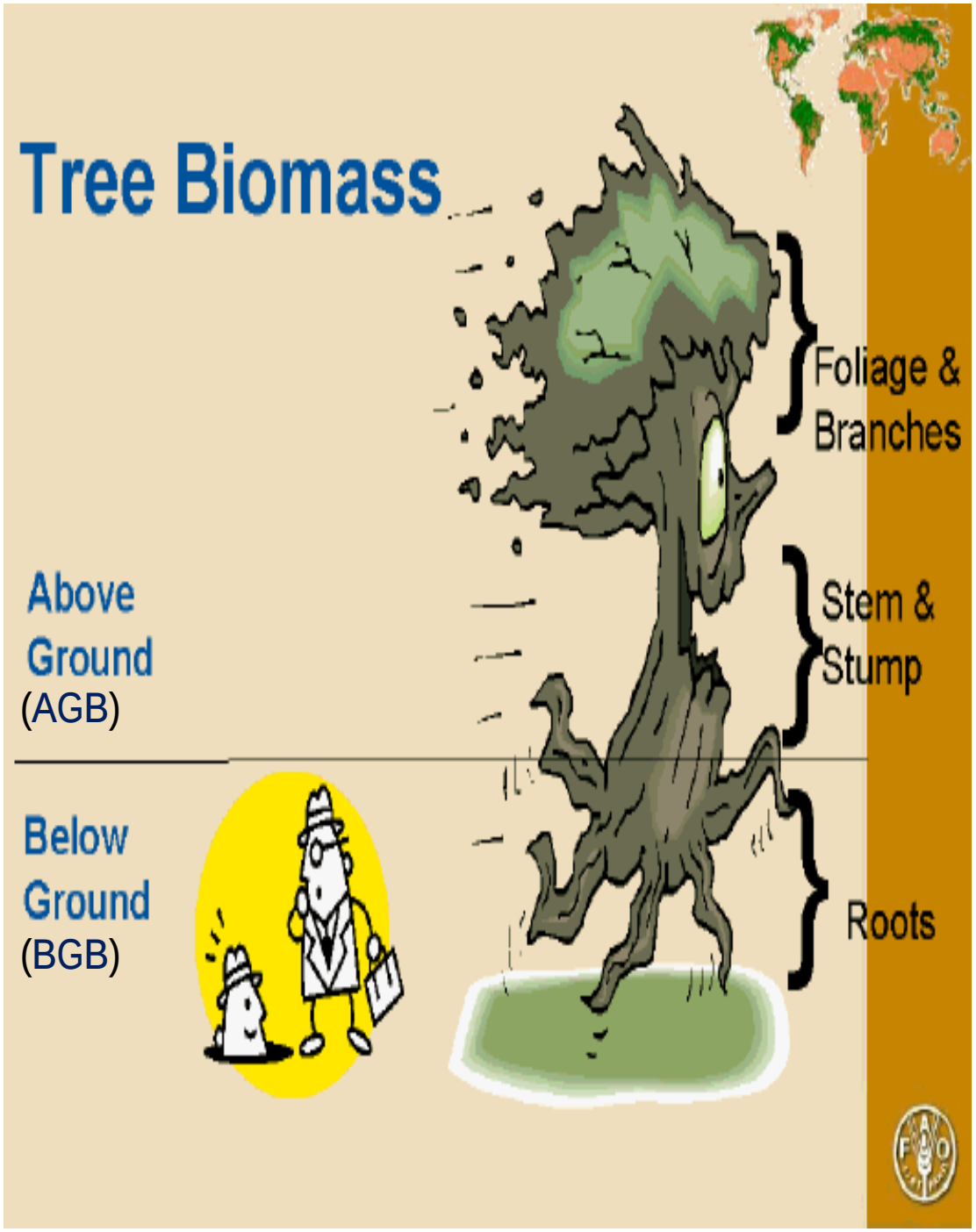
^ DBH size classes for height measurement 05-10 cm 10-30 cm 30-50 cm 50-70cm 70-90 cm 90++ cm
* Quadrate A1 & A2 : measure trees from 5cm and above

No of Plots Established and Their Locations

 Forest Category	Johor	Kelantan	Negeri Sembilan	Pahang	Selangor	Terengganu	Total
Hill logged < 10 years		7			2		9
Hill logged > 10 years	2		1		3		6
Hill unlogged	3	2			5		10
Lowland logged < 10 years			6	2	2	7	17
Lowland logged > 10 years			7	15	6	3	31
Lowland unlogged			2	9	5	2	18
Total	5	9	16	26	23	12	91

ACTIVITY 3

AVERAGE CARBON VALUE FOR EACH CATEGORY IDENTIFIED



Allometric Equations

$1/W_L = 1/(0.124\ W_S^{0.794}) + 1/125$

$W_B = 0.0390\ (D^2H)^{1.041}$

$W_S = 0.313\ (D^2H)^{0.9733}$

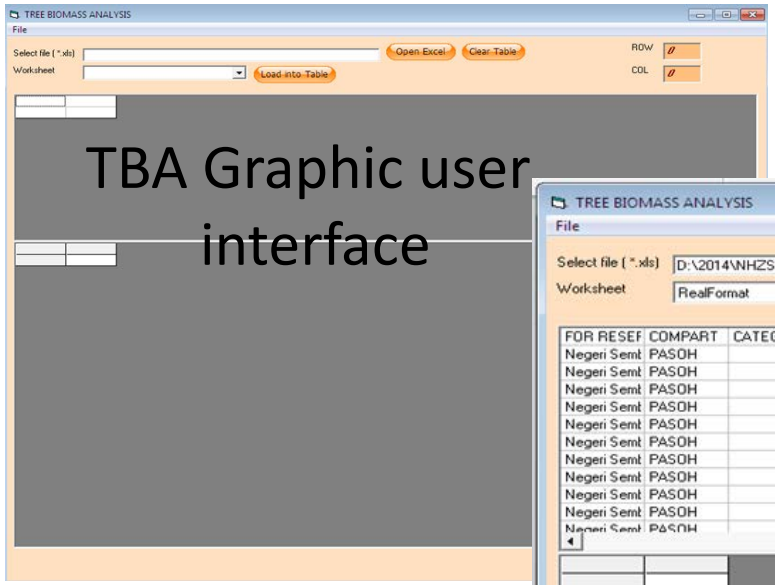
$1/H = 1/(2.0\ D) + 1/61$

$W_R = 0.023\ D^{2.59}$

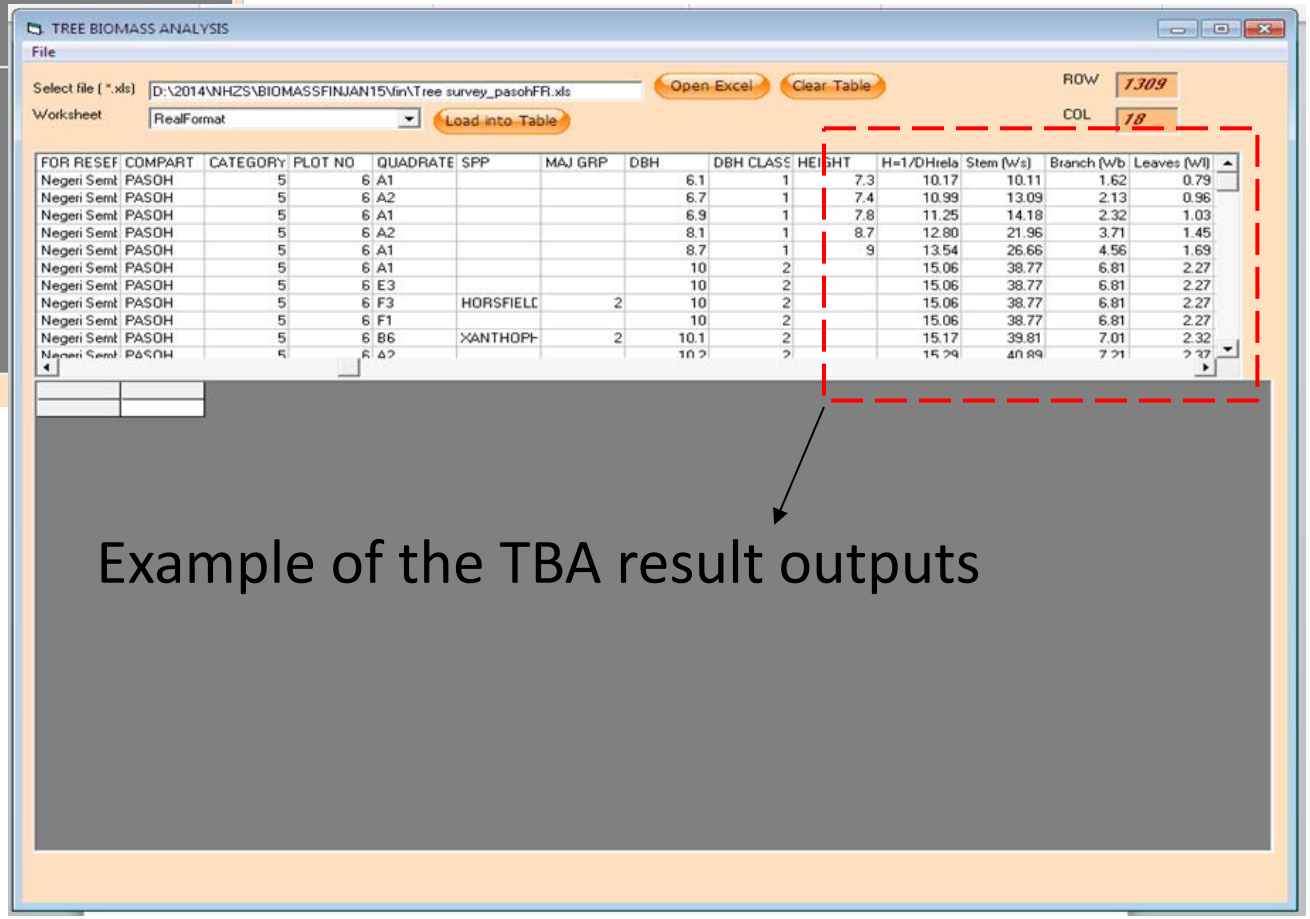
After calculating tree biomass, carbon stock of a tree will be obtained by multiplication of 0.5 (IPCC)

Kato *et al*. (1978) & Niiyama *et al*. (2010)

Tree biomass analysis (TBA) Tool



TBA Graphic user interface



Example of the TBA result outputs

FOREST BIOMASS MONITORING FOR REDD+

MANUAL

Nur Hajar Z.S., Wan Mohd Shukri W.A., Mohd Danial M.S., Mohd Shahid M., Mohd Nizam A., Harfendy O., Sadali S., Jasriza M.H. & Ismail, H.

Version 1 - January 2015

PART 1: Establishment of Monitoring Plot

PART 2: Tree Measurement for Biomass

PART 3: Data Entry and Analysis

PART 4: Estimation of Tree Biomass and Carbon Stocks; Report Writing

CONCLUSION

- Measurement protocol for biomass estimation has been developed. Manual is ready to be used.

- To date 91 plots had been established throughout Peninsular Malaysia using the standard protocol developed.

- Monitoring of fixed sampling plots shall provide us important information of biomass and carbon stock changes as well as biodiversity.

ACKNOWLEDGEMENT

Government of Japan through ***Forestry & Forest Products Research Institute (FFPRI)*** for the research funding.

Forestry Department (Peninsular Malaysia, Selangor, Negeri Sembilan, Johor, Pahang, Terengganu, Kelantan) for the approval to conduct research activities at selected forest reserves.

Perbadanan Taman Negara Johor (PTNJ) for the approval to conduct research in Taman Negara Gunung Ledang

KPKKT for the approval to conduct research in their concession areas

THANK YOU