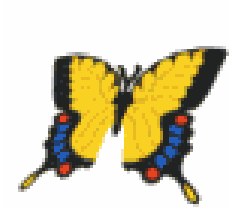


KUMPULAN: BIOMASS

KETUA KUMPULAN : EN. SAMSU ANUAR NAWI

AHLI :

EN. MOHD HAKIMI ABU HASSAN

EN. ZULKEFLI HJ MAT

EN. EDEVALDO J YAPP

EN. FAKRUL HAFIDZ SUKRI

YM. TG. MOHD RIDZUAN TG. IBRAHIM

EN. THARMIZIE SAGIRAN

EN. WAJAHA MAULUD

EN. KHAIRUL AMIRIN MOHAMED

EN. ABDUL MALIK KHAIRI ZAHARI

EN. AHMAD AKMI MOHAMAD

EN. AHMAD NAZERI SHAHABUDDIN

TAJUK

Pengiraan biomas dan stok karbon hutan Taman Negara (Kuala Tahan)

LATAR BELAKANG

- Kajian ini dijalankan di Hutan Taman Negara (Kuala Tahan) sempena “FRIM-FFPRI Training Workshop on REDD+ Project”
- Kajian dijalankan di kawasan “Lowland unlogged Dipterocarp forest”
- Kaedah kajian melibatkan penubuhan petak bancian seluas 60m X 60m atau 0.36 hektar dan bancian sumber hutan bagi pokok-pokok bersaiz 5cm dbh dan ke atas.

OBJEKTIF

- Menentukan biomas dan stok karbon di Hutan Hujan Tropika Taman Negara Kuala Tahan.
- Memberi pendedahan kepada peserta kaedah pengiraan biomas dan stok karbon.

Kaedah Kajian

1. Penubuhan Plot Pemantauan (60m x 60m)

- ✓ Reka bentuk pensampelan (Gambar)
- ✓ Peralatan yang digunakan (Rujuk Manual)
- ✓ Pasukan survey yang terlibat (Senarai Nama)

Rekabentuk Plot Kajian

1. Survey persekitaran lokasi projek kajian
2. Kategori Logged ≤10 tahun,≥10 tahun/Unlogged, Lowland/Hill.
3. Penubuhan plot 60m x 60m :
    1. Tentukan point (0,0) dan point pusat rujukan. Kedudukan plot sentiasa ke arah utara
    2. Seterusnya untuk penubuhan setiap sub plot A1 sehingga F6 (36 sub plot) peralatan terlibat terdiri daripada Trupulse, Impulse, pancang, kompas, marker pen, riben serta clinometer.
    3. Dalam masa yang sama, tugas pencatat dan pengukuran bagi pokok bersaiz 5cm – 10cm dbh ,mengukur ketinggian dan nama spesis di sub plot A1 & A2 dijalankan.(10m x 20m)
    4. Sub plot A3 sehingga F6 diambil pengukuran bagi setiap pokok bersaiz 10 cm dbh dan ke atas. Ketinggian dan nama spesis dicatat di dalam borang khas yang diberikan.

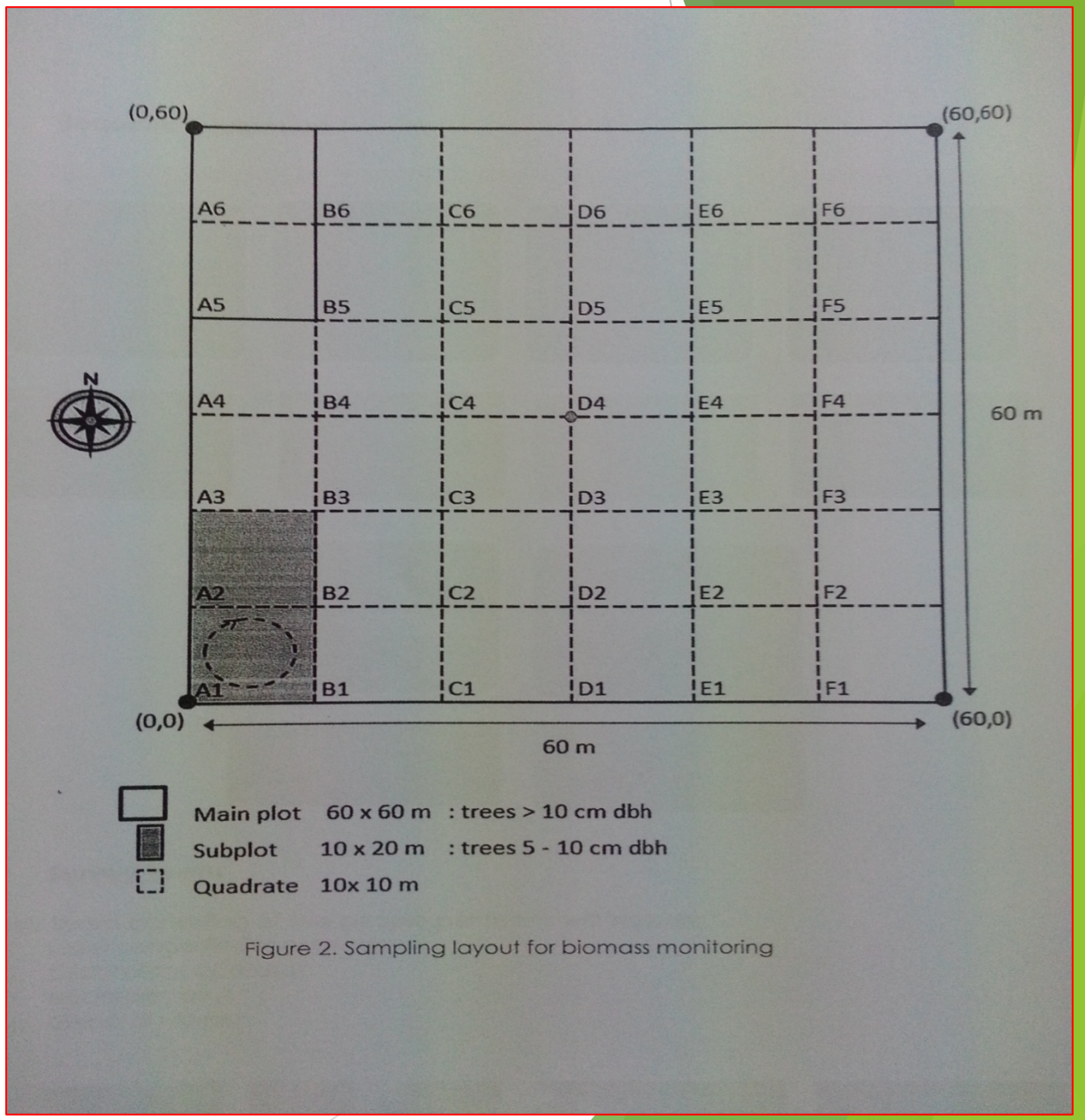


Figure 2. Sampling layout for biomass monitoring

Penentuan Lokasi Plot (0,0)

1.6 Locating the First Point (0,0)

The plot location should be predetermining based on the selected criteria set by the project (or objectives). The survey team, then need to check on the ground the suitability of predetermine plot location to ensure that all criteria have been fullfil. For FRIM FFPRI project, the most important criteria include forest type, altitude and years after logging (if any).

Figure 3. An example of ground checking by the survey team to the predetermine plot location. The entry point should be marked using GPS.

The suitable area for plot establishment should be determine within the selected plot location. Few GPS point should be taken to ensure the whole plot area is within the set criteria (altitude).

Use aluminum pole to mark the starting point (A1). Mark the point using GPS. Pole will be 3 feet at height and quadrate number should be clearly written on the pole.

The baseline of the plot (0,0 to 0,60 ; 60 m) will be laid out towards north direction.

Penentuan Lokasi Pusat Rujukan

1.7 Reference Point

Permanent plots shall be marked using materials that will last longer than project lifetime. Hence, aluminium poles will be used to mark each corners of main plot and tied to permanent benchmark such as river/stream, main road or big tree. The coordinates of each corners and their permanent bench mark will be recorded using GPS.

The GPS location alone cannot be used to locate the plot corners in the future as the error in GPS measurements is too varies and large.

- Select a permanent feature as a referece point for each corner of the main plot and mark using paint. Record the species name.

Step 1

- GPS reading should be recorded for each reference point.

- Record bearing and distance from reference point to the selected main corner pole.

Step 3

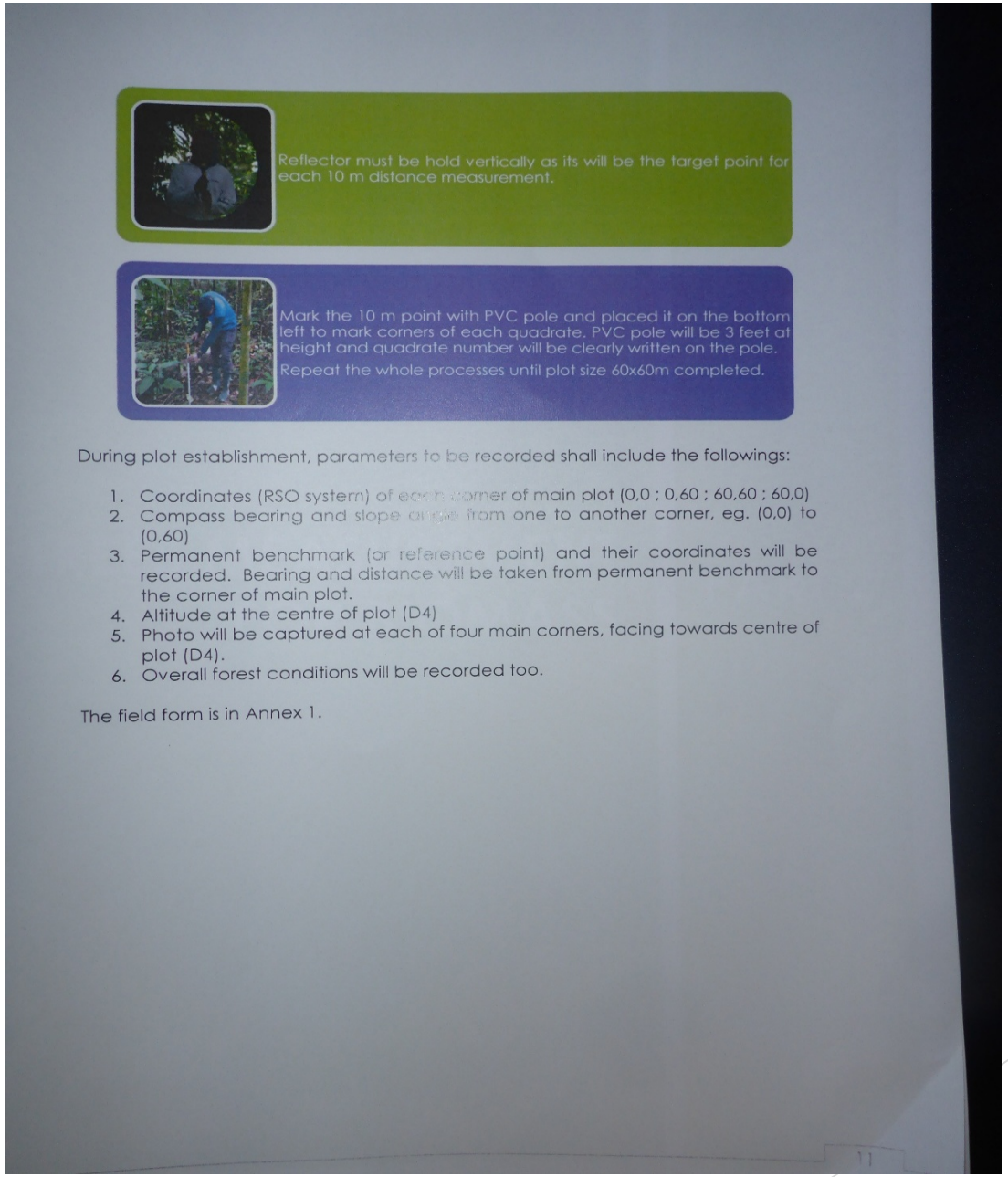
1.8 Main Corner (0,0 to 60,0)

The corners of main plot and each quadrate will be positioned using laser range finders.

Team member ready with pvc pole and reflector.

From first point (0,0), point the laser range finder to north direction and start measure distance at every 10m.

Kumpulan Biosmas



Reflector must be hold vertically as its will be the target point for each 10 m distance measurement.

Mark the 10 m point with PVC pole and placed it on the bottom left to mark corners of each quadrate. PVC pole will be 3 feet at height and quadrate number will be clearly written on the pole.

Repeat the whole processes until plot size 60x60m completed.

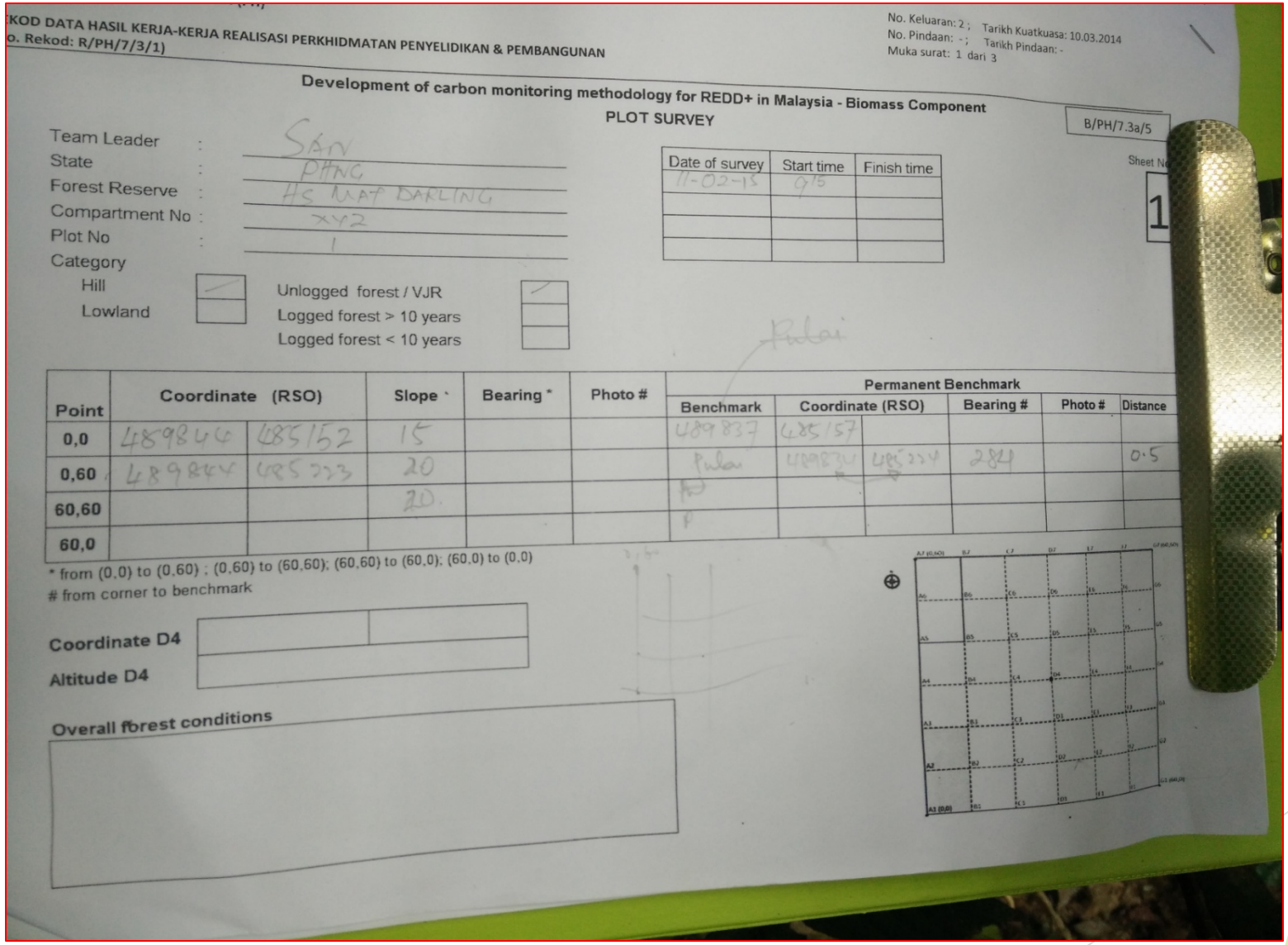
During plot establishment, parameters to be recorded shall include the followings:

1. Coordinates (RSO system) of each corner of main plot (0,0 ; 0,60 ; 60,60 ; 60,0)
2. Compass bearing and slope angle from one to another corner, eg. (0,0) to (0,60)
3. Permanent benchmark (or reference point) and their coordinates will be recorded. Bearing and distance will be taken from permanent benchmark to the corner of main plot.
4. Altitude at the centre of plot (D4)
5. Photo will be captured at each of four main corners, facing towards centre of plot (D4).
6. Overall forest conditions will be recorded too.

The field form is in Annex 1.

11

Rekabentuk Borang Bancian



KOD DATA HASIL KERJA-KERJA REALISASI PERKHIDMATAN PENYELIDIKAN & PEMBANGUNAN
o. Rekod: R/PH/7/3/1)

No. Keluaran: 2 ; Tarikh Kuatkuasa: 10.03.2014
No. Pindaan: - ; Tarikh Pindaan: -
Muka surat: 1 dari 3

Development of carbon monitoring methodology for REDD+ in Malaysia - Biomass Component
PLOT SURVEY

B/PH/7.3a/5

Team Leader : SAN
State : PHG
Forest Reserve : HS MAT DARLING
Compartment No : XY2
Plot No : 1
Category
Hill ✓
Lowland

Unlogged forest / VJR ✓
Logged forest > 10 years
Logged forest < 10 years

Date of survey	Start time	Finish time
11-02-15	0715	

Sheet No 1

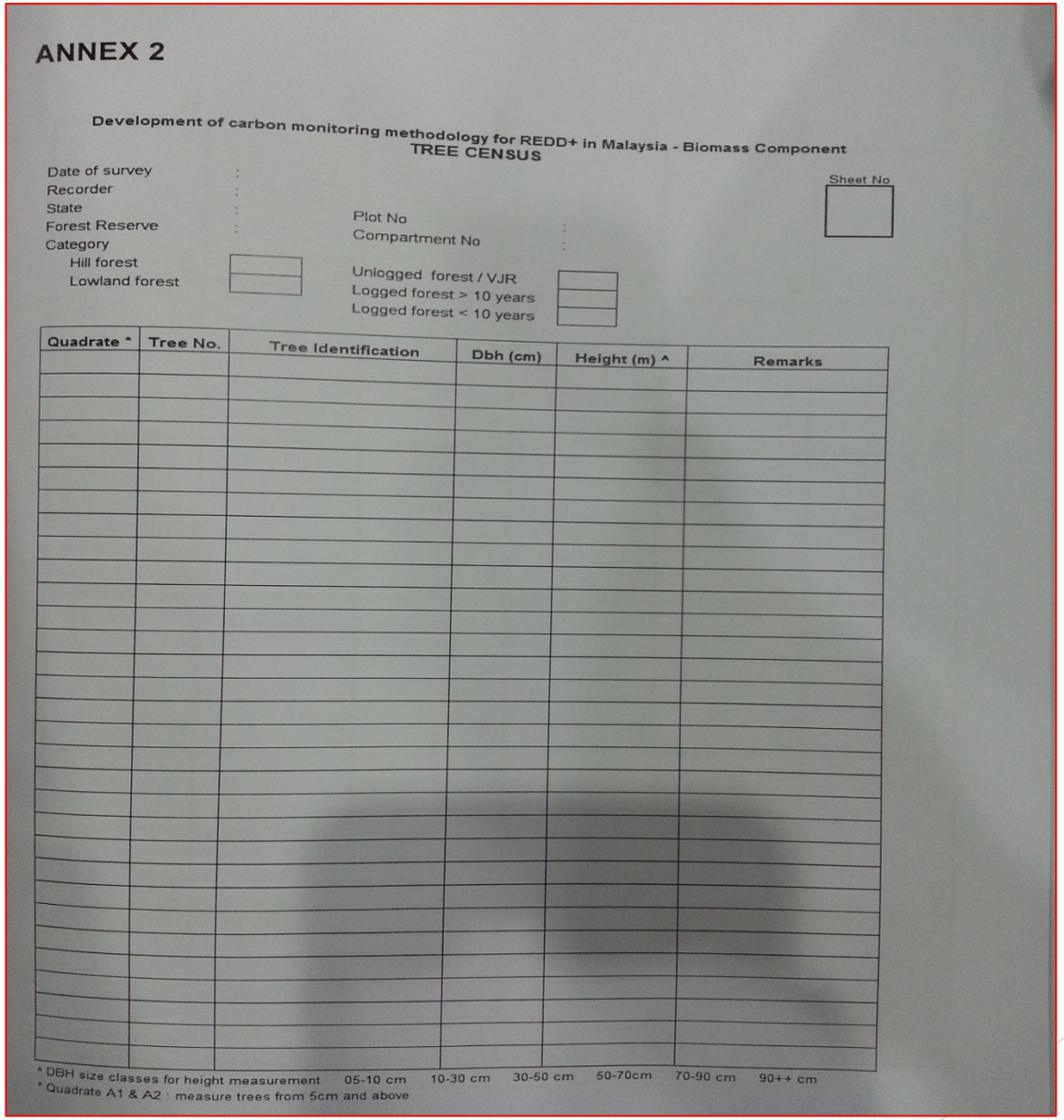
Point	Coordinate (RSO)		Slope `	Bearing *	Photo #	Permanent Benchmark					
						Benchmark	Coordinate (RSO)		Bearing #	Photo #	Distance
0,0	489846	485152	15			489837	485157				
0,60	489844	485223	20			Pulai	489834	485224	284		0.5
60,60			20								
60,0											

* 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

Rekabentuk Borang Bancian



ANNEX 2

Development of carbon monitoring methodology for REDD+ in Malaysia - Biomass Component
TREE CENSUS

Date of survey :
Recorder :
State :
Forest Reserve :
Category
Hill forest
Lowland forest

Plot No
Compartment No :

Sheet No

Unlogged forest / VJR
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

Pemetaan Pokok

- 2. Pengukuran pokok untuk penentuan Biojisim

- ✓ Peralatan yang digunakan (Rujuk Manual)
- ✓ Pasukan Survey (Senarai Nama)
- ✓ Pengukuran Diameter (DBH)
- ✓ Pemetaan pokok
- ✓ Pengukuran ketinggian pokok
- ✓ Pengecaman pokok

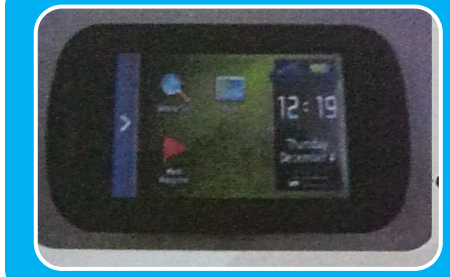
SENARAI PERALATAN UNTUK KAJIAN

LASER RANGE FINDER (IMPULSE)

- Mengukur jarak & bearing untuk pembinaan plot kajian

REFLECTOR

Digunakan bersama Impulse untuk pengukuran jarak & bearing plot



GLOBAL POSITIONING SYSTEM (GPS)

- Mendapatkan bacaan GPS bagi kedudukan pancang plot

ALUMINIUM POLE (3 ft. height)

- Penandaan plot 60 meter x 60 meter yang dibina

PVC POLE (3 ft. height)

- Digunakan bersama Impulse untuk pengukuran jarak plot

CLINOMETER (Suunto)

- Mendapatkan bacaan kecerunan petak kajian

DIAMETER TAPE

- Pengukuran Dbh pokok yang dibanci

LASER RANGE FINDER (TRUPULSE)

Mengukur ketinggian pokok yang dibanci

STAPLER GUN

-Melekatkan Tag Number pada pokok dibanci

TAG NUMBER

- Penandaan pokok yang dibanci

Kaedah Pengukuran Diameter Pokok

2.3 Diameter Measurement

In main plot (60 x 60 m), all individual trees with > 10 cm diameter at breast height (dbh) will be tagged and measured, whereas for individuals with 5 – 10 cm dbh will be tagged and measured inside the subplot (Quadrate A1 & A2) (Figure 2).

A 1.3m stick shall be prepared and used during measurement to reduced the human error.

For each tree, place the stick against the tree to indicate the point of measurement.

Placement of the stick depends on the ground slope, leaning angle of tree and tree bole shape (Figure 4).

Tree diameter will be measured using diameter tape.

If the diameter tape has a hook, push the hook into the bark of the tree slightly to secure it and pull the tape to the right. The diameter tape should always start left and be pulled right around the tree. As the diameter tape wraps around the tree and returns to the hook, the tape should be above the hook. The tape should not come around the tree below the hook. The tape should not be upside down; the numbers must be right side up.

Tree diameter should be measured to the nearest 0.1 cm (eg: 10.2 cm instead of 10 cm)

All measured individuals trees shall be tagged with a plastic numbered tag and nail to tree stem using stapler gun. Tree tag should be placed at the measurement point (1.3m).

Dbh (or diameter, d above the buttresses) of each individual tree will then be recorded in the Field Form (Annex 2).

However, in the events of unsual tree form, point of measurement should be located as follow (Figure 4).

Slope: always place stick and measure diameter on the upper slope side of tree.

Leaning tree: always measure the height of a measurement (eg. 1.3m) parallel with the tree, not perpendicular to the ground. Therefore, if the tree is leaning, measure underneath the lean, parallel with angle of tree. If a tree is not straight, a tape measure must be used to measure the bole distance from ground to location of measurement (e.g. DBH).

Multi stem tree: If the tree is multi stemmed with forking below the point of measurement (eg. 1.3m), measure the diameter on each stem and tag the stems that exceed the minimum diameter for the nest. Record it as if each stem were different tree on the data sheet, but with a note that the stems make up one tree.

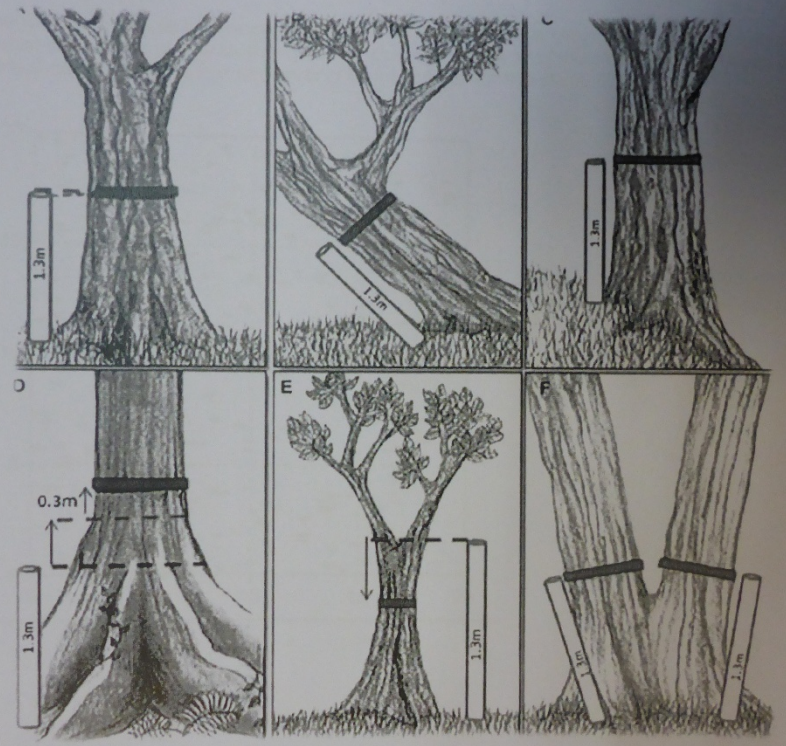


Figure 4. Point of diameter measurement

To ease the census, avoid either missed trees or double recording and minimize human errors, measurement shall be conducted quadrate by quadrate (A1 to F6) with clock-wise rotation (Figure 2).

Kaedah Pengukuran Ketinggian Pokok

2.5 Total Height Measurement

Total height is an important tree variable. It is well correlated with other important tree and stand parameters such as tree volume and the quality of site conditions. Total tree height must be measured if height has been included as a tree variable in the allometric equation/s that will be used.

Total tree height is the distance along the axis of the bole of the tree from ground to the uppermost point of the tree.

Total height will be measured using laser range finder such as trupulse.

Height will be measured from 5 individual trees per dbh class, selected randomly within six predetermined dbh class, which is:

1) 05.0 – 0.99 cm
2) 10.0 – 29.9 cm
3) 30.0 – 49.9 cm
4) 50.0 - 70 cm
5) 70-90 cm and
6) 90 cm and above

To measure height:

1. Find the best location to view the top of the tree.
2. Stand as far as possible away from the tree so that the top of the tree is less than 90 degrees above the line of sight.
3. Always stand up-slope of the tree. Standing down-slope of the tree should only take place when no other option exists.
4. Using laser range finder,
   a) Measure distance from eye of person measuring tree to the tree. It is important to ensure that distance measured is horizontal, not along the slope.
   b) Measure the angle in degree (°) to base of the tree.
   c) Measure the angle in degree (°) to top of the canopy of the tree.
   d) The total height measurement will be automatically calculated (based on trigonometry principle) and the measurement should be recorded in the field form (Annex 2) to the nearest 0.1 meter.

2.5 Tree Identification

Generally, vegetative characteristics of the tree will be used to determine the species. It includes tree stem, buttress, root, bark texture, canopy form, canopy colour, leaf arrangement and leaf form. Below are different techniques used in identifying species on site, including:

Species characteristics as listed in the *'Pocket Checklist of Timber Trees'* (Wyatt-Smith & Kochummen 1999) and the *'Tree Flora of Malaya'* (Whitmore 1973 & Ng 1989) shall be used as a guide. Each individual tree shall be identified up to species level (or as far as possible). The species name will be recorded in the field form (Annex 2).

3. Kemasukan data dan analisis

- ✓ Memasukkan data mengikut format
- ✓ Excell -TBA (Tree Biomass Analysis)
- ✓ Analisa data

A	B	C	D	E	F	G	H	I	J	K
TREEID	FOR RESERVE	COMPART	CATEGORY	PLOT NO	QUADRATE	SPP	MAJ GRP	DBH	DBH CLASS	HEIGHT
b409	Taman Negara	KT	4	1	D1	memecylon	2	8.4	1	11

Kategori Bagi Setiap Column di dalam program Microsoft Excel

using TDA.

Excel column	Column heading	Description
A	TREEID	Tree number
B	FOR RESERVE	Name of the forest reserve
C	COMPART	Compartment name
D	CATEGORY	Forest category 1 - Hill unlogged 2 - Hill logged >10 years 3 - Hill logged < 10 years 4 - Lowland unlogged 5 - Lowland logged > 10 years 6 - Lowland logged < 10 years (Subject to changes)
E	PLOT NO	Plot number
F	SPP	Species name (up to species level or genus)
G	QUADRATE	Quadrate
H	MAJ GRP	Major group 1 – Dipterocarp species 2 – Non dipterocarp species

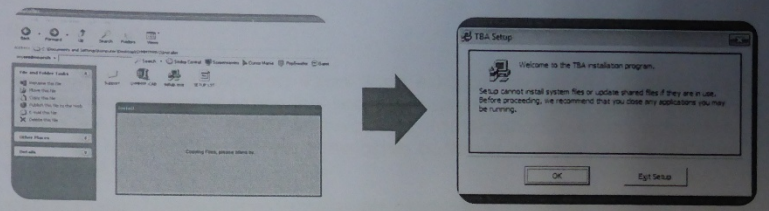
Excel column	Column heading	Description
I	DBH	Diameter at breast height measurement (to the nearest 0.1 m)
J	DBH CLASS	Predetermine dbh class 1. 05.0 – 0.99 cm 2. 10.0 – 29.9 cm 3. 30.0 – 49.9 cm 4. 50.0 - 70 cm 5. 70-90 cm and 6. 90 cm and above (subject to changes)
K	HEIGHT	Measured height in meter
L	H=(1/DH RELATION)	Height calculated using allometric equation develop by Kato et al. (1978)(for trees that has not been measured height) $1/H = 1/(2.0\ D) + 1/61$
M	Stem (Ws)	Calculation of stem biomass using allometric equations develop by Kato et al. (1978) $Ws = 0.0313(D^2H)^{0.9733}$
N	Branch (Wb)	Calculation of branch biomass using allometric equations develop by Kato et al. (1978) $Wb = 0.136Ws^{1.070}$
O	Leaves (W_L)	Calculation of leaves biomass using allometric equations develop by Kato et al. (1978) $1/W_L = 1/[0.124Ws]^{0.794} + 1/125$
P	Root (Wr)	Root biomass = Below ground biomass (BGB) calculated using allometric equations developed by Niiyama et al. (2010). $Wr = 0.023 \times D^{2.59}$.
Q	AGB	Above ground biomass value, consists of stem (Ws), branch (Wb) and leaves (W_L) biomass. $AGB = Ws + Ws + W_L$
R	TOTAL BIOMASS	Total tree biomass. Sum of AGB and BGB.

Table 1. Datasheet column format

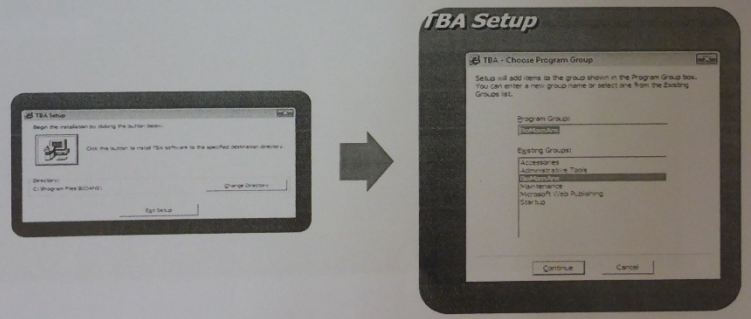
TREE BIOMASS ANALYSIS (TBA)

For installation:

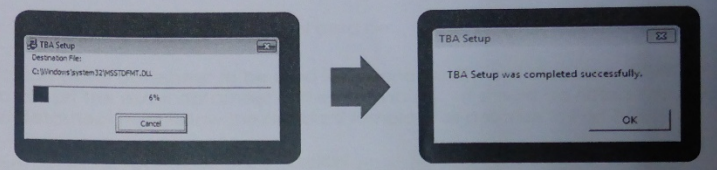
1. Place TBA installation CD into CD-Rom drive.
2. Click the icon Setup.exe to begin installation.
3. The massage box appears *"Copying files. Please standby"*. Click OK button to resume installation.



4. To continue save the installation file in the default directory, click the button. To change directory, click icon Change Directory and specify the destination folder. To begin installation, click Continue.



5. Click OK, when the installation was completed.



3.3 Data Analysis

TBA was developed using Microsoft Visual Basic 6.0 that creates GUI (Graphic User Interface) for easier manipulation by user. The simple interface allows users to interact with the software without technical or mathematical method approach. Users only need to select the file using the open button in order to link the software to the datasheet.

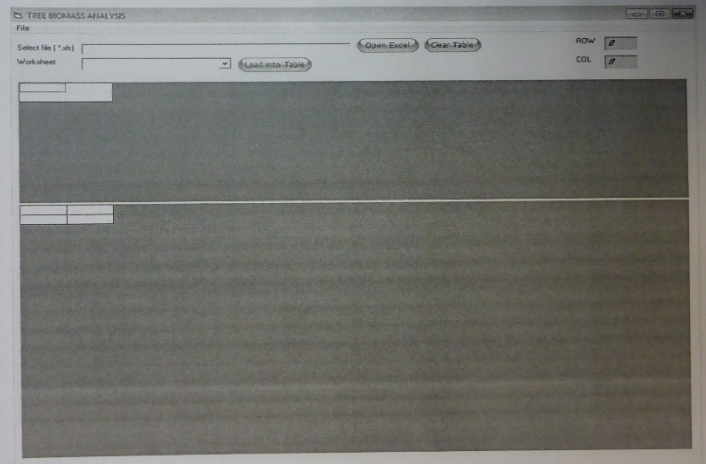


Figure 10. Graphic user interface for TBA

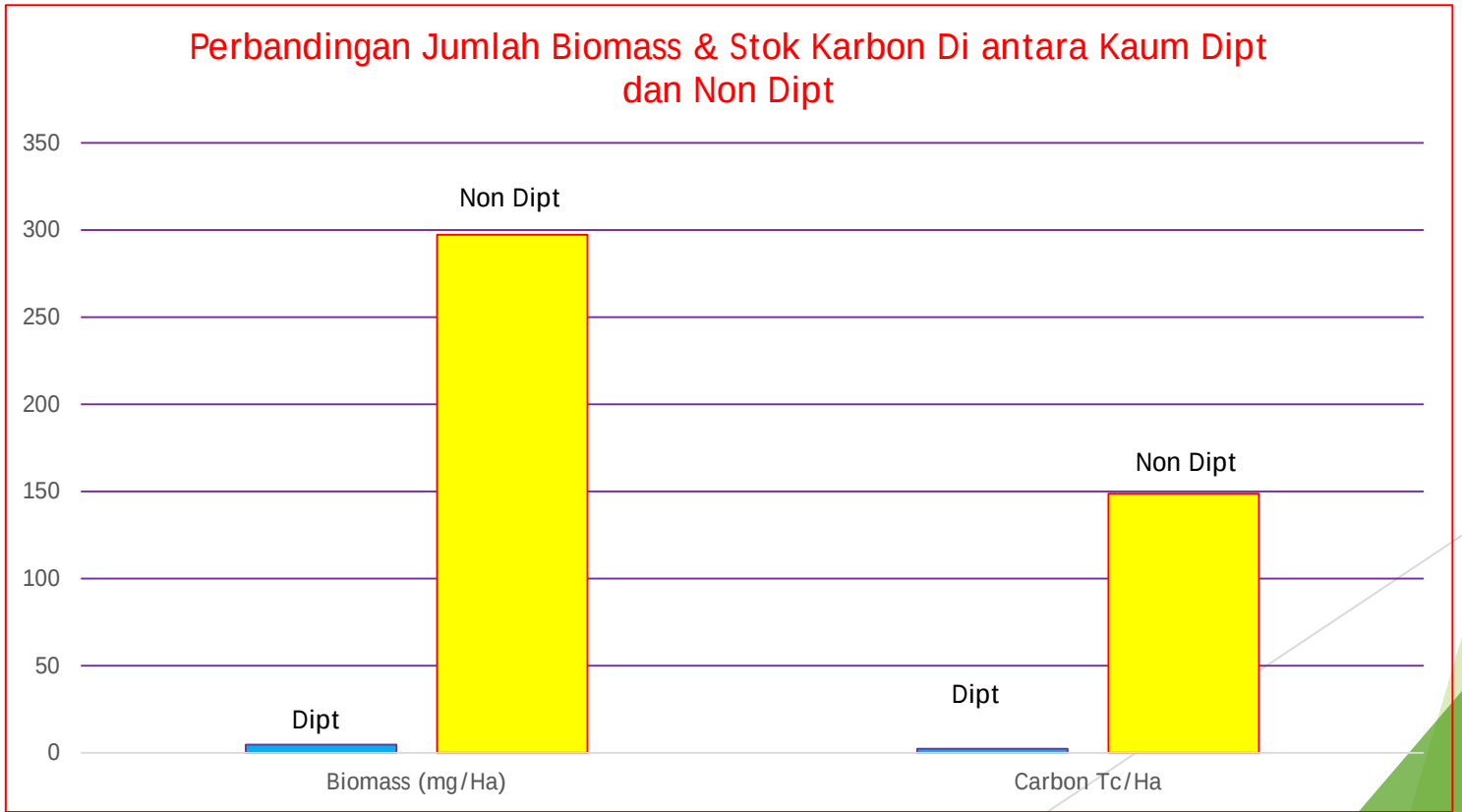
KEPUTUSAN KAJIAN MENGIKUT KELAS DIAMETER

	Dbh class	no of trees	AGB	BGB	Total
Biomass t/ha	1	525	10.89	2.10	12.99
	2	363	63.39	11.69	75.08
	3	50	66.26	13.14	79.40
	4	19	64.74	14.00	78.74
	5	6	44.81	10.69	55.50
	Grand Total	**963**	**250.10**	**51.61**	**301.71**

	Dbh class	no of trees	AGB	BGB	Total
Carbon tC/ha	1	525	5.44	1.05	6.49
	2	363	31.70	5.85	37.54
	3	50	33.13	6.57	39.70
	4	19	32.37	7.00	39.37
	5	6	22.41	5.34	27.75
	Grand Total	**963**	**125.05**	**25.81**	**150.86**

Kumpulan Biosmas

	Tree/Ha	Biomass (mg/Ha)	Carbon Tc/Ha
Dipt	63	4.56	2.28
Non Dipt	900	297.16	148.58
Jumlah	963	301.71	150.86



Biomas

X 0.5

Karbon

Kesimpulan

- Keputusan jumlah biomass bagi kaum Dipt. adalah 4.56 mg/Ha dan kaum Non Dipt. sebanyak 297.16 mg/Ha;
- Manakala jumlah stok karbon yang diperolehi adalah 2.28 Tan/Ha untuk kaum Dipt. dan 148.58 Tan/Ha untuk kaum Non Dipt.
- Jumlah kandungan biomass dan stok karbon untuk kaum Non Dipt lebih tinggi daripada kaum Dipt. Kerana jumlah taburan pokok bagi kaum Non Dipt. kawasan kajian ini lebih dominan daripada kaum Dipt.
- Walaubagaimanapun, perbandingan biomass dan stok karbon dengan data-data yang telah dibuat di kawasan-kawasan lain ada perbezaan data ekoran data yang diambil untuk kajian ini hanya mengambil 16 sub plot (quadrat) daripada jumlah keseluruhan asal adalah sebanyak 36 sub plot (quadrat).

CADANGAN

LATIHAN

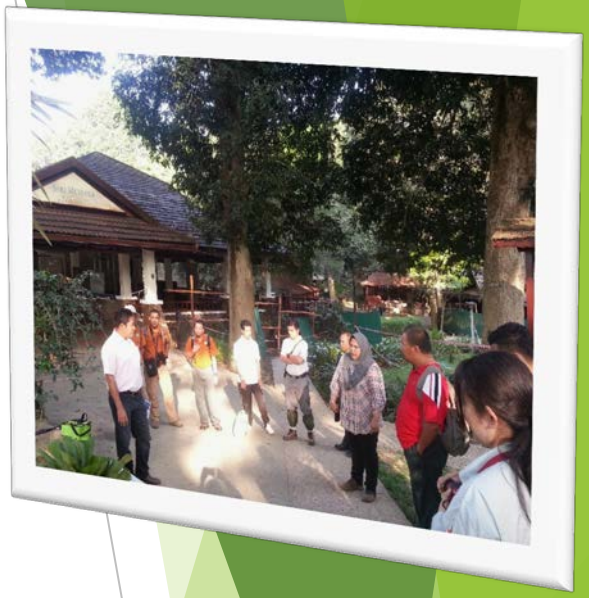
- Masa latihan perlu dilanjutkan dengan menambah modul pemprosesan data secara lebih terperinci.
- Kawasan bancian dipelbagaikan supaya perbezaan jumlah biomas dan stok karbon dapat dilihat dengan jelas mengikut jenis hutan.
- Pendedahan asas berkaitan kajian ini diberikan kepada semua peringkat kakitangan jabatan yang terlibat.

PROJEK

- Kajian diperluaskan kepada semua jenis dirian hutan.
- Pemindahan teknologi dari negara maju.

TERIMA KASIH

Thank You



Obrigado!

ARIGATO

شكراً