Green House Gas Inventory in Malaysia

Presentation for the WGA 4

Jakarta 13-14 February 2007

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Malaysia: National Communication

- National Initial National Communication 1994
- Second National Communication 2000 – on-going

Second National Communication

- FRIM appointed leading LULUCF sector – March 2004
- Working closely with several relevant departments
  - Ministry of Natural Resources & Environment (NRE)
  - Forest Department: Peninsular Malaysia, Sabah & Sarawak.
  - Department of Agriculture (DOA)
  - Universiti Putra Malaysia (UPM)
  - Malaysian Palm Oil Board (MPOB)
  - Malaysian Rubber Board

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Forestry in Malaysia

- Forest sector is an important economic sector
- Contributed about US$5.7 billion in 2005
- Major income earner for some State Governments
- About 60% of land covered by natural tropical forest
- Malaysia recognise the protective role of forest – environment, climate, soil, water, biodiversity, etc.
- Conserving and Managing forest on sustainable basis accorded a high priority

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Forest Lands in Malaysia

- Forested lands in Malaysia categorised:
  - Permanent Reserved Forests
  - National/State Parks, Wildlife Sanc. Etc
  - Stateland Forests
- Permanent Reserved Forest categorised
  - Production Forest
  - Protection Forest

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Malaysia: Distribution and Extent of Major Forest Type, 2000 (Million Hectares)

Region	Inland	Swamp	Mangrove	Others	Total Forested Land
Peninsular Malaysia	5.500	0.200	0.100	0.100	5.900
Sabah	3.810	0.120	0.340	0.340	4.420
Sarawak	8.640	1.040	0.130	0.130	9.840
Total	17.950	1.360	0.670	0.284	20.160

Source: FDPM, FD-Sabah & Sarawak

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Malaysia: Forested Area By Region, 2000 & 2004 (Million Hectares)

Region	2000	2004
Peninsular Malaysia	5.94	5.90
Sabah	4.42	4.38
Sarawak	9.84	9.24
Total	20.20	19.52

Source: FDPM, FD-Sabah & Sarawak

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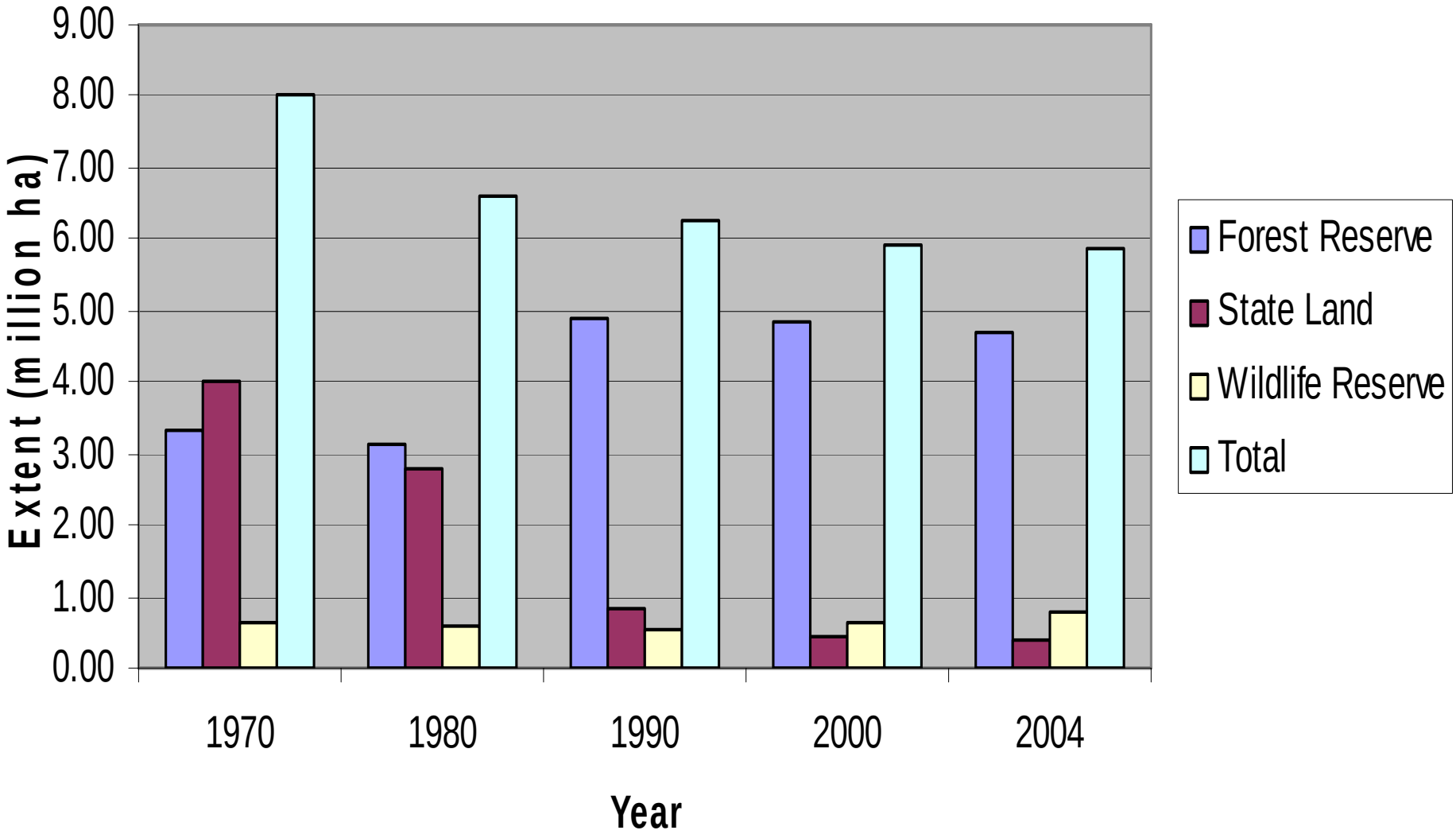
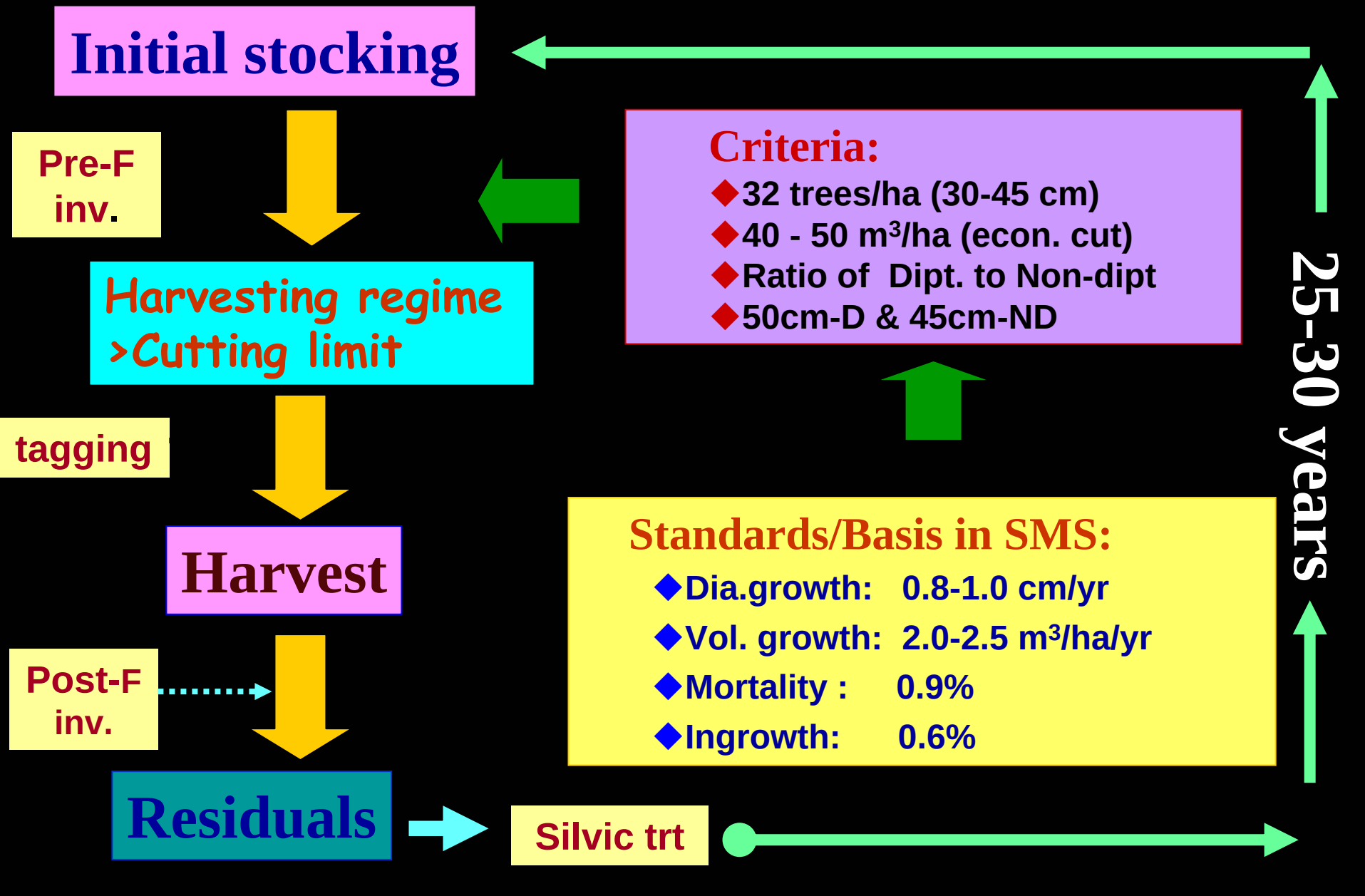
Changes in Forested Area (Pen. M'sia)



Selective Management System (SMS)



Net Changes in CO_2 in forest and other woody Biomass stocks

	Annual Carbon Release (Kt C)	Net Annual Carbon Intake (kt C)	Annual CO2 Removals (Gg CO_2)
Pen. Malaysia	4,765	32,744	120,061
Sarawak	17,728	31,684	116,174
Sabah	**3,218**	**18,272**	**66,996**
Total	**25,711**	**82,699**	**303,231**

Improvements Since the last presentation

- Key categories
  - Only managed forest is considered
  - Totally protected area not included
- Forest Conversion
  - Real 10-year average used
  - Based on FD annual reports
- Current and future work
  - country specific increment data
  - Soil data

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Data Accuracy

- Malaysia has relatively good estimates on forest extent
  - Based on periodic national inventories
  - Accepted sampling procedures and analysis

- Growth data for carbon – still using many default IPCC values
  - Plans to improve further using local growth estimates

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Estimate of Extent- Inventories

- **Macro Level**

  National Forest Inventory
  - ten year intervals
  - cluster plot
  - 95% confidence level
  - < 1% sampling intensity

- **Operational Level**

  Pre-F & Post-F Inventory
  - areas open for logging
  - systematic line plot
  - 10% at 95% confidence level

- Differ in terms of sampling design, information collected & frequency

The National Forest Inventory has the followings objectives:

- **To determine the extent location of forest areas by forest types;**
- **to assess changes in forest resources with respect to distribution, composition, forest stocking, forest stand and total tree volume according to its quality and productivity;**
- **to determine the standing volume of forest areas in accordance with the forest type stratification;**
- **to estimate the net and gross standing volumes of specific diameter classes according to species groups/types and areas with potentials for exploitation; and**
- **to determine the location and assess both the quality and quantity of rattan, bamboo, palm and pandanus.**

NFI method

PHASE 1

The use of satellite imagery* (LANDSAT TM) *for the establishment of a fixed grid of monitoring points over the entire forest area

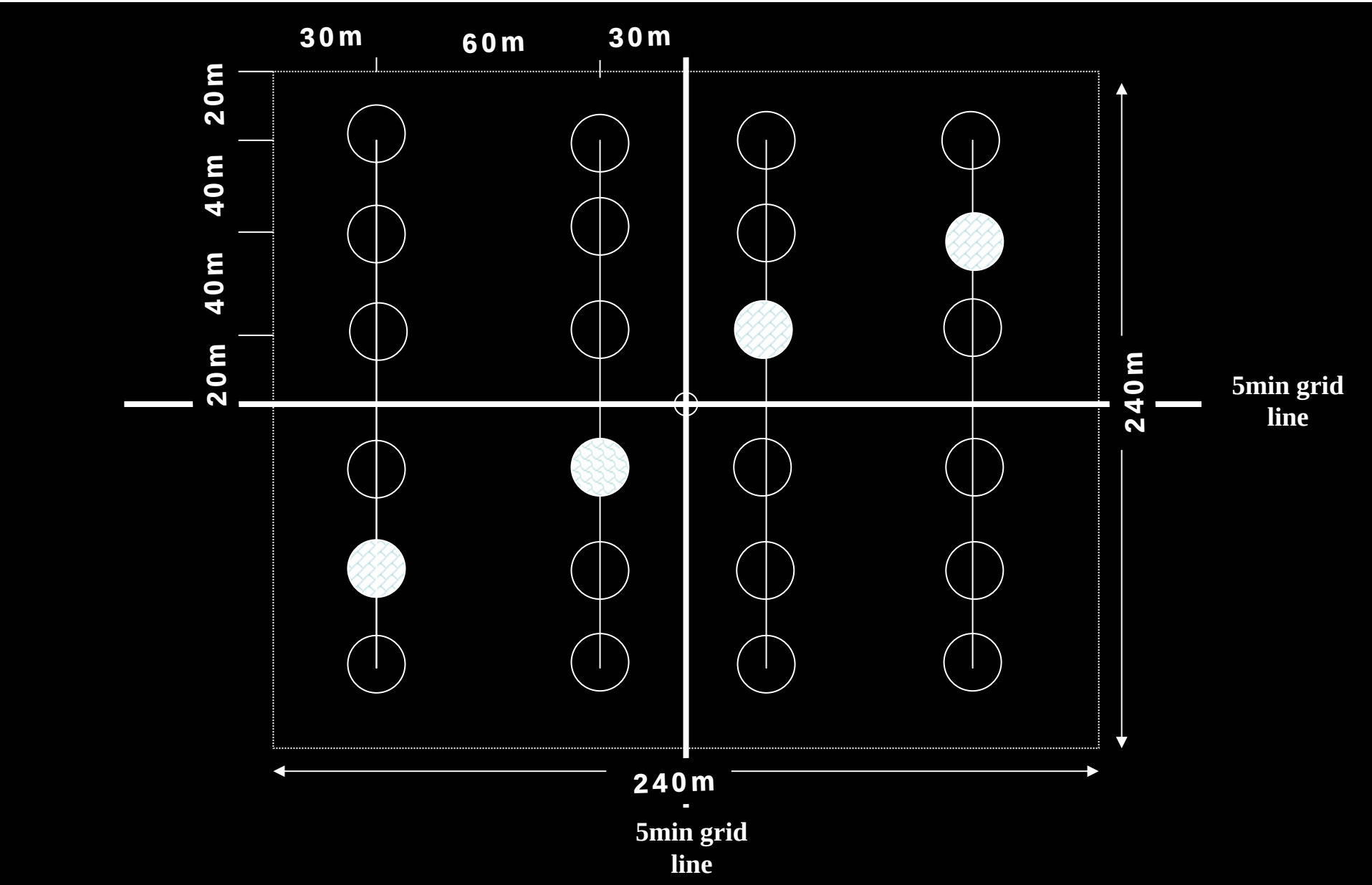
PHASE 2

The establishment of GIS to described in detail forest situation at these grid points

PHASE 3

Field sampling of all forest type on a random selected number of grid points according to predetermined accuracy standards

Layout of the National Forest Inventory Plot



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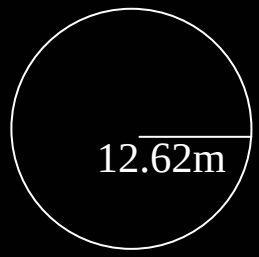


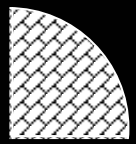
500m² **0.0500ha**

Trees ≥ 29.6 cm dbh

Stump, Rattan, Bamboo, Climbers

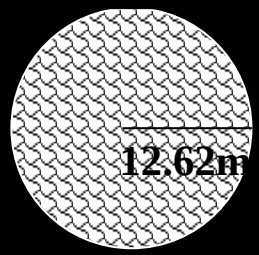
50m² **0.0050ha**

Saplings ≥ 1.5 m hgt - 4.5cm dbh



125m² **0.0125ha**

Small poles 4.6 cm - 9.5cm dbh



500m² **0.0500ha**

Big poles 9.6 cm - 29.5cm dbh

Trees ≥ 29.6 cm dbh

Stump, Rattan, Bamboo, Climbers

Minimum Sample Inventory Unit

Forest type / Strata	Strata Code	Estimated CV (%)*	SE (%)	Min. sample unit
Superior Nat. For.	11	30	15	20
Good Nat. For.	12	30	15	20
Moderate Nat. For.	13	30	15	20
Poor Nat. For.	14	55	-	15
Logged For. 11-20 yrs.	23	45	15	35
Logged For. 21-30 yrs.	24	40	10	65
Logged For. 31+ yrs.	25	35	10	50
TOTAL				225

* 95% probability level

Biomass Increments

- Under National Communication estimates of forest extent, stocking (volume and density estimates) and species composition is reliable based periodical inventory –country specific data
- However, above ground biomass increments and carbon stocks are still based on default factors by IPCC

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Forest Type	Forest Categories	Area of Forest/Biomass Stocks	Annual Growth Rate	Annual Biomass Increment
		(kha)	(t dm/ha)	(kt dm)
Inland	*Virgin Forest Good*	837.03	5.9	4,938.48
	Virgin Forest Moderate	723.31	5.9	4,267.55
	Logged-over 1-10 yrs (exclude enrichment planting)	563.13	9.16	5,158.31
	Logged-over 11-20 yrs	1,014.56	6.93	7,030.89
	Logged-over 21-30 yrs	705.94	4.61	3,254.36
	Logged-over 31-above yrs	620.32	4.17	2,586.73
Peat swamp	*Virgin Peat Swamp Forest*	100.56	2.22	223.23
	Logged-over Peat Swamp Forest	138.196	11.11	1,535.36
Mangrove		87.021	12.47	1,085.15

Mean Annual Increments

Plans to use more country specific increment data

- Mean Annual Volume Increments has been determined under SMS to be between 2.0-2.5 m^3/ha/yr
- Mean diameter increments 0.8-1.0 cm/yr
- Based on studies by Forestry Department and FAO in 1970's
- Current new data on MAI available from growth studies

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Growth and Yield Studies

- Many PSP's have been established over the years for various objectives, have different plot layouts and measurement protocol
- Currently 13 growth studies located in different parts of the country being used for estimating increments
- 5 plot layouts and some differences in measurements protocols
- Studies generally indicate and volume and diameter increments are lower than that estimated under current management practice (SMS)

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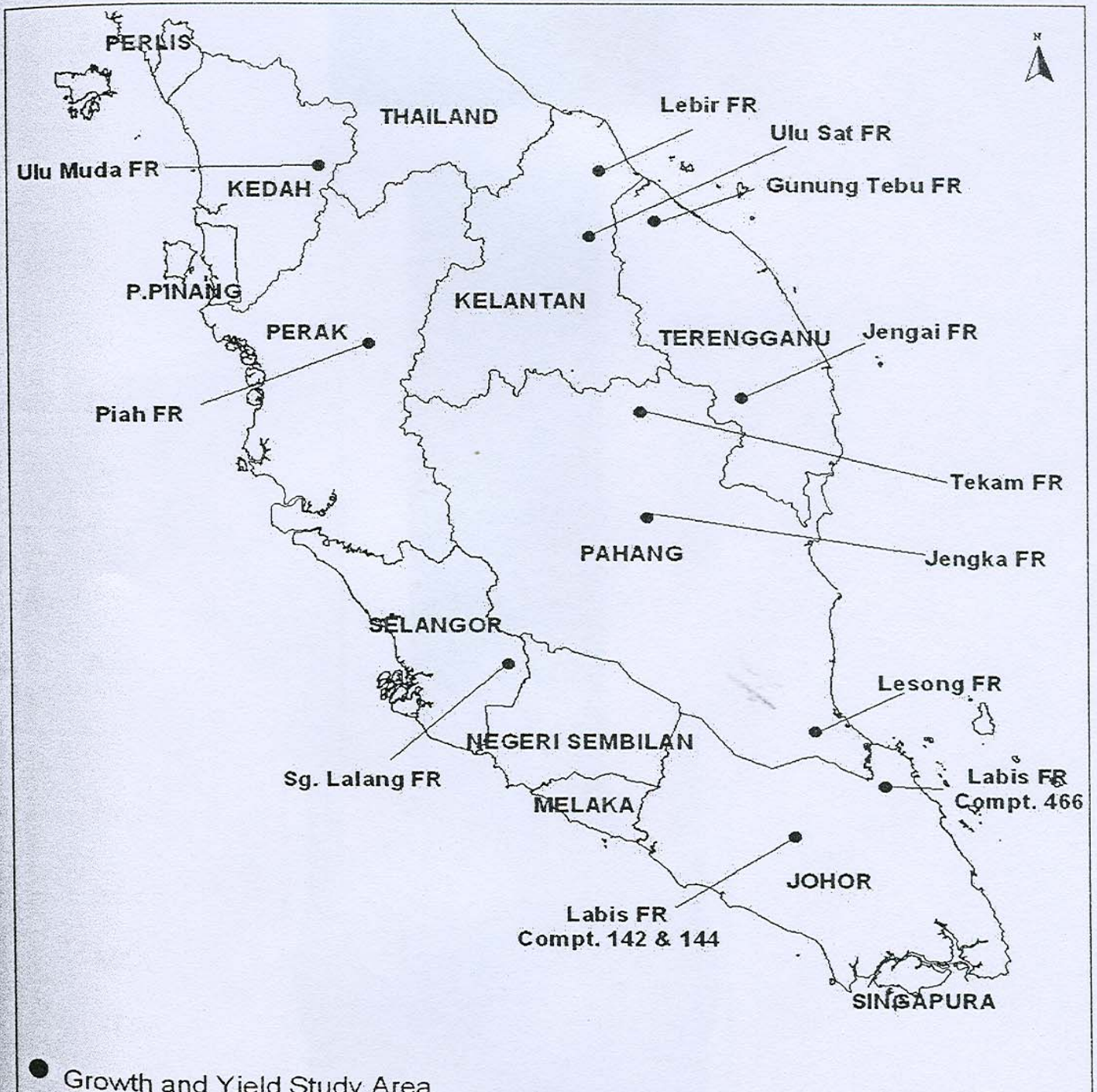

Location of Growth and Yield Plots in Pen. Malaysia

Biomass estimation

Estimation of forest biomass was carried out using allometric relationships obtained in this forest during IBP. This section summarizes the previous work on allometric relations in Plot 1 of the Forest Reserve (Kato *et al.* 1978). The height (H)of a given tree can be estimated from its d.b.h. (D) by the following formula:

$$\frac{1}{H} = \frac{1}{2.0D} + \frac{1}{61} \qquad [\mathrm{m},\ \mathrm{cm}] \qquad (1)$$

From the values of D and H, the dry mass of stem, branches, and leaves of the tree are estimated as:

$$M_s = 0.0313(D^2H)^{0.9733}, \qquad [\mathrm{kg},\ 10^{-4}\,\mathrm{m}^3] \qquad (2)$$

$$M_B = 0.136 M_s^{1.070}, \qquad [\mathrm{kg},\ \mathrm{kg}] \qquad (3)$$

and:

$$\frac{1}{M_L} = \frac{1}{0.124 M_S^{0.794}} + \frac{1}{125}, \qquad [\mathrm{kg},\ \mathrm{kg}] \qquad (4)$$

where M_S, M_B and M_L, respectively, denote the dry mass of stem, branches and leaves. The constants in equations 1–4 were determined using the whole range of tree diameters from samples taking no regard of species in Plot 1 (Kato *et al.* 1978), so that these relations are applied across species. The sampling method is detailed in Kato *et al.* (1978). The total above-ground biomass (TAGB) was computed by summing the above-ground biomass of individual trees ($M_S + M_B + M_L$; Fig. 1) for >5 cm d.b.h.

Increment Data

- From biomass estimate we can use default data to calculate carbon fraction
- These proposal are options that can be explored further to improve estimates compared to IPCC and other default values
- Constraints that there may not be applicable across the 3 regions in Malaysia
- Future – we are looking into soil estimates

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Thank you
Terima Kasih