JRC Scientific and Technical Reports

Expert Consultation on:
"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

20-22 November 2008, Kuala Lumpur, Malaysia

Editors: J.F. Dallemand, K. Sundram, H.J. Stibig

EUR 23979 EN - 2009

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MPOC

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Institute for Energy

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Proceedings of the Expert Consultation on:
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Acknowledgements

This Expert Consultation on “Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia", was held in Kuala Lumpur, Malaysia on 20-21 November 2008. This meeting was jointly organised by *Jean-Francois Dallemand* (Biofuels Action, Renewable Energies Unit, Institute for Energy, Joint Research Centre, European Commission), *Kalyana Sundram* (Malaysian Palm Oil Council - MPOC) and *Hans-Jürgen Stibig* (TREES Action, Institute for Environment and Sustainability, Joint Research Centre, European Commission).

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Table of Content

Expert Consultation on:

"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

20-22 November 2008, Kuala Lumpur, Malaysia

SESSION 1:

Forest monitoring & deforestation

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Expert Consultation
MPOC & JRC
20-22 Nov 2008
Kuala Lumpur

Session1: Forest Monitoring & Deforestation

Hans-Juergen Stibig
Global Forest Monitoring Project (TREES-3): South & Southeast Asia
European Commission
Joint Research Centre
Institute for Environment and Sustainability, Italy

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ies Institute for Environment and Sustainability

Session 1 Objective:

Improve knowledge on forest change and its relation to oil palm development

Where do we have good knowledge?

Where do we have incomplete / contradicting information?

Where is knowledge missing – need for further research?

Topics

•Types of forest land / related forest policies

•Forest Monitoring & Reporting

•Estimates and trends in forest area change (lowland forests, peat-land forests)

•Oil palm as a driver of forest change – how present projections affect forests

•Oil palm plantation practices (including fire)

•Potential impact of an increasing demand for palm oil as bio-fuel on remaining forests

•Impact of potentially increasing plantation area on environment & biodiversity

The JRC Global Forest Monitoring Action – TREES-3

Main motivation:

1. to reduce uncertainties in global estimates of forest cover change and related biosphere-atmosphere processes - one main focus on tropical forests
2. to provide information to European Commission services in support to the definition of policies in the framework of multilateral environmental agreements

➢ **two main activities:**

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Main activity (1): Up-date regional forest cover maps

- based on satellite imagery of ‘coarse’ spatial resolution

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Main activity (1): Up-date regional forest cover maps

Satellite image composite: Insular SE-Asia: Peninsular Malaysia (MODIS, 250-300 m)

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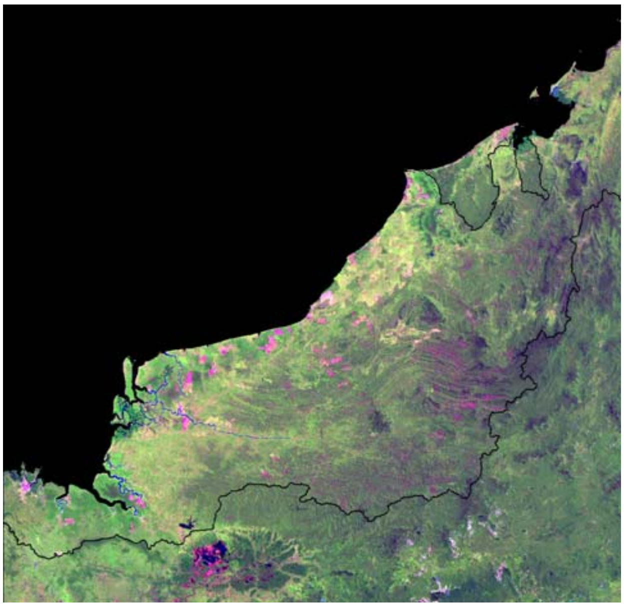
Main activity (1): Up-date regional forest cover maps

ies

Satellite image composite: Insular SE-Asia (MODIS 250-300 m): Borneo



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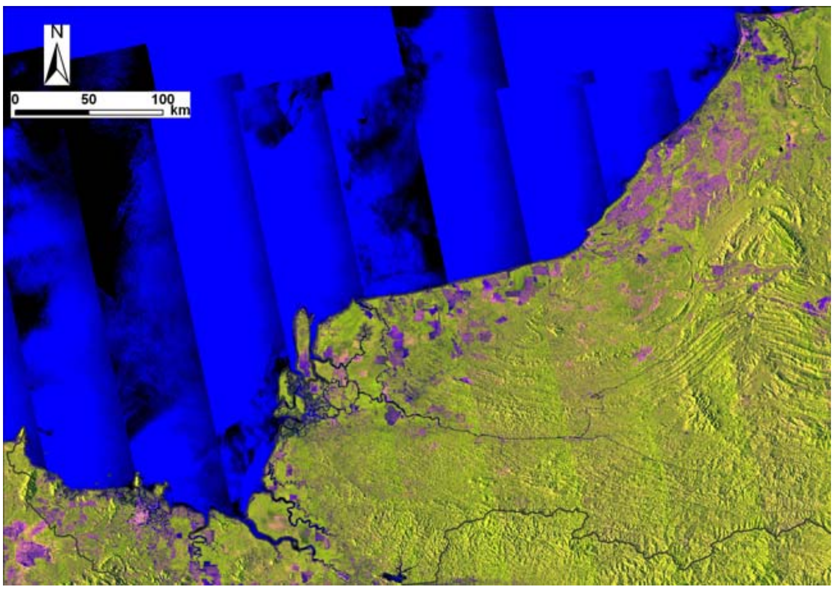
Main activity (1): Up-date regional forest cover maps

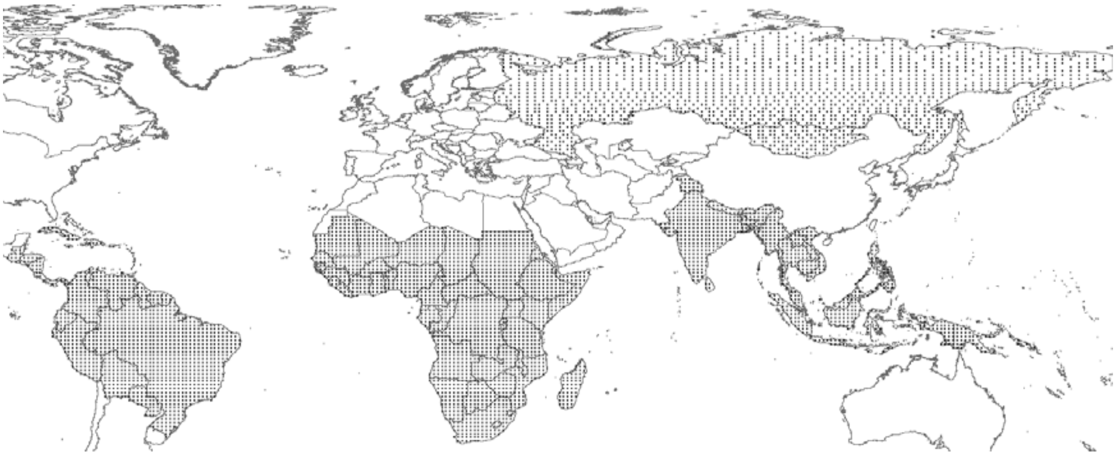
ies

Satellite image composite: Insular SE-Asia (PALSAR RADAR 50m): Borneo



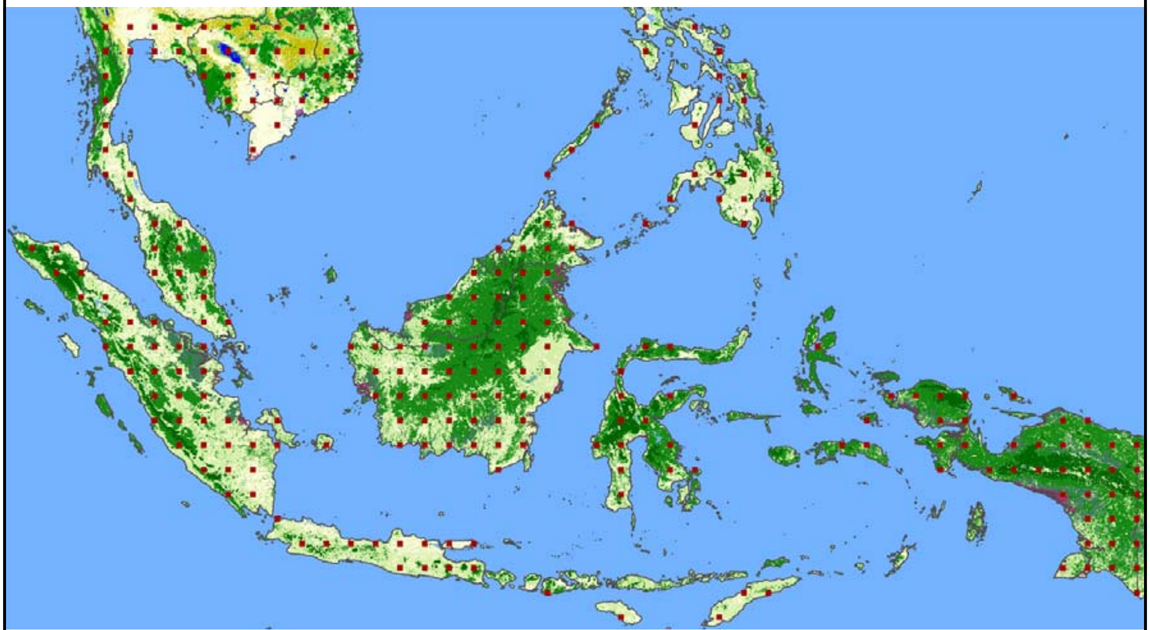
Main activity (2): Estimating forest change 1990-2000-2005

- based on a 1 deg x 1 deg sample of satellite imagery (20-30m resolution)
- in collaboration with FAO FRA 2010
  - supporting the FAO FRA Remote Sensing component for the tropics -



Main activity (2): Estimating forest change

TREES-3 / FRA 2010 Sampling Frame: Insular SE-Asia



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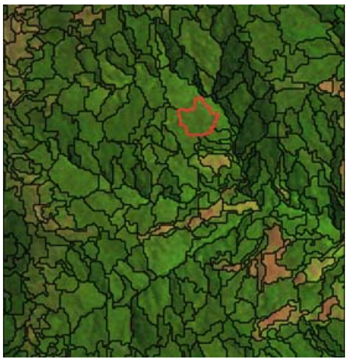
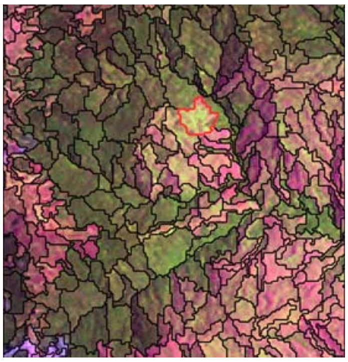
TREES-3 Technical Approach
Forest Cover Change Assessment

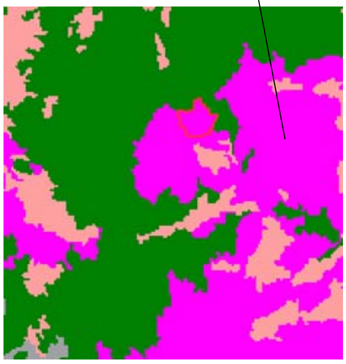


Forest Cover 1990



Forest Cover 2000

Forest Cover Change 1990- 2000



Sample site in PNG
- applying Image Segmentation techniques -

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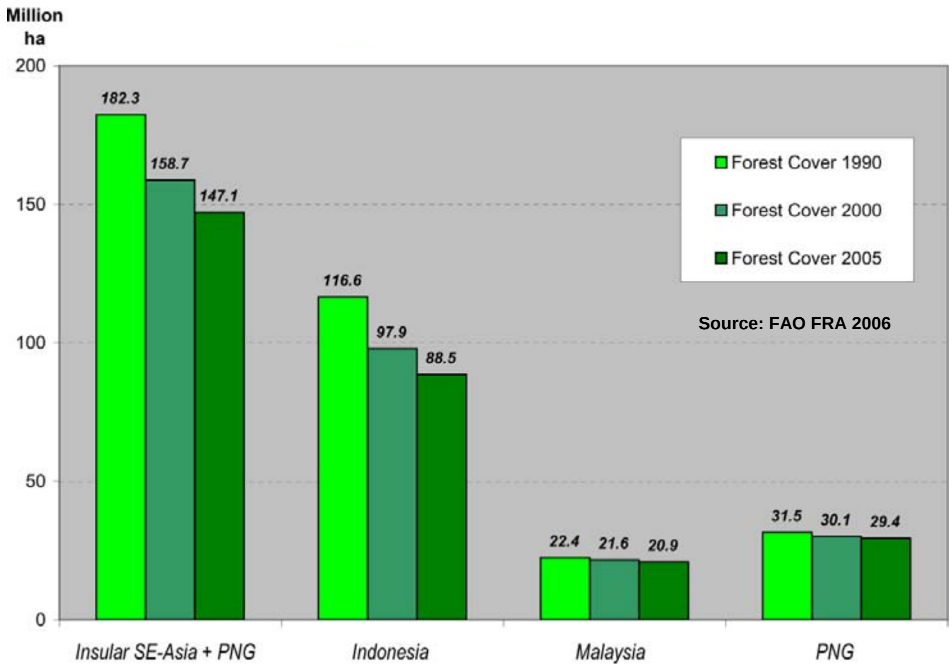
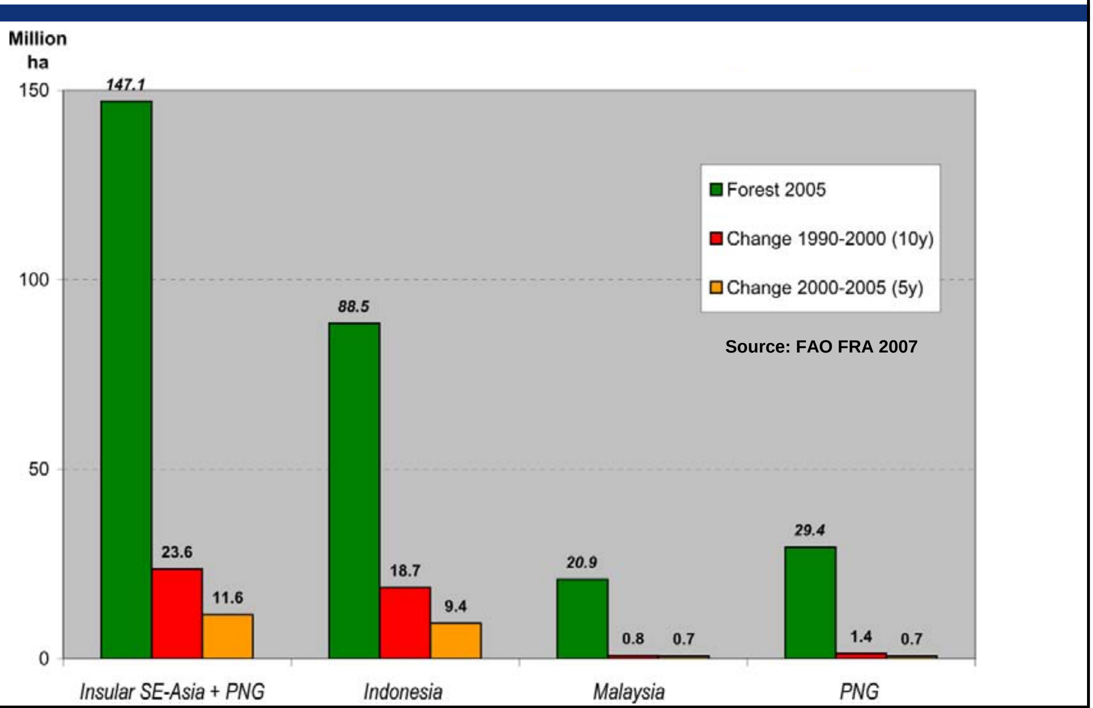
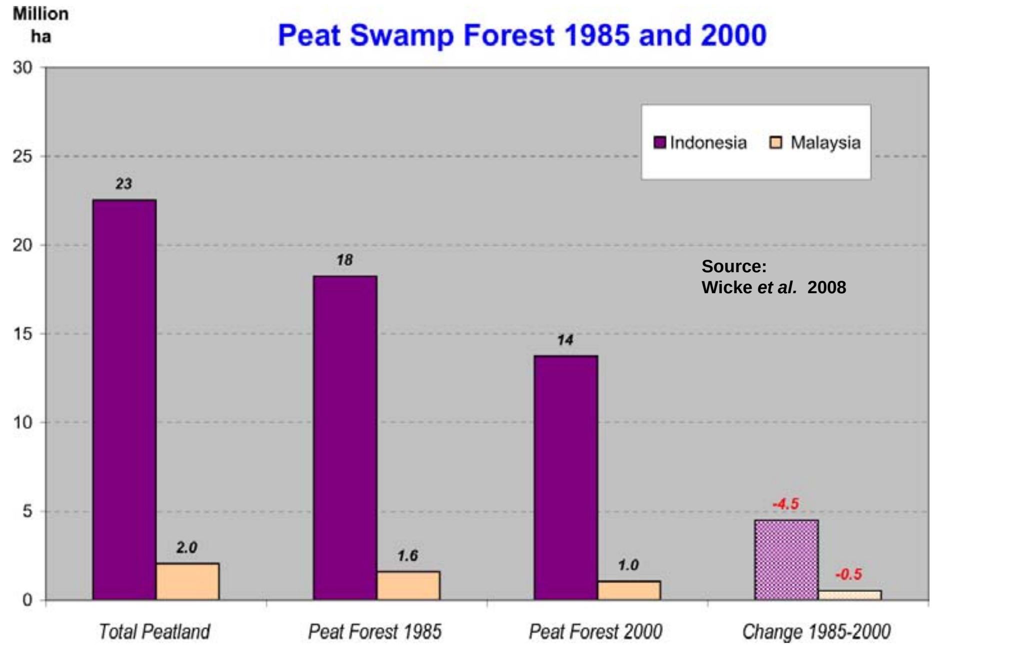
Forest Cover Estimates for Insular SE-ASIA



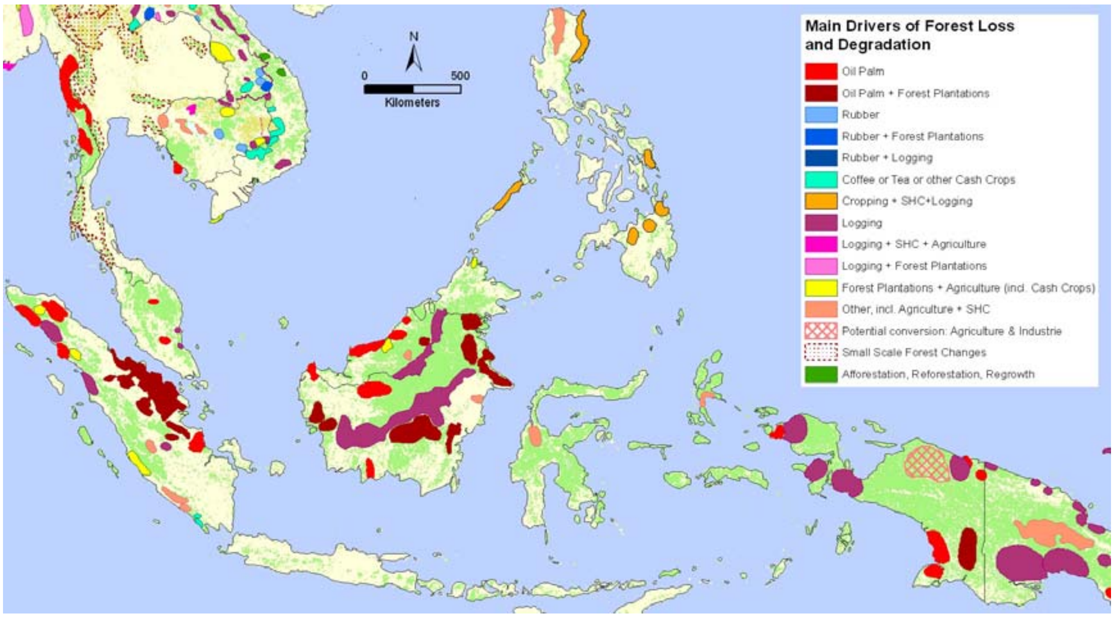
Forest Loss in Insular SE-ASIA 1990-2005



Forest Change in Insular SE-Asia



Regional pattern of forest change processes (based on expert knowledge)



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Regional JRC Workshops on Forest Change
Jakarta (INDONESIA) & Vientiane (LAOS) 2007

Main Drivers of Forest Change:

Sumatra & Borneo

- ***Cash Crop Plantation (Oil Palm)***
- ***Timber Plantations***
- ***Logging***

Papua & PNG

- ***Logging (increasing focus for timber industry)***
- ***Timber Plantations***
- ***Cash Crop Plantations (Oil Palm, expected to increase)***

Example: Logging & Oil Palm Plantations

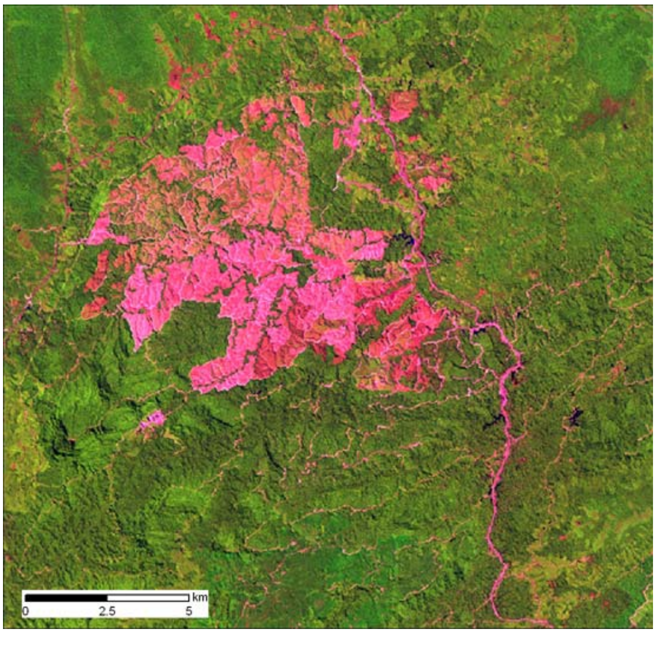
Sample:
(Sumatra)

Landsat TM
IKONOS

Example: Forest Plantations

Sample: N03E113
(Sarawak)

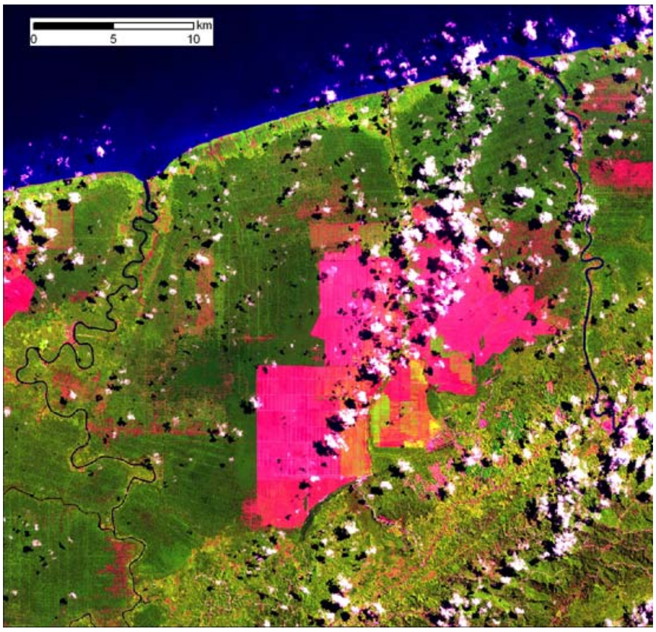
1990 – 2000
Landsat TM / ETM



Example: Oil Palm Plantations (Sarawak)

Sample: N03E112 (Sarawak)

1990 – 2000
Landsat TM / ETM



Impact of Deforestation

Loss of

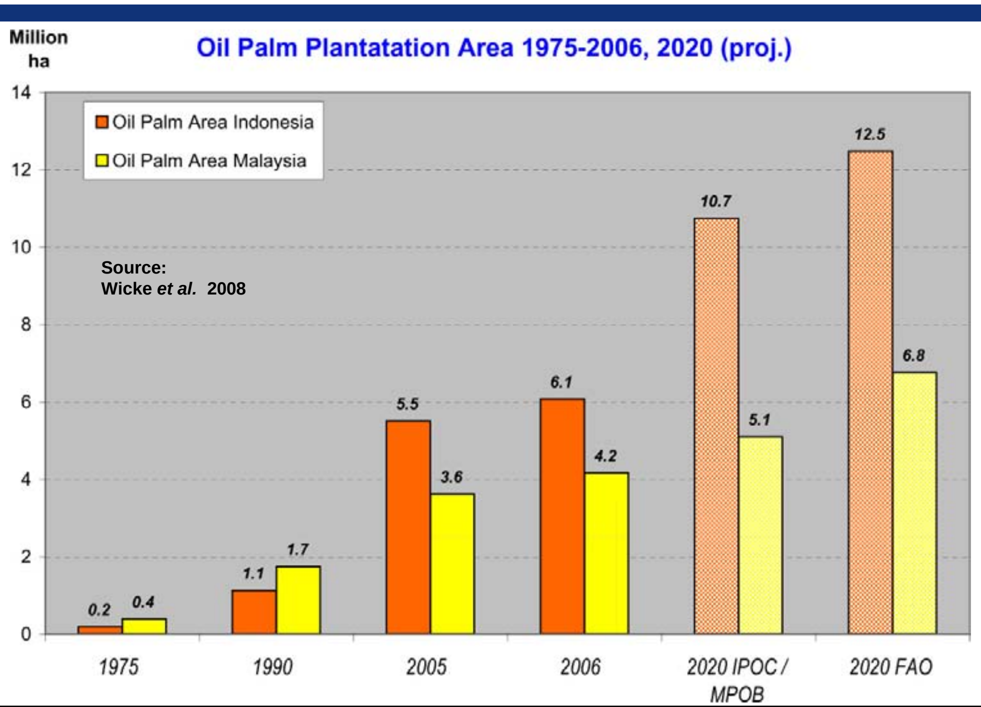
- Biodiversity – specific value of tropical forests
- Environment protection functions (erosion, watershed,..)
- Socio-economic functions & living space for people of the forests
- Forest production functions (timber, NTP)

Impact of Deforestation

•C- emissions from tropical deforestation

	Lowland Forest	Peat Swamp Forest
Example assuming:	*t C/ha*	*t C/ha*
–Removal of tree cover (120-180 and 50-150t C/ha)	150	100
–Soil Carbon Loss	30	--
–Burning of 30 cm [560 t C / ha / m thickness]	--	170
–Oxidation of drained peat [10-20 t C / ha / y] * e.g.15y	--	225
	180	495

Oil Palm Plantation Area in SE-Asia



Direct and Indirect Impacts of Biofuels Policies (National, European and Global) on Deforestation

Expert consultation:
Joint Research Centre (JRC) of the European Commission
& Malaysian Palm Oil Industry (MPO)

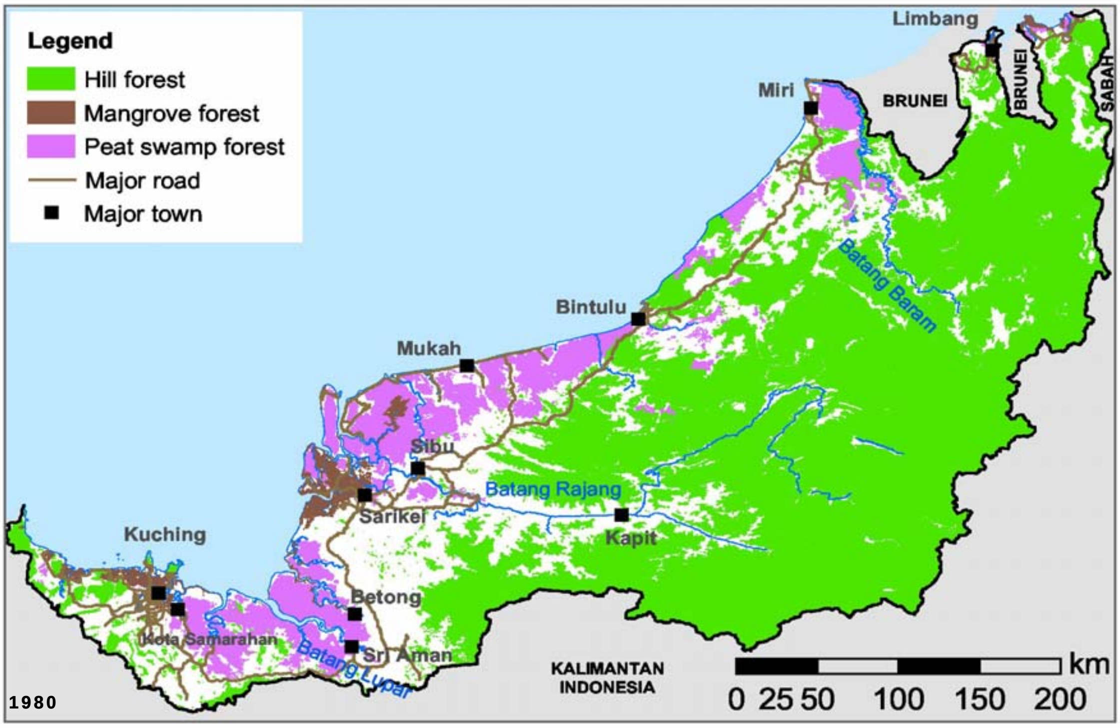
J. Wong, Forest Department Sarawak

Forest Change in Sarawak (1980-2005)

Areas in Ha

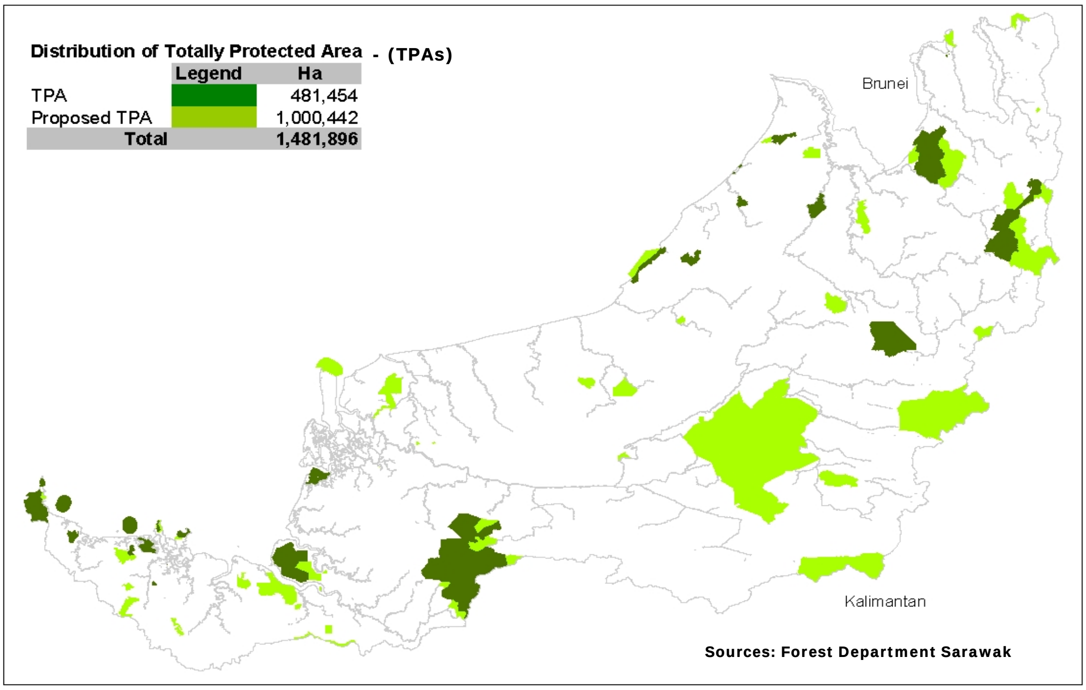
Forest Types	1980	1990	2005
Hill Mixed Dipterocap	7,784,986	7,044,788	6,547,400
Peat Swamp Forest	1,174,050	761,704	450,129
Mangrove Forest	173,788	168,030	125,508
Secondary Forest	2,250,700	3,336,005	3,944,271
Total:	11,383,524	11,310,527	11,067,308

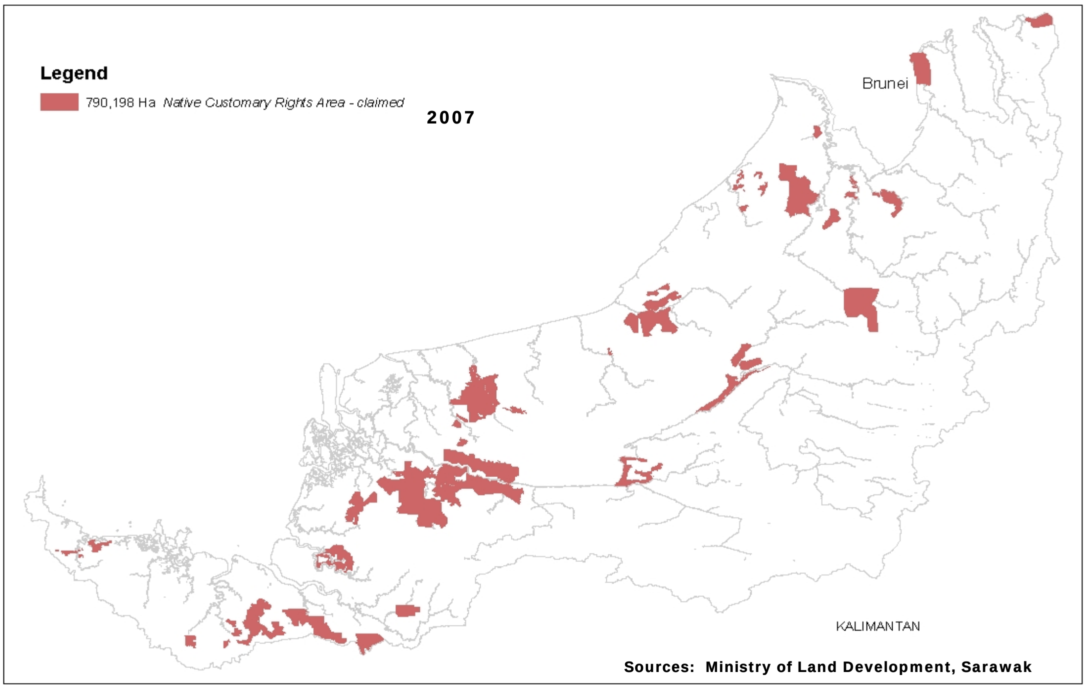
Sources: Forest Department Sarawak



Land Classification and its uses in Sarawak

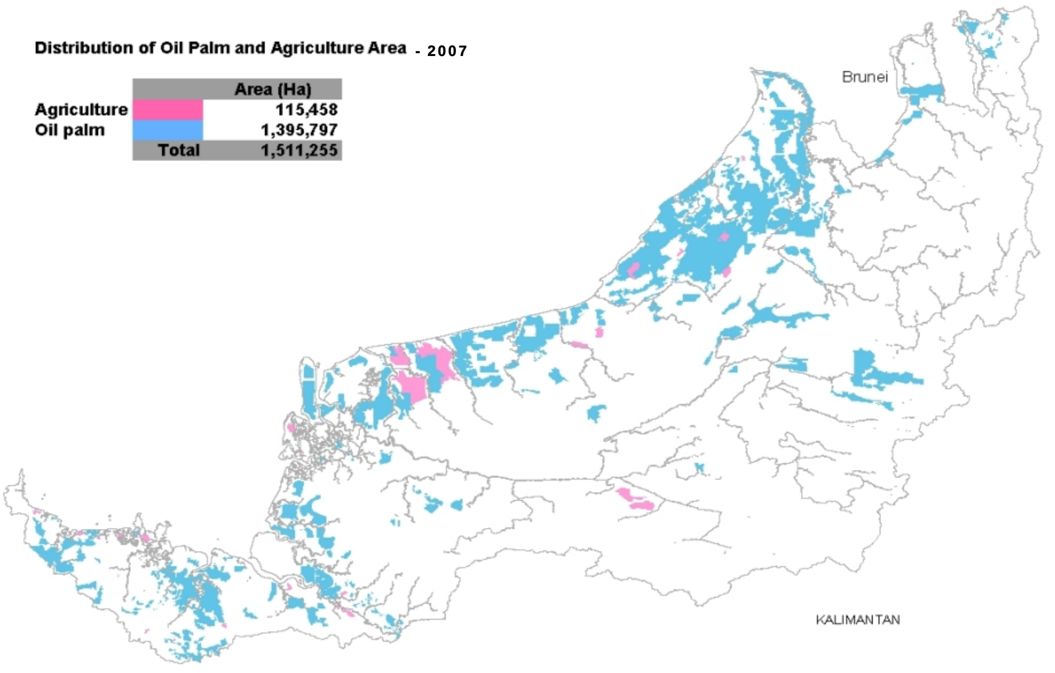
- TPA – Totally Protected Area
  - conservation of habitats and biodiversity;
  - Environmental protection;
  - Protecting areas of natural and cultural significance;
  - Provision of socio-economics benefits;
  - Provision of locations for environmental education and scientific research;
- PFE – Permanent Forest Estate
  - Protected land allocated for timber production
  - Harvesting is done on sustained yield basis based on prescriptions as laid out in the Forest Management Unit (FMU)
  - Each concession areas has it own Forest Management Plan which forms part of the Forest Timber License
  - Target 1 million ha for forest plantation Area
- NCR – Native Customary Rights
  - Land subjected to Native Customary Rights claim
  - Government aided agriculture plantation
  - Small holders cash crop or agriculture
- StateLand
  - land for other usage that can be converted for agriculture


Distribution of Totally Protected Area - (TPAs)
Legend Ha
TPA 481,454
Proposed TPA 1,000,442
Total 1,481,896
Brunei
Kalimantan
Sources: Forest Department Sarawak


Legend
790,198 Ha Native Customary Rights Area - claimed
2007
Brunei
KALIMANTAN
Sources: Ministry of Land Development, Sarawak

Distribution of Oil Palm and Agriculture Area - 2007

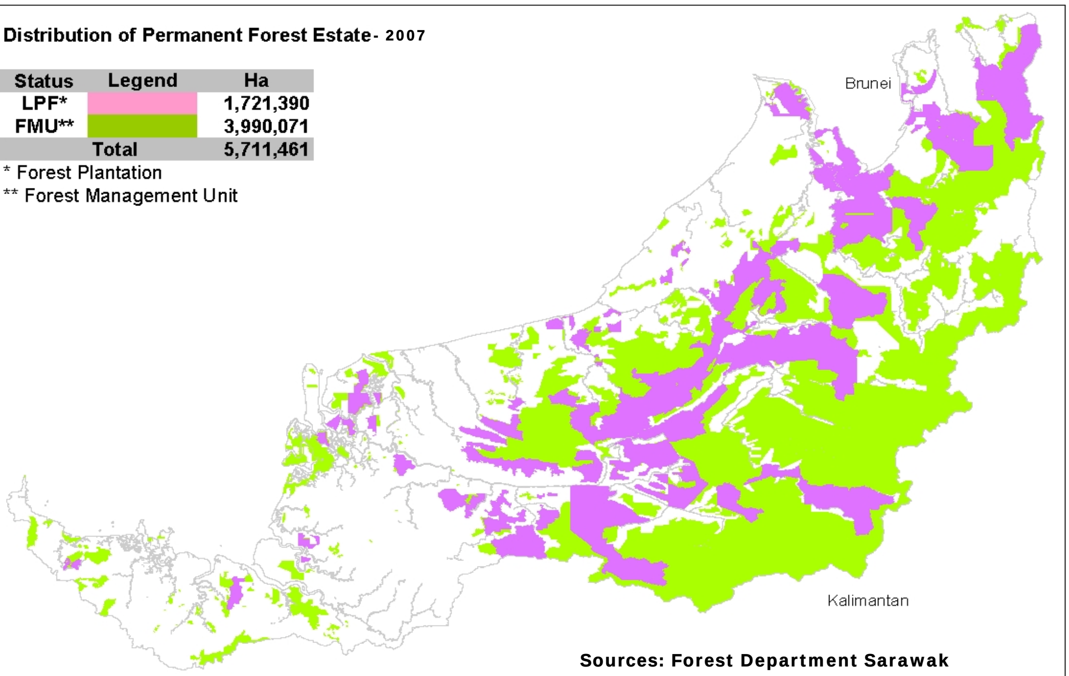
	Area (Ha)
Agriculture	115,458
Oil palm	1,395,797
Total	1,511,255



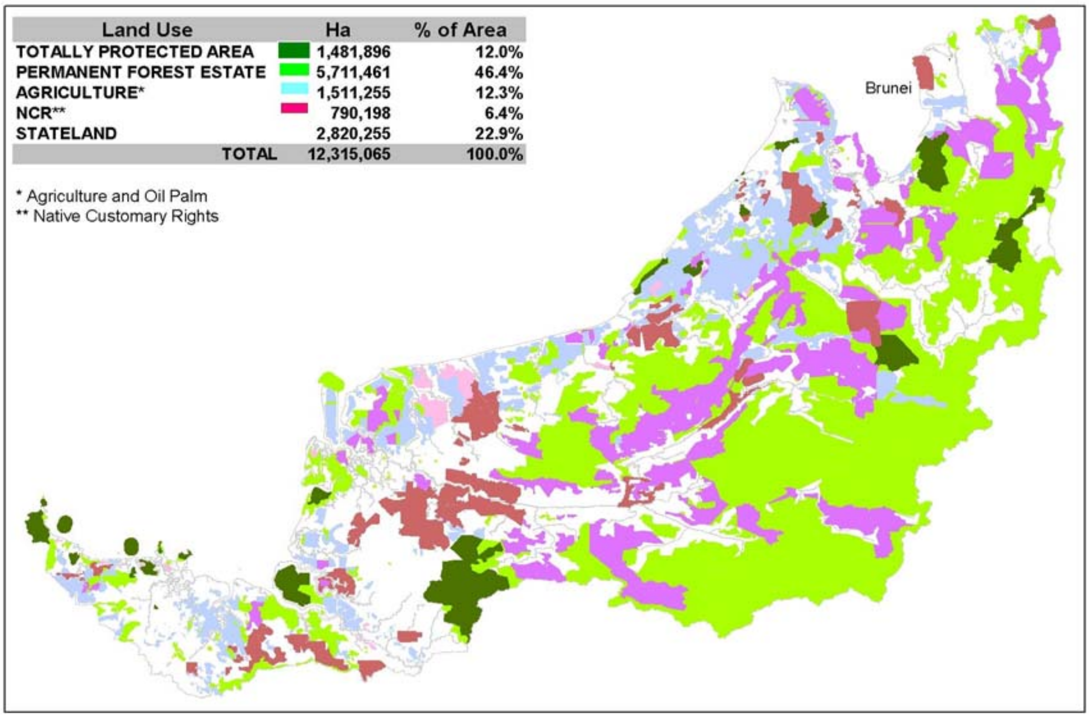
Distribution of Permanent Forest Estate - 2007

Status	Legend	Ha
LPF*		1,721,390
FMU**		3,990,071
Total		5,711,461

* Forest Plantation
** Forest Management Unit



Sources: Forest Department Sarawak



Development of Oil Palm Plantation in Sarawak

Status of Oil Palm Development

	Potential	Planted	Target
Stateland	1,345,101	478,362	464,096
LPF	235,904	75,000	235,904
NCR	792,997	174,620	300,000
Total	**2,374,002**	**727,982**	**1,000,000**

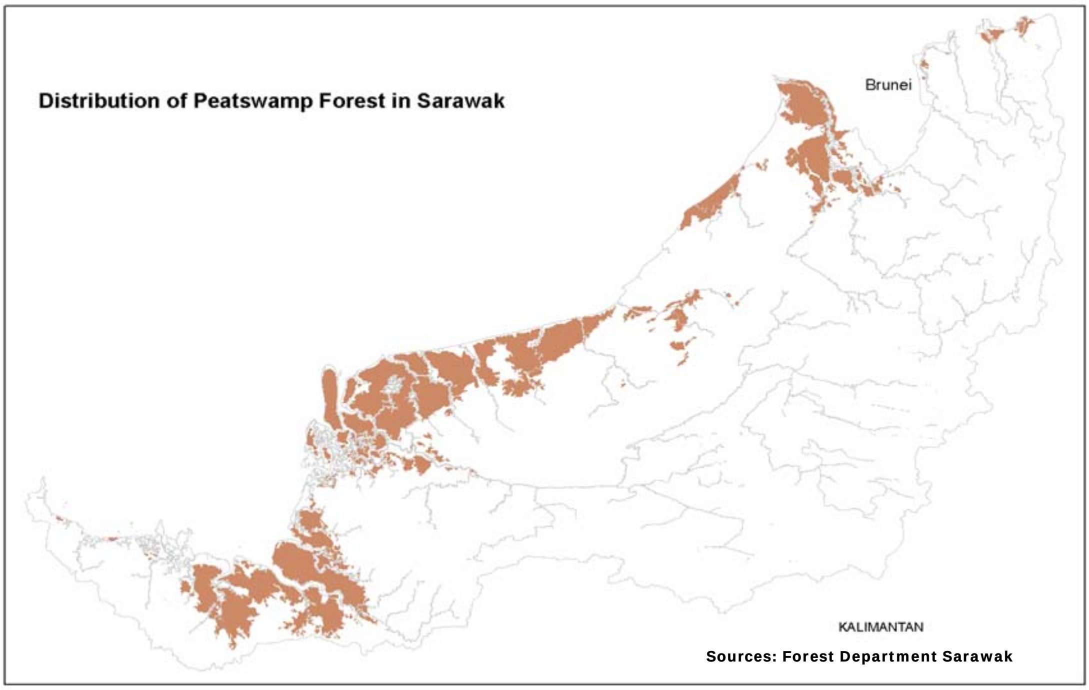
Sources: Ministry of Land Development
Forest Department Sarawak

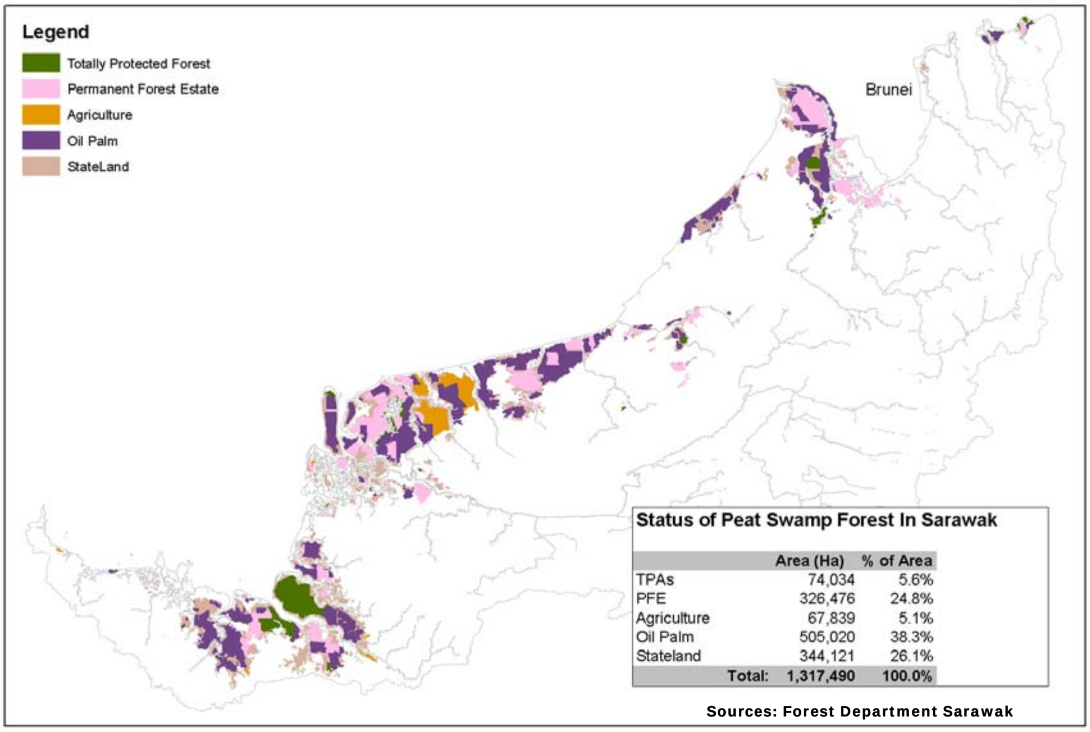
Role of Oil palm in Forest Change in Sarawak

- Government Targeted 1 million ha to be developed by 2010 with 400,000 ha from NCR
- 727,982 ha planted(73% of targeted 1 million ha)

Possible Future Trend of Oil Palm Extensions

- Degraded Shifting Cultivation area?
- Land under Native Customary Rights Claims?





Status of Peat Swamp Forest In Sarawak

	Area (Ha)	% of Area
TPAs	74,034	5.6%
PFE	326,476	24.8%
Agriculture	67,839	5.1%
Oil Palm	505,020	38.3%
Stateland	344,121	26.1%
Total:	1,317,490	100.0%

Report on:
Session 1: Deforestation – Forest Monitoring

Dr. Gary Theseira

Expert Consultation: Joint Research Centre of the EC & the Malaysian Palm Oil Industry

21st November, 2008,
Shangri La, Kuala Lumpur

Axioms:

- Tropical forests in Malaysia are uniquely different from other land uses and are worth conserving.
- It would be unreasonable to assume that no forests should be converted to other land uses.
- Deforestation would result in emissions and loss of bio-d
- Direct impacts of palm biodiesel demand on OP expansion 0.7% of market
- Indirect impacts (definition needed) of biofuel demand on OP expansion not entirely understood.

Goals:

- Improve knowledge on forest change and OP development
- Determine areas where we have good knowledge vs. poor or contradicting information
- Identify further research needs

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FOREST RESEARCH INSTITUTE MALAYSIA (FRIM)

1.Types of forest land and forest policies (1)

• Forest classification schemes are purpose-based and therefore not necessarily consistent across management units, e.g. Peninsular Malaysia, Sabah and Sarawak.

• Within any given forest classification scheme, forest and other land-use classes need to be defined and the range of acceptable use clarified.

• Which, if any, classes are bound or limited by legal instruments or policy statements, and what are the limits?

• What action has been or should be taken in the event of a violation, e.g. encroachment?

1.Types of forest land and forest policies (2)

• Relationships between land-use classes needs to be understood, particularly where classes may be nested, may overlap, or where coverage might not be comprehensive.

•The relationships between each class to the total land area must be clear.

• Some tools for assessing HCV areas exist.

• Transparency in HCV determination needed.

• Methodologies not defined

• Indirect impacts not understood

• Commodities will tend to find their own equilibrium

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FOREST RESEARCH INSTITUTE MALAYSIA (FRIM)

Permanent Forest Estates = Permanent Reserve Forests?
(PRFs and PFEs)

In general understood as natural forest areas that are managed either as totally protected areas or as selectively logged forest (with an extraction rate of 7 to 12 trees per hectare per cycle). Low risk for deforestation.

Intermediate to high C stocks

Totally Protected areas (TPAs) or Protection Forest

Self explanatory; consisting of lands selected based on rich biodiversity or flora and fauna endemism otherwise designated as HCV areas (sometimes distinguished from Protected Forest or Protected Areas). Low risk for deforestation.

High C Stocks

Degraded Lands = Degraded Forest?

Lands that have been either logged previously or used for shifting cultivation. Usually State Land Forest or Alienated lands.

Permanent Reserve Forests, when managed according to the sustainable criteria should theoretically never reach the status of degraded lands.

Low to intermediate C stocks

Native Customary Rights Lands (NCR) = Communal forest?

Lands previously used by local peoples for sustenance farming and currently abandoned and now primarily stocked with weedy species and pioneer or secondary forest vegetation

Low to intermediate C stocks

Peatlands/Peatswamp Forest
Understood as forested ecosystems formed under saturated soil conditions and characterized by organic soils of variable depth. Generally agreed to have high C density.
High C stocks

Plantation Forests/Tree Plantations/Non-Forest Tree Plantations
Poorly defined classification which needs clarification that makes no distinction between long-rotation tree species such as teak, intermediate rotation species such as Acacia and Eucalyptus, or Food and Fibre crops, including OP, coffee, cocoa, etc.
Variable C stocks

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Agro-forestry and the interface to Agriculture
Another poorly defined classification for obvious reasons
Variable C stocks

State Land Forests = Conversion Forest
Land of variable afforestation or degradation status that is designated as Malaysia's development land bank.
Variable C stocks

A more detailed glossary based on a harmonized definitions would improve understanding and facilitate communication.

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FOREST RESEARCH INSTITUTE MALAYSIA (FRIM)

Policies:

• Peninsular Malaysia, Sabah, Sarawak and Indonesia all have forest and land use policies in place.

• These policies need to be understood in the context of development policies that have been adopted.

• Policy implementation varies (e.g., 126,000 out of 500,000 ha NCR planted to OP)

• Success (as measured by compliance/violations) varies and needs to be monitored.

• Land use planning is in place in Malaysia to avoid uncontrolled deforestation.

Some policies are based on bounds:

Lower bound for PFEs, PRFs and TPAs
• 1 million ha TPAs
• 6 million ha PFEs

Upper bound for OP Plantations
• 1 million ha OP
• 500,000 ha on NCR
• 1 million ha Fast Growing species in PFEs

Others on permissible use or suggested conversion
• Degraded lands recommended for converted to forest plantations
• Permissible establishment of OP on peat (and if so under what conditions)

Mechanisms to enhance compliance and methods to correct policy contravention.

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2. Forest monitoring & reporting

- Both ground-based and remotely sensed data should be used for monitoring

- Bodies, Institutes, Departments or Agencies responsible should be identified.

- Availability of data and Consistency of data between agency should be verified.

- Reports are generated annually and should be checked against policy objectives/limits.

3. Estimates and trends in forest area change (lowland/peat) data sources … FAO etc

As described in section 2, data on the current extent of OP plantations and the potential areas for development are readily available. Of the 270,000 ha that remain to be developed for OP in Sarawak, it is almost certain that a significant area will be developed on peat soils. As such it would not require undue effort to quantify the impacts of the range of probable scenarios,

4. Oil palm as a driver of forest change – present projections about fate of remaining forest

While the existing hectarage of OP plantations remains below policy limits, Malaysia will continue to increase yields from existing OP plantations and develop additional OP plantations (following recommended guidelines) to meet global demands. However, Malaysia will not exceed policy-based area limits once they are reached. Thereafter, any increase in production to meet additional demand will have to be accomplished through yield enhancement.

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5. Oil palm practices – including fire

National (Federal) environmental regulations for best practices correspond with those recommended by the RSPO.

In some cases, State environmental regulations are more liberal:
As an example, the burning of residues is permitted in some situations.

There are certainly situations where the presence of an organic soil makes the use of fire an unacceptable risk.

There are also practices related to the special needs of peat and organic soil ecosystems including:
- water table management
- compaction of substrate to increase bearing strength and reduce oxidation rates and subsequent CO_2 evolution
- emerging technologies to enhance fertility, etc.

6. Potential impacts of increasing demand as biofuel on remaining forests

As described under item 4, there will be limited development of new plantations (approximately 270,000 ha) based on the 500,000 ha target for NCR lands, the current hectarage (determined by remote sensing) of 727,982 ha, and the total overall target of 1 million ha for OP plantations in Sarawak.

In most cases, the land that is being targeted for conversion is NCR land which was previously used for slash and burn or shifting cultivation (sustenance farming) and has since been abandoned.

As mentioned earlier, Peninsular Malaysia and Sabah are at or close to their limits for plantation expansion and will therefore undergo minimal forest conversion.

Additional OP hectarage will, in all probability, be sourced from other agricultural land areas or non-PFE land.

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7. Impact of potentially increasing plantation area on environment and biodiversity

As described under items 4 and 6 above, the land that is being targeted for conversion is NCR land which was previously used for slash and burn or shifting cultivation. Due to anthropogenic disturbances, these lands are unlikely to have a biodiversity complement and conservation value equal to TPAs or even of PFEs. As such, the conversion of such areas into OP will likely have a minimal effect on biodiversity and other ecosystem services.

Expert Consultation on:

"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

20-22 November 2008, Kuala Lumpur, Malaysia

SESSION 2:

Biodiesel from palm oil: Life Cycle Analysis and GHG emissions

GHG Emissions: From Oil Palm Cultivation to Biodiesel Production

Dato' Dr. Mohd Basri Wahid
Director General
Malaysian Palm Oil Board

MPOB

Ministry of Plantation Industries and Commodities, Malaysia

Presentation Outline

MPOB

- Biofuel Policy
- Demand and Supply
- EU Directive
- LCA – Oil Seed and Oil Palm
- Upstream – Land Use Change, GHG Emissions
- Conclusion

National Biofuel Policy

Released in March 2006

- Use of environment-friendly, sustainable and viable alternative source of energy in order to reduce dependency on depleting fossil fuels; and
- Enhanced prosperity and well-being of all the stakeholders in the agriculture and commodity-based industries, through stable and remunerative prices

Five Strategic Thrusts

Thrust 1: Biofuel for Transport Sector

Thrust 2: Biofuel for Industrial Sector

Thrust 3: Biofuel Technologies

Thrust 4: Biofuel for Export

Thrust 5: Biofuel for Cleaner Environment

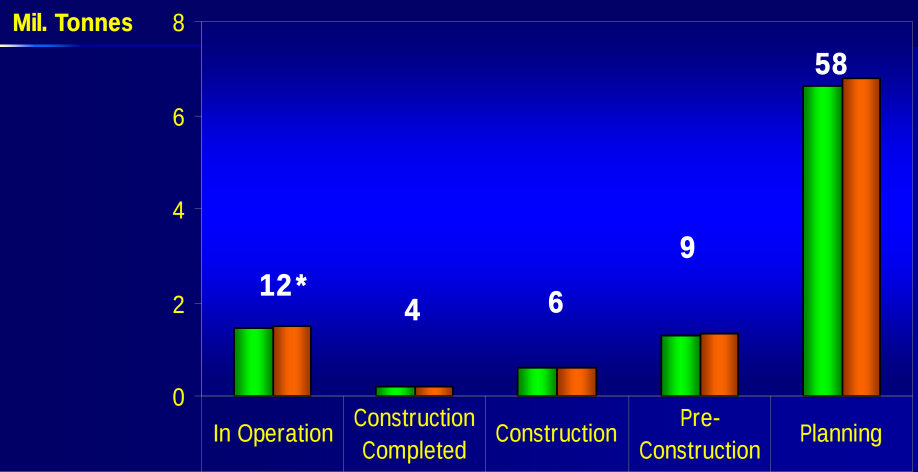
Mandatory Blending (Biodiesel)

- Require 500,000 t/year biodiesel for 5% blend
- RM 200 million allocated for implementation
- February 2009 in Government Vehicles, subsequent nationwide

Biodiesel Production

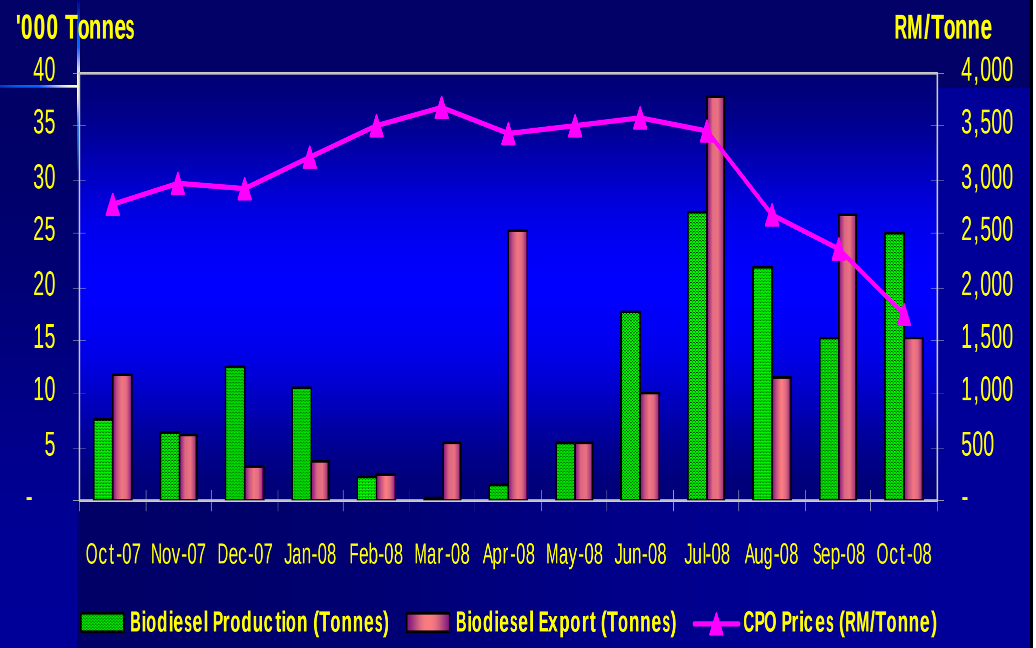
- 12 biodiesel plants in operation with combined capacity of 1.5 million t/year
- Four plants completed, yet to start operation (190,000 t/year)

Progress of Approved Biodiesel Projects (October 2008)



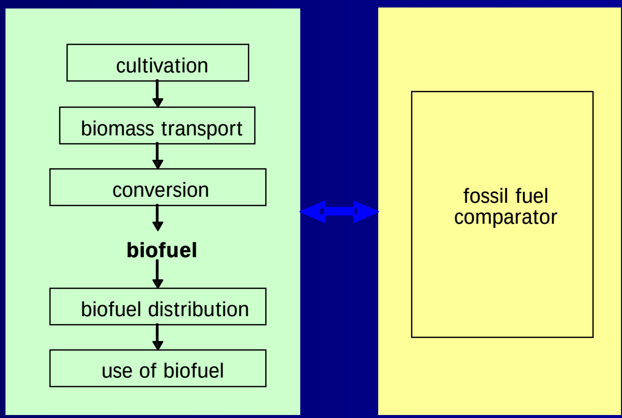
	In Operation	Construction Completed	Construction	Pre-Construction	Planning
Biodiesel Capacity	1,472,000	190,000	605,000	1,306,500	6,620,130
Feedstock Requirement	1,498,750	192,000	608,000	1,315,895	6,787,276

Production and Export of Biodiesel (Tonnes) and CPO Prices (RM/Tonne) (Oct 2007 – Oct 2008)



Scope: Life Cycle Greenhouse Gas emissions

- Comparison on the basis of the fuel (gCO_2eq/MJ)



“Off limit” areas

- Highly biodiverse land
- High carbon stock land
  - Wetlands, peatlands and continuously forested areas

Calculation of GHG emissions

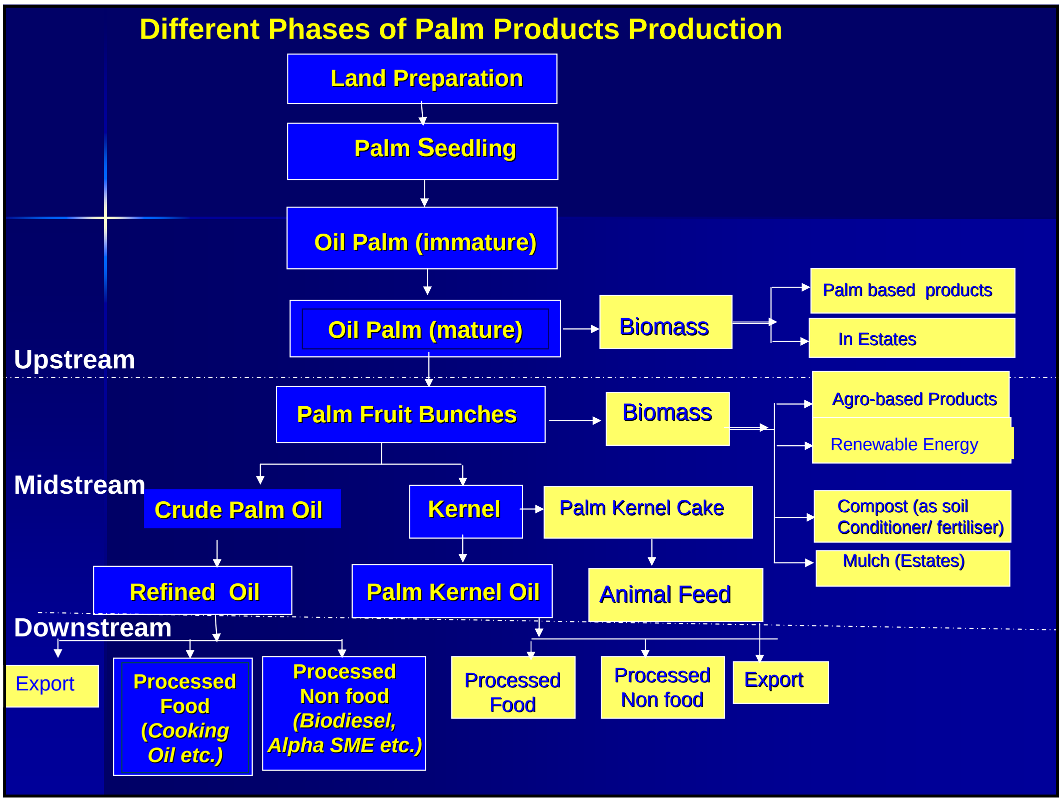
$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{ccs} - e_{ccr} - e_{ee}$$

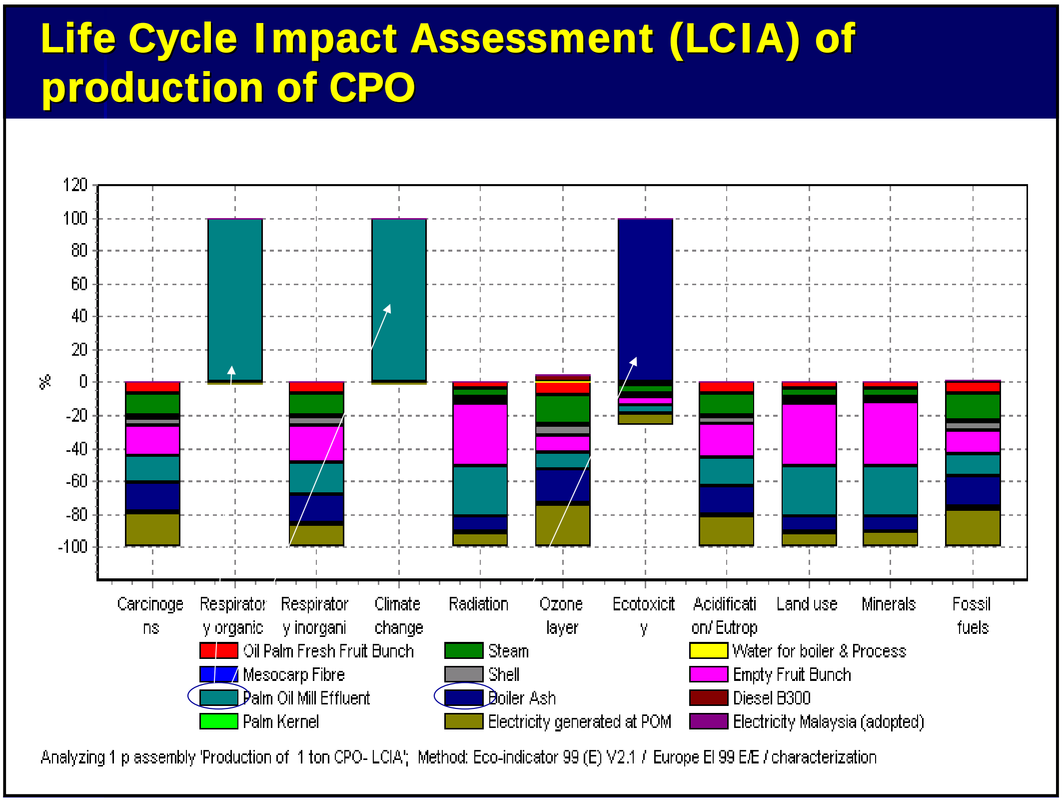
E	total emissions
e_{ec}	emissions from the extraction/cultivation of raw materials
e_l	annualized emissions from C stock changes caused by land use change
e_p	emissions from processing
e_{td}	emissions from transport and distribution
e_u	emissions from the fuel in use
e_{ccs}	emission savings from C capture and sequestration
e_{ccr}	emission savings from C capture and replacement
e_{ee}	emission savings from excess electricity from cogeneration

Damage Categories

No	Impact Category	Damage Category	Emissions to	Examples
1	Carcinogens	Human Health	Air, Water & Soil	Chlorinated compounds, Heavy metals
2	Respiratory Organics	Human Health	Air	Organic particulates
3	Respiratory inorganic	Human Health	Air	Particles from combustion processes
4	Climate Change	Human Health	Air	CO2 from combustion, CH4 from anaerobic digestion
5	Radiation	Human Health	Air, water & soil	Cobalt, hydrogen, Radon, Plutonium etc
6	Ozone Layer	Human Health	Air	CFC 11, HCFC 22
7	Ecotoxicity	Ecosystem Quality	Air, water & soil	Pesticides, Heavy metals
8	Acidification Eutrophication	Ecosystem Quality	Air Water	SOx, NOx NO3 from fertilizers, Nitrogen& Phosphate compounds
9	Land Use	Ecosystem Quality	-	Emissions from raw materials, traffic
10	Minerals	Resources	-	Al, Fe, Cu, Pb
11	Fossil Fuels	Resources	-	Coal, oil, gas

(Goedkoop & Spriensma 2001)


Different Phases of Palm Products Production
Land Preparation
Palm Seedling
Oil Palm (immature)
Oil Palm (mature)
Biomass
Palm based products
In Estates
Upstream
Palm Fruit Bunches
Biomass
Agro-based Products
Renewable Energy
Midstream
Crude Palm Oil
Kernel
Palm Kernel Cake
Compost (as soil Conditioner/ fertiliser)
Mulch (Estates)
Refined Oil
Palm Kernel Oil
Animal Feed
Downstream
Export
Processed Food (Cooking Oil etc.)
Processed Non food (Biodiesel, Alpha SME etc.)
Processed Food
Processed Non food
Export


Life Cycle Impact Assessment (LCIA) of production of CPO
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
%
Carcinogens
Respiratory organic
Respiratory inorganic
Climate change
Radiation
Ozone layer
Ecotoxicity
Acidification/ Eutrop
Land use
Minerals
Fossil fuels
Oil Palm Fresh Fruit Bunch
Mesocarp Fibre
Palm Oil Mill Effluent
Palm Kernel
Steam
Shell
Boiler Ash
Electricity generated at POM
Water for boiler & Process
Empty Fruit Bunch
Diesel B300
Electricity Malaysia (adopted)
Analyzing 1 p assembly 'Production of 1 ton CPO- LCIA'; Method: Eco-indicator 99 (E) V2.1 / Europe EI 99 E/E / characterization

LCI of OP cultivation, for production of 1 ton FFB

Input Output / parameters	N (kg)	P2O5 (kg)	K2O (kg)	Diesel (l)	Pesticides	Yield (t/ha)
Average over 102 estates	3.49	2.8	11.5	2.37	0.126	20.5

Comparison of fertilizer usage for oil palm and oil seed crop (kg/t oil)

	N	P_2O_5	Pesticides
Oil Palm	18.62	14.15	0.126
Soya Bean	124.77	101.34	1.827
Sunflower	38.03	94.73	1.764
Rapeseed	39.22	55.36	0.693

Source: FAO 1999

Total CO_2 Emissions in Plantation

Total CO_2 emission in the plantation

= 7 g CO_2/MJ biodiesel,

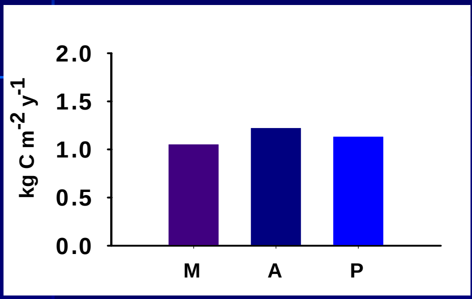
Much lower than 18 gCO_2 /MJ (EU)

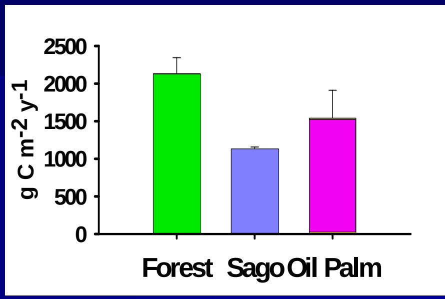
GHG Emission Savings

Type of Biodiesel	Typical GHG Emission savings (%)
Palm oil biodiesel (process not specified)	36
Palm Oil Biodiesel (process with methane capture at oil mill)	62
Soybean oil biodiesel	40
Rapeseed oil biodiesel	45
Sunflower seed oil biodiesel	58

Source: European Commission 7th Nov 2008

Annual soil CO2 flux



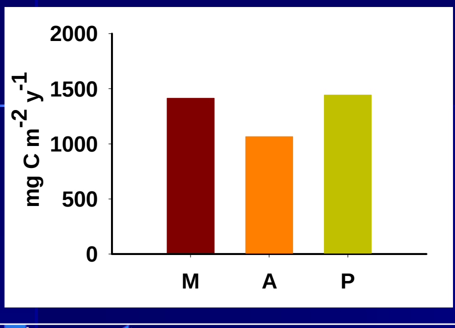


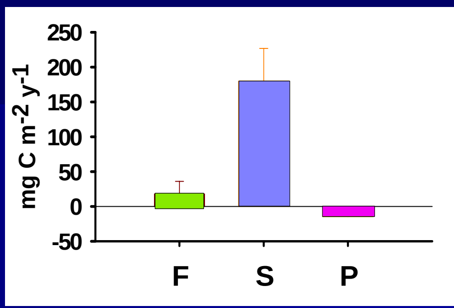
Forest	kg C $m^{-2}y^{-1}$
Mixed Peat Swamp	1.05
Alan	1.22
Padang Alan	1.13

Forest	kg C $m^{-2}y^{-1}$
Sago	2.10
Oil palm	1.10
	1.50

Melling et al. TELLUS, 2005

Annual CH_4 flux





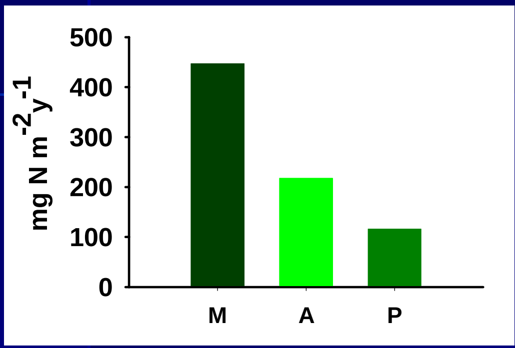
Forest	mg C $m^{-2}y^{-1}$
Mixed Peat Swamp	1414
Alan	1065
Padang Alan	1443

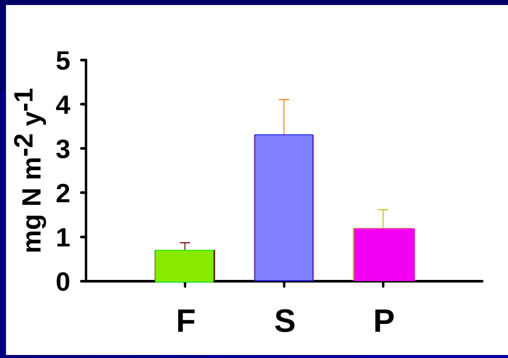
	mg C $m^{-2}y^{-1}$
Forest	18.34
Sago	180
Oil palm	-15.14

- IPCC estimated value of 54,750 mg C m^{-2} yr^{-1}

Melling et al. Soil Biol & Biochem. 2005

Nitrous Oxide Emissions





Forest	mg N m^{-2}y^{-1}
Mixed Peat Swamp	447
Alan	218
Padang Alan	116

	mg N m^{-2}y^{-1}
Forest	70
Sago	330
Oil palm	120

Melling et al. SSPN. 2007

Land Use Change

- Lightly forested area (181 t/ha) to oil palm (189 t/ha)*
- Logged-over forest to oil palm
- Grassland (82 t/ha) to oil palm (189 t/ha)*
- Rubber, Cocoa, Coconut to oil palm
- Peat to oil palm
- Shallow Vs Deep peat
- Setting up Tropical Peat Research unit

Source: * EU proposal January 2008

The Way Forward

- Developing countries have social equity in biofuel production
- Aforestation, reforestation , Avoided deforestation and Reduced Emissions from degradation and Deforestation (REDD) negotiated for compensation
- Tier 2 and Tier 3 data to be collected to quantify emission and sequestration to obtain carbon footprint (CFP)
- Continuous improvement for enhancing sustainability

Conclusion

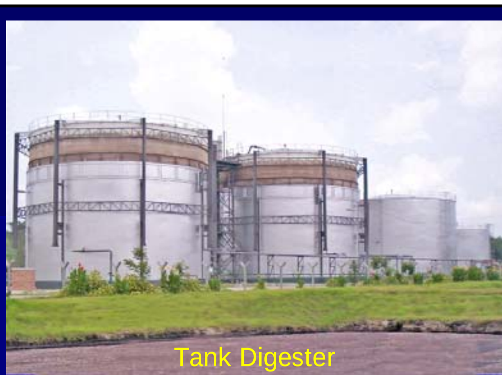
- Malaysian palm oil is produced in a sustainable manner
- Malaysia is implementing biodiesel blending in February 2009
- LCA for the whole supply chain is ongoing and iterative
- Some data have been submitted to JRC/EC
- Research ongoing to clarify controversies

Acknowledgement

- Dato' Dr Choo Yuen May
- Dr Chan Kook Weng
- Dr Lim Weng Soon
- Dr Puah Chiew Wei
- Dr Zulkifli Hashim
- Dr S. Vijaya
- Dr Tan Yew Ai

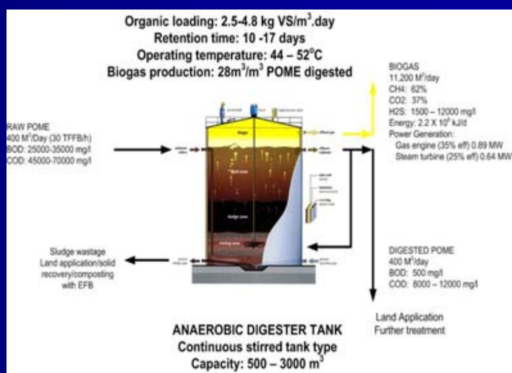
Production of compost from EFB and effluent – Asia Green

Effluent pond



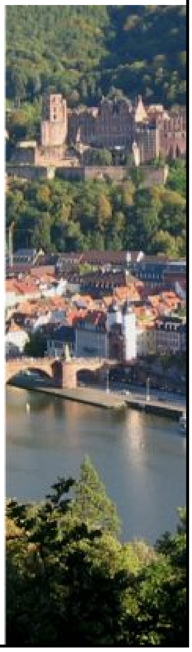
Tank Digester

Poly ethylene membrane



Session 2:

Report on Session 2:
LCA and GHG emissions



Rapporteur: Nils Rettenmaier (IFEU)

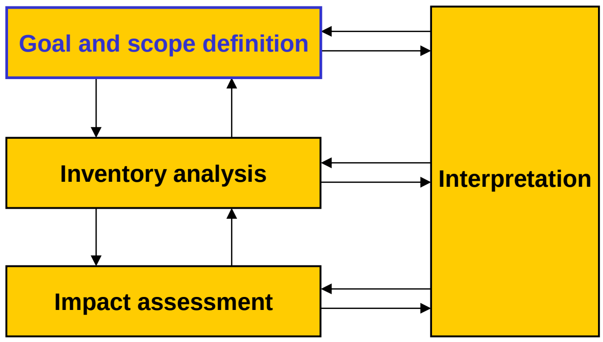
E-mail: nils.rettenmaier@ifeu.de
Tel: + 49 - 6221 - 4767 - 0 / - 24
www.ifeu.de

Session 2: LCA and GHG emissions

- **Objective: Discuss present knowledge on GHG emissions related to oil palm cultivation, effect of land use change, life cycle assessment of oilseeds and palm oil**
- **Chair person: Dr. Chan Kook Weng (MPOB)**
- **Rapporteur: Nils Rettenmaier (IFEU)**
- **Topics:**
  - **Climate change, GHG emissions and the oils and fats industry, with particular reference to palm**
  - **LCA**
  - **Land use change**
  - **Peat soils**
  - **Biofuel / bioenergy policies, demands, supply and EU directives**

Session 2: Life cycle assessment

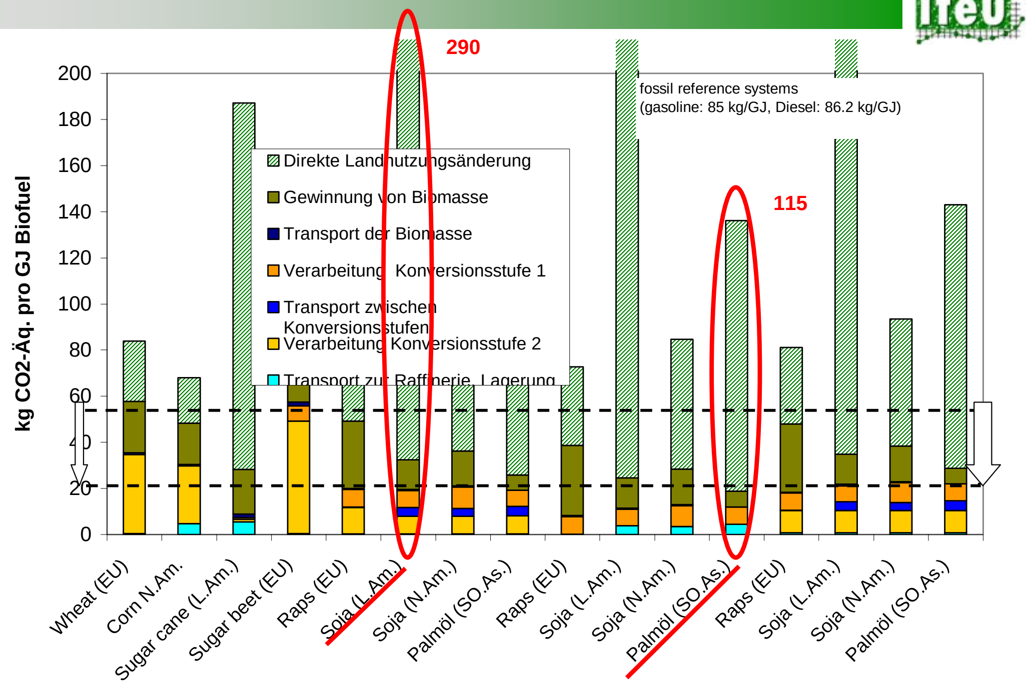
- **Issues discussed:**
  - Reason: Biofuels have to save GHG emissions compared to fossil fuels!
  - Life cycle assessment (ISO 14040 & 14044) versus life cycle GHG emissions (RES Directive proposal)



Session 2: Life cycle assessment

- **Issues discussed:**
  - Reason: Biofuels have to save GHG emissions compared to fossil fuels!
  - Criticism of European LCAs for palm oil, e.g. on carbon sequestration
  - Life cycle assessment (ISO 14040 & 14044) versus life cycle GHG emissions (RES Directive proposal)
    - Allocation versus credit method
  - Uniform system boundaries needed
    - Whole life cycle, from land use change to end use
    - Biofuel + all co-products versus fossil fuel
- **Conclusions:**
  - LCA can give an answer to a specific question
  - Disagreement on default values and typical values
  - Lack of transparency regarding both data and methodology in RES
    → open up calculations
  - Further methodological specifications needed in RES Directive proposal
  - Joint task force needed to agree on data and methodology for palm oil

Session 2: Life cycle assessment



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Session 2: Land use change

- **Issues discussed:**
  - **Direct versus indirect LUC**
  - **Methodology:**
    - **Time span of carbon allocation is decisive: 20 years vs. 100 years**
    - **Perennial versus annual crops: Carbon sequestration in oil palm trunk and soil are included!**
  - **Data:**
    - **Carbon stock of natural ecosystems highly variable**
- **Conclusions:**
  - **Up to now, only direct land use change is included in GHG balance**
  - **No consensus regarding time span → joint task force needed**
  - **More research is urgently needed in order to provide reliable data on carbon stocks of tropical natural ecosystems**

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Session 2: Peat soils

- **Issues discussed:**
  - Little knowledge on GHG emissions from tropical peat soils available
    - High wood content is often overlooked
    - Literature values on GHG emissions possibly to high
- **Conclusions:**
  - More research is urgently needed in order to provide reliable data on tropical peat soils

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Session 2

- **Overall conclusion:**
  - Due to the disparities regarding the calculation of GHG balances, there is a strong need to sit together and discuss default values and assumptions behind them in a scientific-technical manner.
  - MPO industry requests direct collaboration with JRC experts

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Expert Consultation on:

“Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia”

20-22 November 2008, Kuala Lumpur, Malaysia

SESSION 3:

Sustainability certification and wildlife conservation

JRC MPO Industry Expert Consultation

Session 3: Status of Biofuels Sustainability Certification and Wildlife Conservation

By Dr Steffen Preusser
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Sime Darby Plantation Sdn Bhd
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Status of Biofuels Sustainability Certification and Wildlife Conservation

21st November 2008,
Perak Room, Shangri-La Hotel
Kuala Lumpur

Sime Darby Plantation

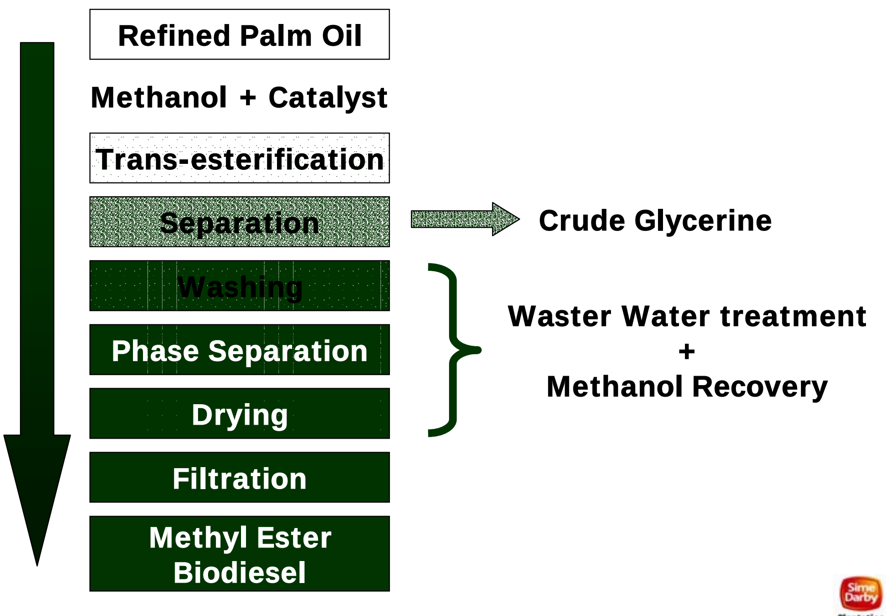
OVERVIEW

- Why Palm Biodiesel?
- Biodiesel in Malaysia
- The Use of Palm Oil in Foreign Biodiesel Plants
- The "Knock-on" Effect
- It's Food not Fuel
- Palm Industry / Sime Darby Policies Relating to Deforestation
- Life Cycle Analysis

Why are biofuels necessary?

- To reduce the amount of CO_2 emissions and help mitigate climate change
- Energy security – reducing reliance on fossil fuels (key policies in US & EU)
  - Biodiesel is part of a basket of energy options
  - Both first and second generation biofuels will play a role

Biodiesel Process Flow



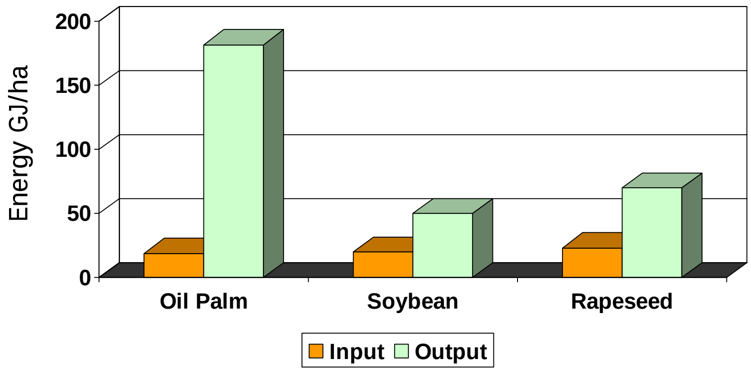
Advantages of Biodiesel

- Environmental (reduces overall CO_2 emissions by more than 75% compared to petroleum diesel)
- Improved flash point and cetane value (methyl ester molecule resembles the cetane molecule)
- Lower viscosity than refined vegetable oils
- Biodiesel exhaust emissions contain less carbon monoxide, hydrocarbons, poly-aromatic hydrocarbons, particulates, NO_x emissions
- Increased lubricity for low-sulfur mineral oil diesel
- Contains no sulfur, no aromatics, no benzene

Why Palm Biodiesel?

- Palm biodiesel has best yield and economics as compared to other oilseed crops
- Chemical characteristics close to diesel
- Can be treated to meet seasonal requirements
- Overall sustainable crop management

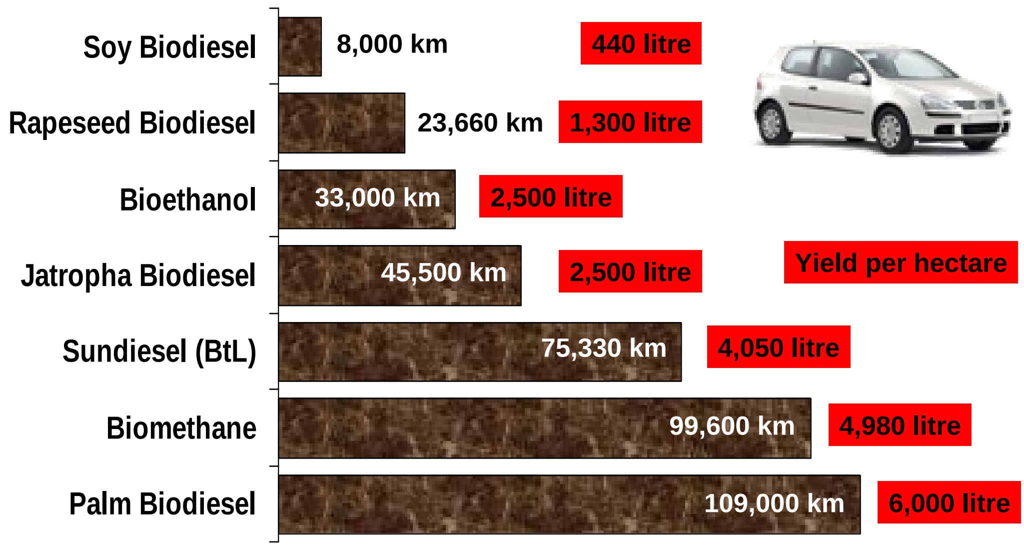
Energy Balance of Major Oilseed Crops



- Oil palm requires less energy input than other biodiesel crops to produce one ton of oil

Source: Wood & Corley, 1991

Mileage per hectare per year
-based on a VW Polo-



Source: "Biofuels", Fachagentur Nachwachsende Rohstoffe e.V. (FNR), 2006 and own data

Minimising New Areas Needed for Biodiesel

What if a global 5% biodiesel blend was based only on palm oil?

	2015
Food + 5% Biodiesel blend	30.2 mio ha
Only Food	19.6 mio ha
Additional requirement	10.6 mio ha

If all oil crops (soy, rapeseed) shared proportionately in this blend, an additional 47 mio ha would be required – as compared to 10.6 mio ha for only palm oil

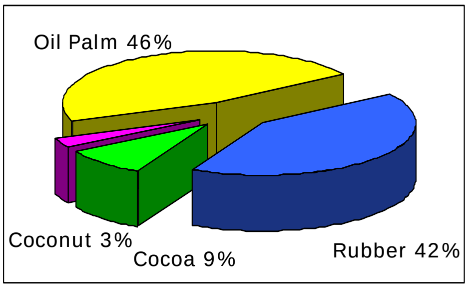
Source: Dr James Fry
LMC International Ltd, 2007

Palm Oil Sustainability

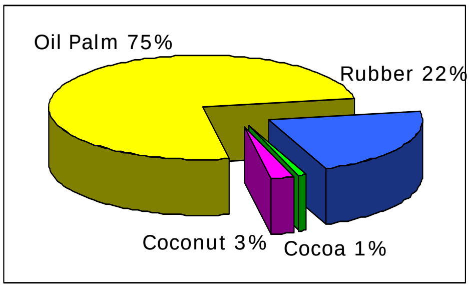
- Palm oil yield per area superior to other oilseed plants
- Lower chemical inputs such as fertilizers, herbicides and insecticides as compared to other oilseed crops
- Malaysia has legislated 60% of its land base as protected rainforest (most of it virgin) – In comparison, EU forests account for approximately 35% of the EU land base

Changes in Land Use of Major Tree Crops in Malaysia

In 1990, 4.39 million ha



In 2006, 5.56 million ha



Crop	1990	2006
Oil Palm	2.029	4.170
Rubber	1.836	1.212
Cocoa	0.393	0.032
Coconut	0.134	0.142
Total	**4.392**	**5.556**

Other agricultural crops lost 0.98 mil ha which were mainly converted to oil palm from 1990 to 2006

Source: MPOB, MRB, Agricultural Department, MCB

Biodiesel Development in Malaysia

March 2006

- 3 companies awarded to commercialise MPOB's biodiesel technology

June 2006

- 1st dedicated Biodiesel plant started
- No. of biodiesel licences issued >60

Dec 2007

- No. of plants operational ~ 12
- Capacity ~ 1mil ton
- No. of licences issued >90

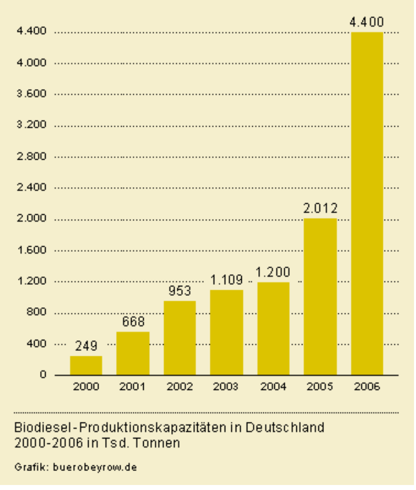
Palm Biodiesel Production in Malaysia

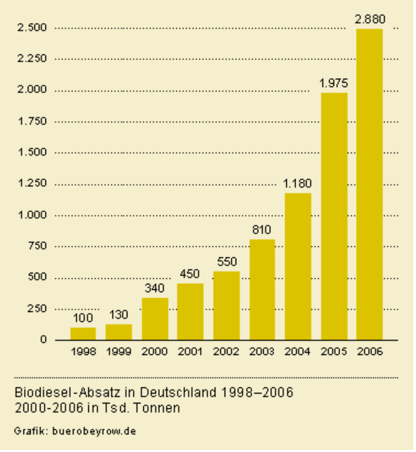
- Of 91 licenses to build biodiesel plants (2007), only 14 have been completed and 5 are actually producing
- Of the 1.68 million tons of biodiesel capacity, 129,715 tons were actually produced in 2007 - Of that, 95,013 tons were exported
- In comparison, 17.7 million tons of CPO were produced in 2007*
- This works out to 0.7%

* MPOB: 15.8 mio tons CPO & 1.9 mio tons CPKO

German Biodiesel Statistics for 2006:

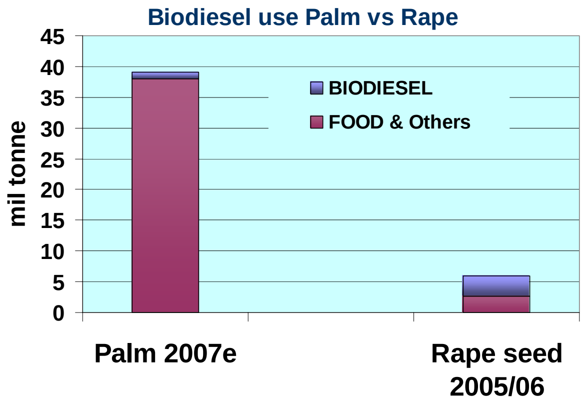
4.4 mio tons capacity with a turnover of 2.88 mio tons





For EU: 5.7 mio tons biodiesel production in 2007

Palm Oil Used for Biodiesel is still small

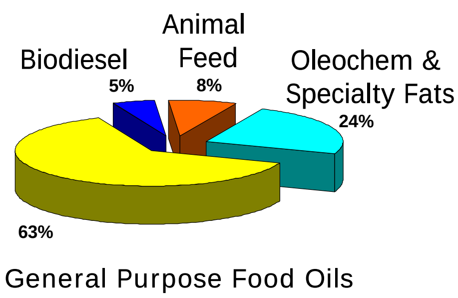


- ➲ More than 50% of Rape oil is used for biodiesel in Europe in 2005/06 season
- ➲ Is Rape more sustainable for biodiesel?

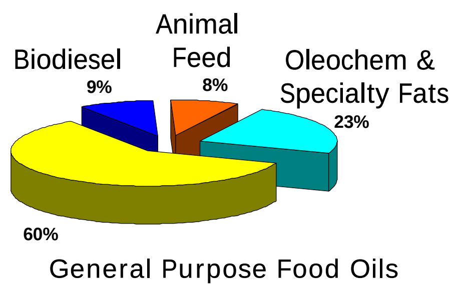
Developing Sustainable Futures

Food vs. Fuel

2007
153 mio t / yr



2010
175 mio t / yr



- Non-food applications already take up 29% of the global oils market
- Food will continue to be dominant market
- Substantial share of the increased demand will come from the biofuel market

Source: Crowne Iron Works, OFI, Cairo, 2007

Overseas Use of Palm for Biodiesel

- Purchases of crude palm oil for use in European and US biofuel plants
- Limited volumes due to palm-based biodiesel's high melting point (ca. 13°C)
- 20% of summer blend can be PME, for a B5 blend this leads to a maximum of 1% PME in European diesel: Of course, only in the summer.

  BUT...

Trade Barriers for Palm Biodiesel

1. The German changes to their biodiesel regulations are meant to exclude palm methyl ester (PME) and Soy Methyl Ester from their biofuels quota and their subsidies unless the feedstock is certified as sustainable.

   It goes on to say that the sustainability criteria has not yet been passed and, until it is passed, these biofuel feedstocks are ineligible.

2. In the US, the new biodiesel specifications requires that it passes a cold soak filter test before being eligible for the Blender's Credit. Unprocessed palm biodiesel cannot pass this test. (In any case, the US has a 4.5% import duty on biodiesel from Malaysia.)

The Knock-on Effect

The Theory

1. Rapeseed oil is used for biodiesel in Europe
2. Results in shortage of rapeseed oil for food applications
3. Palm oil is used to fill the void
4. Hence, more palm is planted to substitute for rapeseed shortages

Reality is Much Different

- Palm oil cannot be used to substitute for rapeseed oil because its freezing point will render it a solid in Europe: Only soy, corn or sunflower can substitute rapeseed in temperate climates.
- There is really no shortage of rapeseed oil: One reason that biodiesel was introduced in Germany was to find a use for surplus rapeseed oil and to find a non-food use for crops grown on set-aside land.

Deforestation and the Palm Industry

Policies Related to Deforestation

- Biofuels have a minimal effect on deforestation
- The most effective way to stop deforestation for the palm oil industry is the implementation of a certification process such as the RSPO principles

Definition - RSPO

Round Table

A Round Table is one which has no “heads” and “sides” , and therefore no one person sitting at it is given privileged positions and all are treated as equals. The Idea stems from the Arthurian about the Knight of the Round Table in Camelot

Source: RSPO

Sustainable

Capable of meeting the needs of the present without compromising the ability of the future generation to meet their own needs

Source: The Brundtland Commission’s Definition

RSPO - Objective

RSPO - Principle & Criteria

The RSPO Principle & Criteria consists of 8 Principles and 39 Criteria

Principle # 1: Commitment to transparency

Principle # 2: Compliance with applicable laws and regulation

Principle # 3: Commitment to long-term economic and financial viability

Principle # 4: Use of appropriate best practices by growers and millers

Principle # 5: Environmental responsibility and conservation of natural resources and biodiversity

Principle # 6: Responsible consideration of employees and of individuals and communities affected by growers and mills

Principle # 7: Responsible development of new plantings

Principle # 8: Commitment to continues improvement in key areas of activity

GHG emissions are being incorporated into the principles.

RSPO - Principle & Criteria (Excerpt)

Principle # 5: Environmental responsibility and conservation of natural resources and biodiversity

- Aspects of plantation and mill management that have environmental impacts
- The status of rare, threatened or endangered species and high conservation value habitats
- Waste is reduced, recycled, re-use and disposed
- Efficiency of energy use and use of renewable energy is maximised

Principle # 7: Responsible development of new plantings

- Social and environmental impact assessment
- Soil surveys and topographic information are used
- No new planting on primary forest or in area containing High Conservation Values
- To avoid planting in steep terrain, and or marginal and fragile soil
- To obtain permission before developing local people land
- Compensation for local people for any agreed land acquisition
- No use of fire in the preparation of new plantings

SIME DARBY'S LAND ACQUISITION POLICIES

Choice of Land

- **No** Peat Land
- **No** Primary Forest
- **Yes** to Logged-over/ Secondary Forest
- **Yes** to 'Brown Fields'

No

YES

SIME DARBY'S LAND ACQUISITION POLICIES

Slope Class

Categorize	Slope (0°)	Remark
Level / flat	0° – 2°	Yes
Gently undulating	2° – 6°	Yes
Rolling	6° – 12°	Yes
Hilly	12° – 20°	Yes
Somewhat Steep	20° – 25°	No
Steep	25° – 30°	No
Very Steep	>30°	No

SIME DARBY’S LAND ACQUISITION POLICIES

River Buffer Zone

River Buffer zone are identified, and areas involved are excluded in computation net plantable areas

River Width (m)	River Reserve (both river banks)	
	Peninsular Malaysia	Sabah & sarawak
More than 40	50m	For river > 3m width, a buffer zone of 20m shall be maintained at both sides of the river bank
20 to 40	40m	
10 to 20	20m	
5 to 10	10m	
Less than 5	5m	
More than 3	-	

Sime Darby’s Good Agriculture Practices

Land management

1. **Retaining natural forest cover on hill slopes greater than 25º**

2. **Maintaining riparian reserves to minimise soil run-off**

3. **Conducting land development in phases by incorporating the planting of legume covers, construction of retention ponds, terraces and silt traps**

Sime Darby's Good Agriculture Practices (Cont'd)

Water management

1. Fresh water management on flat and coastal soils
2. Management of fresh water on undulating/hilly/inland soils

Zero Burning Replanting Technique

- It allows complete return of organic matter to the soil
- It allows immediate replanting of trees as the new stands can be planted simultaneously while felling and shredding are being done
- The process not dependent on weather condition
- Contributes positively towards minimising global warming

Sime Darby's Good Agriculture Practices (Cont'd)

Integrated Pest Management

1. Environmentally friendly insecticides
2. Direct bio-control such as viruses and fungi to infect the pests
3. Predatory animals/insects that feed on the pests such as barn owl to control rat population

Palm Oil Mill Effluent Treatment System

1. Despite its biodegradability, POME cannot be discharge without first being treated because POME is acidic and has very high biochemical oxygen demand

Sime Darby's Good Agriculture Practices (Cont'd)

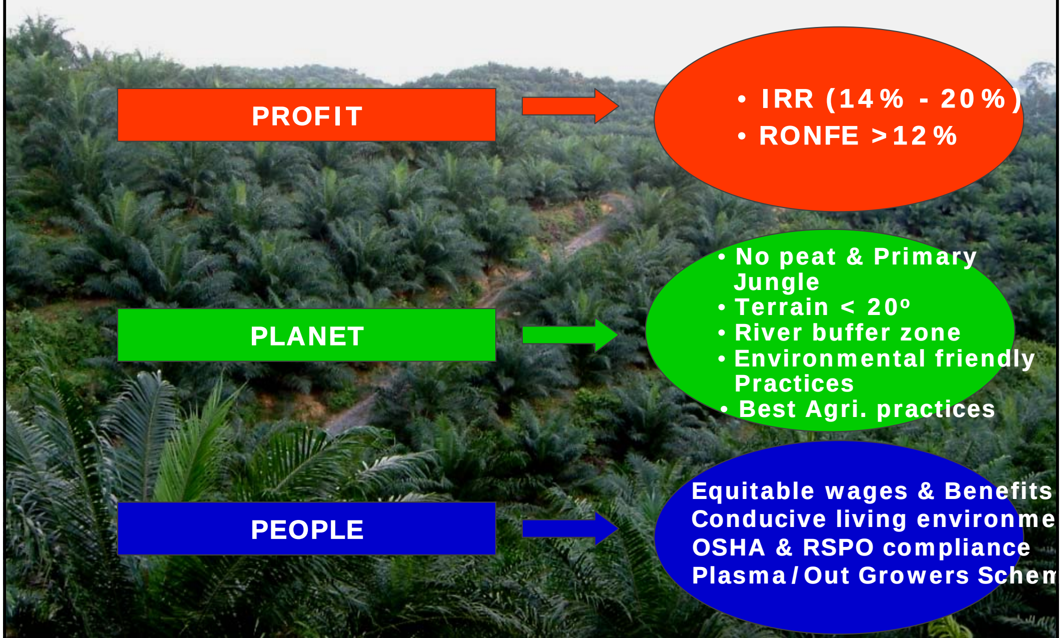
Biodiversity

1. Conservation
   - Practices zero burning replanting technique
   - Ensures maximum conservative of soil
   - maintains natural vegetation, permanent greenbelts and water catchments

2. Enhancement
   - Encourages crop diversification to include planting of forest trees
   - Enhances soil biodiversities by establishing creeping leguminous soil covers
   - Cultivates beneficial plants to diversify flora which also attract predator insects

Currently, Sime Darby has 17,000 ha for conservation. This will increase to ca. 40,000 ha in the coming years.

Summary – Triple Bottom Line (3P's)



Additional Activities

Life Cycle Analysis

- Currently being evaluated on an industry-wide basis
- First numbers will be out in January
- Models will be refined on an ongoing basis to get best fit for a tropical climate

Composting & Biogas

- Already evident that the methane release from open anaerobic effluent ponds (POME) reduces the LCA values
- POME can be used on empty fruit bunches to generate a compost under aerobic conditions. The application of compost can further reduce the use of mineral fertilizers that release GHG such as nitrogen oxides.
- POME can be digested in tanks to capture the methane and use it as an energy source. The remaining material can also be used as a fertilizer.
- Composting and biogas projects using POME are eligible for carbon credits under the Clean Development Mechanism.

Conclusions

- The connection between the use of biofuels and deforestation in SE Asia is weak (under current market conditions)
- Food applications drive palm oil demand
- To address deforestation, appropriate criteria have been developed by RSPO and by individual companies

Universiteit Utrecht

Report on Session 3: Sustainability Certification and Wildlife Conservation

Chairperson: Dr. Steffen Preusser
Rapporteur: Birka Wicke

Objective: Discuss the status of certification initiatives

JRC/MPOC Expert Consultation on "Direct and Indirect Impacts of Biofuels Policies on Tropical Deforestation in Malaysia"

Copernicus Institute
Research Institute for Sustainable Development and Innovation

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Certification System

- Lots of different initiatives but no common international system
  - need international agreement
- But such international certification initiatives should not become barriers of trade

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Trade / Technical Barriers

- Trade barriers: palm and soy excluded unless certified sustainable. But no certification scheme yet and so they are excluded (Legislation in Germany vs. EU)

→ Need better understanding of these proposals

- Technical barriers by lower temperatures in Europe
  - Alternatives: NESTE (problem: losses during processing) or additives (higher costs and not that low temperatures possible)
  - Expensive to make it suitable for even lower temperatures
- Still need to investigate more about the policies

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RSPO

- Commonly agreed: RSPO is an honourable and important initiative
- Main initiative supported by MPO Industry
- RSPO does not currently include a GHG emission criterion but inclusion of a GHG emission criterion is being discussed
- Important aspects: only few plantations certified yet; many on the way but process is quite complex and time-consuming
- Also for other certification systems:
  - –Need internationally agreed production standard, but not protectionist purposes
  - –Credibility: if tools are not credible, stakeholders will criticize them

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RSPO

- Problem with smallholders/private millers: still need a solution for how to certify
  - Different views: does the whole sector actually need to be certified?
  - Possibility of collaboration of smallholder/private companies for certification
- Difficulties from many different angles: deciding what criteria to include, how to certify, how to document at the plantation/for smallholders, traceability (bar code system at RSPO)

→ many challenges for future. There will be revisions, improvements and over time hopefully we'll get there.

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LCA

- Still differences in views
- Emission reduction numbers used as defaults in EU directive are not transparent
  - important for better understanding and acceptance
- Suggestion: joint study team
  - but criticism about methodology is not appropriate. We are not picking and choosing, set methodology.

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Concluding Remarks

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- There still remain some differences in views, especially with respect to LCA/GHG emission calculations
- From these differences we can learn from each other, which can help to find consensus in the future
- Other issues about certification systems
- Point not addressed in this session:
  - wildlife conservation
  - biodiversity

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Expert Consultation on:

“Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia”

20-22 November 2008, Kuala Lumpur, Malaysia

CLOSING REMARKS

“Direct and indirect impact of biofuels policies on tropical deforestation in Malaysia“

Closing remarks

Wolter Elbersen, Wageningen University and Research Centre
E-mail: wolter.elbersen@wur.nl

Bioenergy at WAGENINGEN UR

JRC/MPO expert consultation
Malaysia November 20-212008

WAGENINGEN UR

Current use of Palm oil for biodiesel is unclear…..

Estimated Feedstock Use for Biodiesel Production (in 1,000 MT)

	2006	2007e	2008e	2009f	2010f
Rapeseed Oil	3,150	3,550	3,700	4,900	5,650
Soybean oil	800	900	900	1,000	1,200
Palm oil	150	400	400	420	450
Sunflower	180	220	300	420	450
Other and not attributed	110	110	100	100	160
Subtotal Vegetable oils	**4,390**	**5,180**	**5,400**	**6,840**	**7,910**
Recycled Vegetable Oil	120	135	230	300	490
Animal Fats	10	35	130	160	200
Grand total	**4,520**	**5,350**	**5,760**	**7,300**	**8,600**

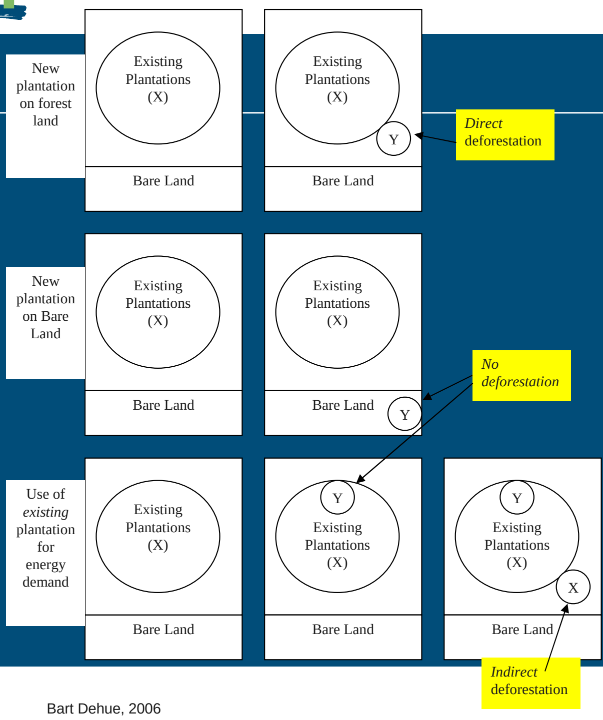
Note: Data for feedstock use is not available. The figures above represent estimates by EU FAS posts.

USDA, 2008

WAGENINGEN UR

Institute AFSG of Wageningen UR

- Developing technology for sustainable agri-chains
- You can do a lot on the technical side!
  - Biorefinery: share the footprint with more products= energy + other products



Have we discussed indirect effects?

Indirect GHG effect is not the same as blame!

Generally someone else (in another country) is to blame for the indirect GHG effect!

It can also be GHG emissions due to LUC

Bart Dehue, 2006

- Estimates of the indirect effect vary from ±0% (potential studies) to ±80% (Searchinger et al., 2008, Science) (Eickhout, 2008)
- Indirect (GHG) effects appear significant enough to make agri-biofuel unsustainable in the Business As Usual scenario
- Is the indirect GHG effect of rape biodiesel (or maize for anaerobic digestion) in Europe different from the indirect effect of palm biodiesel? More indirect but not necessarily smaller??

WAGENINGEN UR

- There is a concern that sustainability demands will become an (undue) trade barrier –> scientific basis for sustainability assessment is therefore even more important ->

How to isolate yourself from the indirect effect?

- Oil palm appears to have a large untapped potential to also produce other (fibre) products (which may share the footprint) thus reducing the time to repay the carbon debt. Oil yield potential has potential to improve too!
- Is allocation on the basis of LHC (for by-products) the way to go? It appears this gives the least credit to making added value products from by-products – Any other allocation system seems better (price – mass – replacement)

WAGENINGEN UR

- Is degraded land the way to go? We need to understand if the use of “degraded land” is an option to avoid indirect effects! – Where is the land? What is the extra cost? What is the GHG effect of conversion? What is the productivity? etc.

WAGENINGEN UR

- “We argue that the official sustainability demands will focus heavily on GHG performance of biofuel as this is a primary driver for the existence of biofuels in the EU. Furthermore it is also a demand that can be set under WTO and EU trade regulations”
- “GHG performance can in principle be quantified in an objective way, though much needs to be assessed and developed”
- “Methods and cost effective certification (or other systems) will have to be implemented and producers may have to adapt production systems in order to improve GHG impact”
- “Challenges lie in agreeing on methods for GHG assessment especially for indirect effects”

Elbersen et al., 2008

WAGENINGEN UR

Expert Consultation on:

"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

20-22 November 2008, Kuala Lumpur, Malaysia

Meeting Motivation

Meeting Motivation

Place: Kuala Lumpur, Malaysia

Date: 20-21 November 2008

(Meeting followed by a field visit on 22 November)

Background

This Expert Consultation is organised by the Joint Research Centre (JRC) of the European Commission (www.jrc.cec.eu.int) and the Malaysian Palm Oil Council (MPOC, see http://www.mpoc.org.my). This Meeting is a follow-up of the Symposium on Sustainable Resource Development organised in Brussels on 6 June 2007 by MPOC (http://www.mpoc.org.my/mktstat_pressrelease_060607.aspws).

This Expert Consultation is based on a concept of scientific networking used recently in previous occasions in the fields of biofuels or bioenergy such as :

- JRC/EEA/CENER Joint Seminar on "Sustainable bioenergy cropping systems for the Mediterranean, Madrid", Spain, February 2006,

- JRC/CENER Expert Consultation on the "Energy potential from cereals straw in the European Union" 25, Pamplona, Spain, October 2006 ,

- JRC/EEA/Rothamsted "Short Rotation Forestry, Short Rotation Coppice and energy grasses in the European Union: Agro-environmental aspects, present use and perspectives", Halpenden, United Kingdom, October 2007 (see Proceedings on http://re.jrc.ec.europa.eu/biof/).

This concept of scientific networking for policy support will also be applied in 2008 to analyse with Brazilian and international specialists the impact on tropical deforestation of soya and sugar cane cultivation in Brazil.

This Expert consultation addresses “Direct and indirect impact of biofuels policies on tropical deforestation in Malaysia". At Joint Research Centre level, it results from the cooperation between two Research Actions: the Biofuels Action of the Institute for Energy and the TREES Action of the Institute for Environment and Sustainability.

The Biofuels Action aims to provide robust information on the most important quantifiable parameters needed to formulate biofuels policy, such as:

- availability from EU and world sources,
- energy balance,
- greenhouse-gas-balance,
- environmental impact,
- cost of production and mobilisation,
- potential in emerging countries,
- effect on commodity / food / by-product prices,
- competitive use and impact on existing industries,
- overall cost-benefit analysis.

The Biofuels Action is partly based on the experiences gained with the joint JRC-CONCAWE-EUCAR Well-To-Wheels study, which is recognised as one of the main references for Life Cycle Analysis of biofuels. This study addresses energy balance, greenhouse-gas balance and costs of alternative fuels including biofuels. All the quantified benefits of biofuels are related to the cost-to-Europe. This is particularly important for the resource assessment; because knowing how much resource is available at what cost, and with which environmental impact, determines the mobilisation potential. A large part of biofuels or of feedstock for biofuels is expected to come from imports, mainly from tropical countries, therefore the sustainability and resource considerations must be taken into account in the EU and beyond EU borders.

There are thus four main aspects addressed by the Biofuels Action:

- Cost versus availability for EU-sourced feedstock for biofuels and bioenergy, for different regional scope settings,

- Imported biofuels and feed-stocks,

- Greenhouse gas performance of biofuels,

- Environmental impact assessment of biofuels/bioenergy policy options.

The TREES-3 Action provides quantitative measurements and mapping of changes in forest resources for the EU policies related to global environmental and forestry issues, with a focus on Eurasian boreal forests and tropical forests, including the Caribbean and Pacific regions. Forest cover and cover change issues related to EU commitments to Multilateral Environmental Agreements, especially to UN conventions such as the UN Framework Convention on Climate Change, UN Convention to Combat Desertification and UN Convention on Biological Diversity, and the UN Forest Forum, as well as Action Plans such as on Forest Law Enforcement Governance and Trade (FLEGT) are also addressed. The Action addresses deforestation issues in a global perspective. The work generates regional forest maps, track areas of rapid forest change and produces statistically valid estimates of cover change for the current and previous decades (from the mid 1970's up to 2005-2010). The drivers of deforestation are identified at the regional levels, with a focus on Eurasian boreal forests and tropical forests. The TREES-3 products will be used as inputs in future climate change impact scenarios and, through close co-operation with EC DG Environment, will provide a basis for providing inputs to developing countries ("Non-annex 1 countries" to the Kyoto Protocol) into the UNFCCC process. The regional forest maps and estimates of cover change are shared with Commission services, European Commission's Delegations, International organisations in particular, the Food and Agricultural Organization (FAO), and partner countries. Biomass maps and carbon emission/storage estimates will be produced for selected forest ecosystems. Due to persistent cloud in the tropics and poor illumination in winter months in the boreal ecosystems, the TREES-3 Action will develop forest monitoring techniques which also include the use of radar technologies, as these have good cloud penetration properties and operate without sunlight.

The Malaysian Palm Oil Council MPOC goal is to contribute to the market expansion of Malaysian palm oil and its products by addressing awareness of various techno-economic issues and environmental sustainability of palm oil. Its specific objectives are:

- To enhance trade opportunities in the market place by addressing the latest opportunities in the market and diversification of products for the improvement of total sales and exports of Malaysian palm oil.

- To improve the understanding of palm oil, its applications and its properties.

- To uphold the reputation of Malaysian palm oil by closing the gap between the issues of perceptions and the realities of palm oil.

- To safeguard Malaysian palm oil as the most dominant palm oil in terms of market coverage, nutritional benefits, environmental sustainability and commercial success.

Motivation

EU Legislative Framework

On 23 January 2008, the European Commission issued a Communication on the use of energy from renewable sources (see http://ec.europa.eu/energy/climate_actions/index_en.htm). This Communication includes a Draft Directive submitted to the European Council and European Parliament. Prior to this initiative, in January 2007 the European Commission had put forward an integrated energy/climate change proposal that addressed the issues of energy supply, climate change and industrial development. Two months later, European Heads of State endorsed the plan and agreed to an Energy Policy for Europe.

The plan called for a:

- 20% increase in energy efficiency,
- 20% reduction in greenhouse gas (GHG) emissions,
- 20% share of renewables in overall EU energy consumption by 2020,
- 10% biofuel component in vehicle fuel by 2020.

These targets are very ambitious: today about 8.5% of energy is renewable. To achieve a 20% share by 2020 will thus require major efforts across all sectors of the economy and by all European Union Member States.

To achieve the renewable energy policy goals, the European Commission has proposed a Directive. This aims to establish national renewable energy targets that result in an overall binding target of a 20% share of renewable energy sources in energy consumption in 2020 and a binding 10% minimum target for biofuels in transport to be achieved by each Member State.

Three sectors are implicated by renewable energy: electricity, heating and cooling and transport. It is up to the Member States to decide on the mix of contributions from these sectors to reach their national targets, choosing the means that best suits their national circumstances. They will also be given the option of achieving their targets by supporting the development of renewable energy in other Member States and third countries.

The minimum 10% share of biofuels in transport is applicable in all Member States. Biofuels tackle the oil dependence of the transport sector, which is one of the most serious issues affecting security of energy supply that the EU faces.

Finally, the Directive also aims to remove unnecessary barriers to the growth of renewable energy - for example by simplifying the administrative procedures for new renewable energy developments – and encourages the development of better types of renewable energy (by setting sustainability standards for biofuels etc).

The 10% target for renewable energy in transport has been set at the same level for each Member State in order to ensure consistency in transport fuel specifications and availability. Member States which do not have the relevant resources to produce biofuels will easily be able to obtain renewable transport fuels from elsewhere. While it would technically be possible for the European Union to meet its biofuel needs solely from domestic production, it is both likely and desirable that these needs will in fact be met through a combination of domestic EU production and imports from third countries.

Concerns have been raised about whether biofuel production is sustainable. Whilst biofuels are a crucial part of renewable energy policy and a key solution to growing emissions in the transport sector, they must not be promoted unless they are produced sustainably. Although the majority of biofuels currently consumed in the EU are produced in a sustainable manner, the concerns are legitimate and need to be addressed. The Directive therefore sets out stringent environmental sustainability criteria to ensure that biofuels that are to count towards the European targets are sustainable and that they are not in conflict with our overall environmental goals. This means that they must achieve at least a minimum level of greenhouse gas savings and respect a number of requirements related to biodiversity. Among other things this will prevent the use of land with high biodiversity value, such as natural forests and protected areas, being used for the production of raw materials for biofuels.

Meeting scientific Objective

The objective of this Expert Consultation is to exchange expertise, collect/analyse/discuss data and information on the following topics:

- Direct and indirect effect of biofuels policies (National, European and global) on tropical deforestation in Malaysia,
- Status of biofuels sustainability certification, with specific reference to palm oil and the Round Table on Sustainable Palm Oil (RSPO, see http://www.rspo.org)

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- Wildlife conservation and environmental care,
- GHG emissions related to palm oil cultivation and use, effect of land use change, Life Cycle Analysis of Biofuels.

What this meeting is:

A scientific meeting to exchange and discuss data availability, accuracy and uncertainties in order to provide the best technical support to Malaysian or European decision-makers in the field of biofuels and bioenergy. A scientific meeting to improve understanding in the field of biofuels on: what is known, what is uncertain, what is unknown.

What this meeting is not:

A forum of decision-makers or a meeting to identify, design or influence biofuels policies.

Expected outcome

This Expert-Consultation will be organised in such a way that instead of a sequence of presentations, a large space will be given to interactive technical discussions. Each Session will be coordinated by a Chair Person appointed by the Meeting organisers and a Chair Person will be appointed. The outcome of the Expert Consultation will be summarized in Proceedings prepared by the Meeting organisers, focussing on the areas above and based on the input provided by the Meeting participants.

Experts:

This Workshop is intended to include 20 participants maximum in order to allow interactive discussions. Experts will be invited from Malaysia and European Union. Experts will originate mainly from agricultural/forestry/environmental institutes, renewable energy institutes, research centres and energy companies, environmental NGOs. The main thematic specialities of the participants will be related to biofuels (especially from palm oil) and tropical deforestation assessment.

Of special interest for this meeting is expertise related to:

- Agronomic knowledge on palm tree and farming practices,
- Environmental impacts of palm oil production,
- Research and R&D on palm tree cultivation and use.
- Deforestation monitoring
- GHG emissions and land use
- Wildlife conservation.
- Soil science and peatlands.

Contacts:

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- Kalyana Sundram, Deputy Chief Executive Officer (DCEO), Malaysian Palm Oil Council (MPOC), kalyana@mpoc.org.my

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Expert Consultation on:

"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

20-22 November 2008, Kuala Lumpur, Malaysia

MEETING AGENDA

PROGRAMME – DAY 1 (20/11/08)

Date	Programme	Venue
19/11/08 (Wednesday)	**Arrival and check-in of JRC members and local experts**	**Shangri-La Hotel, KL**
20/11/08 (Thursday)	**JRC MPO Industry Expert Consultation - Day 1**	**Perak Room, Shangri-La Hotel**
8.30am	Introductory Remarks from hosts – MPO and JRC MPO: Tan Sri Datuk Dr. Yusof Basiron JRC: Mr. Jean-Francois Dallemand	
9.30am	**Session 1: Forest monitoring & deforestation** **Objective:** Improve understanding of direct and indirect impacts of bio-fuels policies (National, European and global) on deforestation *Chairperson: Mr. Hans-Jürgen Stibig* *Co-chairperson: Datu Hj. Len Talif Salleh* *Rapporteur: Dr. Gary Theseira* **Topics proposed for discussion:** - Deforestation and drivers of deforestation - The role of oil palm plantations for deforestation - Biodiversity and environmental impacts of deforestation - Potential effects of an increasing demand for bio-fuels Deforestation-Malaysian and European policies and legislations	Perak Room
10.30am	Coffee Break	
11.00am	Session 1 (continue)	
12.30pm	Buffet Lunch	Lemon Garden Café, Shangri-La Hotel
2.00pm	**Session 2: Biodiesel from palm oil: Life Cycle Analysis and GHG emissions** **Objective:** Discuss present knowledge on GHG emissions related to oil palm cultivation, effect of land use change, Life Cycle Analysis of oilseeds and palm oil *Chairperson: Dr. Chan Kook Weng* *Rapporteur: Mr. Nils Rettenmaier* **Topics proposed for discussion:** - Climate change, GHG and the oils and fats industry, with particular reference to palm - LCA - Land use change - Peat soils - Biofuel-bioenergy policies, demands, supply and EU directives	Perak Room
3.30pm	Tea Break	
4.00pm	Session 2 (continue)	
5.30pm	End of Session 2 and Day 1	
8.00pm	Dinner hosted by JRC	Saloma Theatre Restaurant, KL

PROGRAMME – DAY 2 (21/11/08)

21/11/08 (Friday)	**JRC MPO Industry Expert Consultation - Day 2**	**Perak Room, Shangri-La Hotel**
8.30am	**Session 3: Sustainability certification and wildlife conservation** **Objective:** Discuss the status of certification initiatives *Chairperson:* *Dr. Steffen Preusser* *Rapporteur:* *Ms. Birka Wicke* **Topics proposed for discussion:** - Status of certification schemes – RSPO, COA, others - NGO's and industry's views on biofuels - Food-fuel debate: Malaysia's policy and perspectives - Oil palm plantation practices	Perak Room
10.30am	Coffee Break	
11.00am	Session 3 (continue)	Perak Room
12.15pm	Buffet Lunch	Lemon Garden Café, Shangri-La Hotel
2.30pm	Viewpoints from individual participants **Concluding Session** Presentation by Rapporteurs (3 x 10 minutes each) Session 1: *Dr. Gary Theseira* Session 2: *Mr. Nils Rettenmaier* Session 3: *Ms. Birka Wicke* *Concluding remarks (10 minutes)* *W.Elbersen, Wageningen University*	Perak Room
4.00pm	Concluding Remarks by: - JRC: Mr. Jean-Francois Dallemand - MPO: Tan Sri Datuk Dr. Yusof Basiron	Perak Room
4.30pm	Tea & End of JRC-MPO Expert Consultation	
8.00pm	Dinner hosted by YB Datuk Peter Chin Fah Kui, Minister of Plantation Industries and Commodities, Malaysia	Johor Room, Lower Lobby, Shangri-La Hotel
22/11/08 (Saturday)	**Field visits for JRC delegation to oil palm plantation, palm oil mill and associated facilities – Day 3** For JRC delegates	**Carey Island, Banting**
23/11/08 (Sunday)	**Check-out and Departure of JRC delegation**	

Expert Consultation on:

“Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia”

20-22 November 2008, Kuala Lumpur, Malaysia

LIST OF PARTICIPANTS

List of Participants - MALAYSIA

Name	Organization	Area of expertise
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Y. Bhg. Dato' Dr. Choo Yuen May *Deputy Director-General I*	Malaysian Palm Oil Board (MPOB) No. 6, Persiaran Institusi Bandar Baru Bangi 43000 Kajang Selangor, Malaysia Tel: +603-8925 2945 Fax: +603-8926 3984 E-mail: choo@mpob.gov.my Website: http://www.mpob.gov.my	Research and policies on palm oil Biodiesel , LCA management of palm oil
Dr. Chan Kook Weng *Senior Research Fellow*	Malaysian Palm Oil Board (MPOB) No. 6, Persiaran Institusi Bandar Baru Bangi 43000 Kajang Selangor, Malaysia Tel: +603-8769 4400 ext.4582 / 8920 2791 Fax: +603-8926 1337/ 8925 8215 E-mail: chankw@mpob.gov.my Website: http://www.mpob.gov.my	Environment, sustainability and climate change

Dr. Chen Sau Soon *Senior General Manager*	Environment & Bioprocess Technology Centre SIRIM Berhad 1, Persiaran Dato' Menteri 40911 Shah Alam Selangor, Malaysia Tel: +603-5544 6564 Fax: +603-5544 6579 E-mail: sau.soon_chen@sirim.my Website: http://www.sirim.my	LCA for biodiesel from crude palm oil; coordinator for the National Project on Life Cycle Assessment
Dr. Lulie Melling *Director*	Sarawak Agricultural Department Tropical Peat Research Laboratory Unit Chief Minister's Department Jalan Badruddin 93400 Kuching Sarawak, Malaysia Tel: +6082-429 621 Fax: +6082-429 624 E-mail: lulie_melling@yahoo.com Website: http://www.doa.sarawak.gov.my	Peat soils and GHG research, with a particular focus on Sarawak peatlands.
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Expert Consultation on:

"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

20-22 November 2008, Kuala Lumpur, Malaysia

ANNEXES

Expert Consultation on:

“Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia”

20-22 November 2008, Kuala Lumpur, Malaysia

ANNEX 1

Carbon Footprint of Malaysian Palm oil and Future Areas of Research

Chan Kook Weng

MPOB

Outline of presentation

- Introduction
- Five initiatives
- Develop a C sustainability framework
- Aim of paper

- Understand carbon footprint
- Research into oil palm carbon footprint
- Climate change, carbon market, standards
- Way forward and conclusion

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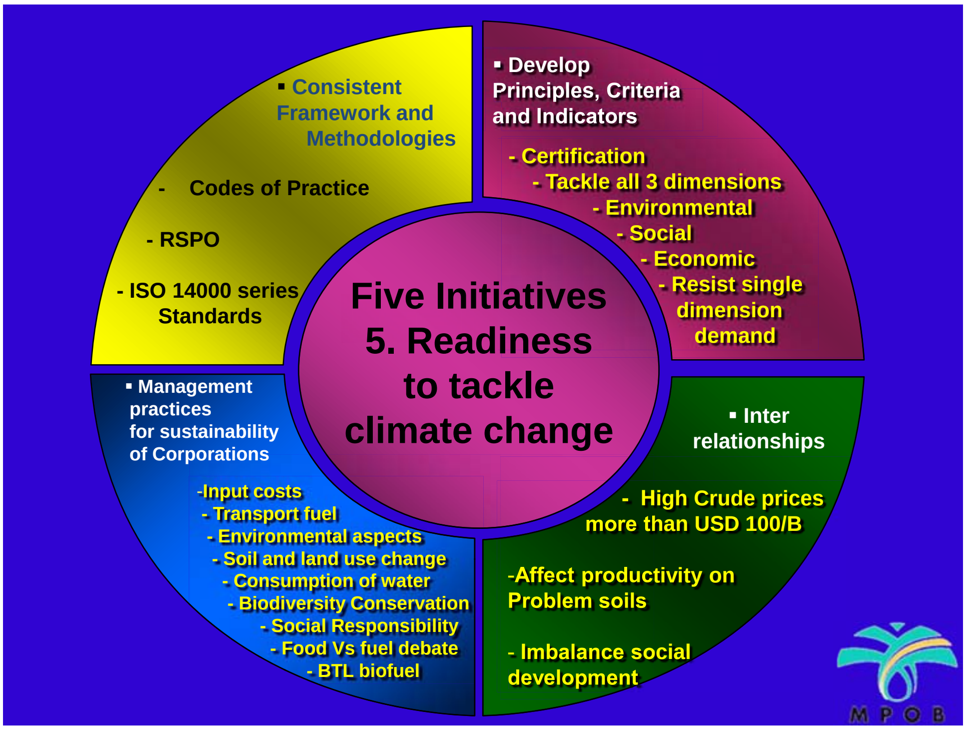
Introduction

- Overarching requirement of C footprint
- Address climate change
- Reduce greenhouse gas & global warming
- Five initiatives: - Harmonized approach
  - Ensure palm oil industry is green
  - Gaining global creditability
  - Define sustainability of industry
  - Readiness to tackle climate change

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)



Source: *International Palm Oil Sustainability Conference 2008 (IPOSC 2008)*

Develop Sustainability Framework to Assess Carbon Balance

- Have an objective
- Develop principles
- Have criteria

- Look at indicators
- Have verifiers
- Certification

Urgency to be Green

- Narrow gap of compliance
- Doing best to fulfill requirement but not fast enough
- Speed to market yet possess technical rigour
- Data collection remains fragmented
- Quality of data, Action plans, Milestones, Deliverables, Budgets and Reviews

Aim of paper

- Take action to reduce GHG emissions
  - UNFCCC Fourth Assessment Report
  - Stern Report
  - Bali Roadmap
- Tell Malaysian palm oil industry's reduction of carbon footprint on Government, business and individual levels

Understanding Carbon Footprint, Offset and Carbon Neutral Claims

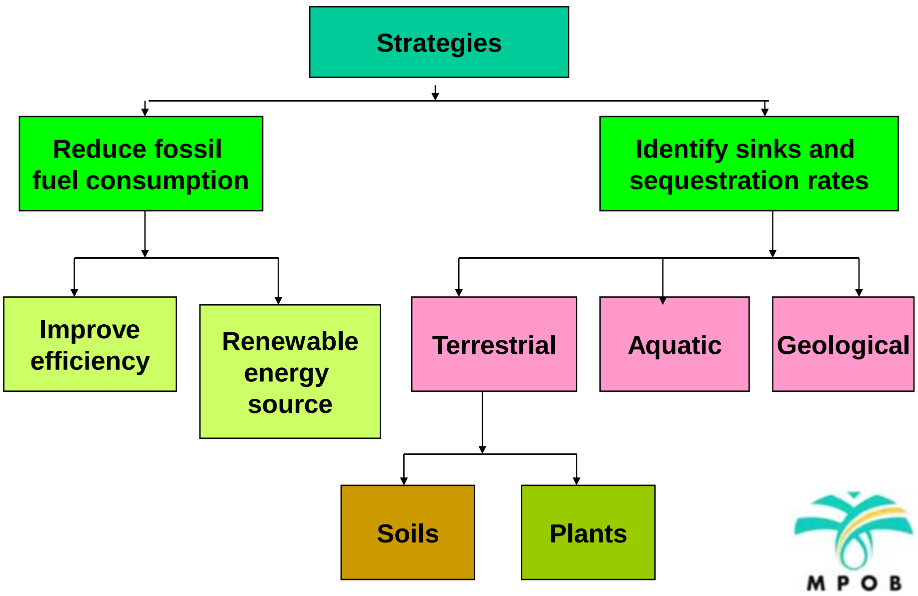
- (Carbon footprint + Offset = Carbon neutral)
- Carbon footprint = Carbon emission
- Carbon offset = Carbon credit or removal

- Carbon neutral when carbon footprint equals carbon offset
- Put carbon eco label on products
- Who to pay for food miles?

EU targets for renewable energy and Biofuel in 2010 and 2020

Sources	2010	2020
Renewable Energy (Biofuel, Solar, Wind, Hydro, Geothermal, etc)	10%	20%
Biofuel	5.75%	10%

Strategies to reduce Atmospheric CO_2



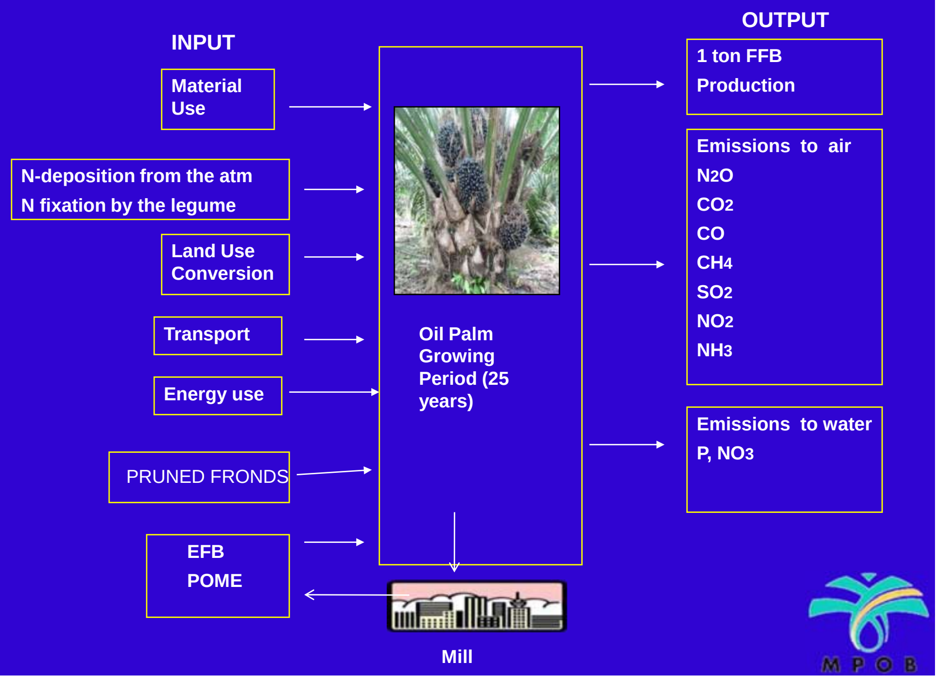
Source: *International Palm Oil Sustainability Conference 2008 (IPOSC 2008)*

Avoid Conflicting Approaches

- A detailed full MPOB LCA study in progress
- Review of current published work
- MPOB interim studies on carbon accounting

- Research into carbon footprint at 3 levels
- Local, Landscape or Regional and National levels

BOUNDARY SYSTEM UPSTREAM LCA – FFB PRODUCTION



Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Methodology for GHG Emission for Palm Oil

Emissions = a + b + c + d + e – f – g -h

Emissions	Requirements	Comments
a) Cultivation and harvesting	Emissions from fertilizers, pesticides and machinery at 338 and not 666kg/t biodiesel compared with 1411 and 1110 Kg/t each for sunflower and rape	Palm oil has advantage with lower inputs at 18 versus rape at 30gCO_2e/MJ
b) Carbon stock changes from land use	Mentioned in the equation but not form a part of the whole calculation of carbon balance and default figures are hardly provided. The carbon stock at 189tC/ha is high compared with 51tC/ha obtained	The inclusion of this is often neglected in the directive; and spreading to 20 years means one cycle of palm
c) Processing	The factor encompasses a wide range of emissions from milling to esterification.	It is felt that 1221kg/t biodiesel is lower than 1311kg/t quoted or 481 Vs 435kg/t for non-waste situation
d) Transport	Overall emission is small. At 185kg/t biodiesel is 5 times higher than 37kg/t for sunflower and rape	It is felt that emission at 5 times more than rape, palm oil transport is still small

Methodology for GHG Emission for Biofuel

Emissions = a + b + c + d + e – f – g -h

Emissions	Requirements	Comments
e)Fuel in use	These factors can only be non-zero in situations where CO_2 emissions incurred during the production of vegetable oils are stored underground or reused for industrial purposes. This is difficult and expensive even in large CO_2-rich flow let alone a vegetable oil supply chain with dispersed CO_2 emission sources	It is felt that this may be set to zero
f) Savings from carbon capture and sequestration		This is felt that this may be set to zero
g) Saving from Carbon capture and replacement		This is felt that this may be set to zero
h) Savings from excess electricity		This is felt that this could be larger than zero as in some mills have excess electricity for sale to national grid

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Comparison of Carbon Budget

Carbon (tC_e/ha/yr)	Peat	Average	Coastal	Inland
On Site gain[1]	2.307	1.858	2.297	2.137
Off Site gain[2]				
Mill & products[3]	0.226	0.073	0.118	0.115
CH_4 POME[4]	0.759	0.605	0.812	0.586
Total gain	3.292	2.536	3.227	2.838
Losses				
Total[5]	12.222	2.963	2.488	0.696
Balance	-8.930[6]	-0.427	0.739	2.140

(Source: MPOB, 2008; Henson and Chang, 2008;1=Oil palm including roots, ground cover, oil palm litter of frond piles, leaf bases, male inflorescences; 2= FFB transported to Mills;3 = Mill products and by products; Losses Plantation use of fossil fuel; 4 = When captured is grouped under gain; 5 = include N_2O from N fertilizers and initial biomass losses from previous LUC; 6= Based on default figures from published work.

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Improvements during 1981-2005

- Three distinct regional classification: Peninsular, Sabah, Sarawak
- 1989: Zero burn policy in place: no methane, nitrous oxide and carbon monoxide
- 1990: No oil palm on jungle clearing:
- 2002: Trapping of biogas over POME ponds under CDM projects

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Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Net Carbon Sequestration Over the Estates

-	-	-	-
+	-	-	-
-	-	0	+
0	+	-	-

Sequestration (-), Emission (+), Breakeven (0)

Potential Carbon Balance (tC_e/ha/yr) based on Improvements of Practices

1981-2005[1]	Peninsular	Sabah	Sarawak	Malaysia
Sequestration	1.908	3.401	2.596	2.356
Biogas POME	0.598	0.535	0.309	0.564
Total	2.505	3.936	3.905	2.919
Emission	3.786	7.572	12.812	5.254
Biogas POME	-0.598	-0.535	-0.309	-0.564
CH_4, N_2O, CO Zero burn	-0.702	-0.694	-0.426	-0.681
Total	2.486	6.344	12.076	4.010
Potential net	0.020	(-2.408)	(-8.172)	-1.090

(Source: Basri and Chan, 2007, 1 = mean acreage at 2.44 million ha; 2007 3.40 million ha with 2.36, 1.28 and 0.66 million ha in Peninsular, Sabah and Sarawak respectively)

Comparison of Carbon balance

- Palm oil: Potentially positive (Present study)
- Rapeseed: 70% more (Crutzen *et. al*., 2007)
- Corn: 50% more (Crutzen *et. al*., 2007)
- Due to $N_{2}0$ with 296 times global warming

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Total Carbon at National Level

- 60% under forest
- 10% more than 50% pledged at Rio Summit
- Forest net sink (Azmi Khalid, 2007 at Bali)
- Based on Article 3.3 and 3.4 UNFCCC
- Take into account afforestation, reforestation, land under harvesting, land not harvested, deforestation, forest management, crop land, grazing and re vegetation

GHG Source and Sink Activities	Net Emissions/Removals								
	BY	08	09	10	11	12	**Total**	Parameter	Quantity
	Cg CO_{2e}								
A. Article 3.3 activities									
A.1 Afforestation & Reforestation									x
A1.1 Unit land not harvested		X	x	x	x		x		x
A.1.2 Unit land harvested									x
Unit A		X	x	x	x		x		x
Unit B		X	x	x	x		x		x
Unit C		X	x	x	x		x		x
Unit D		X	x	x	x		x		x
Unit E		X	x	x	x		x		x
A.2 Deforestation		X	x	x	x		x		x
A. Article 3.4 activities									
B.1. Forest Management		X	x	x	x		x		x
3.3. Offset								x	x
FM cap								x	x
B.2.Cropland Management	x	X	x	x	x	x	x	x	x
B.3.Grazing Land Management	x	X	x	x	x	x	x	x	x
B.4. Revegetation	x	X	x	x	x	x	x	x	x
(Source: Adapted from FCCC/SBSTA@)/L.21, 2007)									

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Climate Change, Carbon Market and ISO Standards

- ISO 14064 Parts -1, -2 and -3 and ISO 14065
- Worldwide uptake *e.g*. EU ETS, WRI/WBCSD
- Voluntary and Regulated Schemes

- Use in non-signatory countries, CDM projects, UNEP programme , VCS
- Other ISO standards, ISO 14040, ISO 14025, ISO 14062

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The Way Forward on Carbon Balance

- Harmonized use of ISO standards
- Harmonized Codes of Practice
- Normalize life cycle impact over supply chain
- Provide informed environmentally preferred choices of products
- New standards ISO 14066 and ISO 14067

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Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Conclusion

- Valuable lessons learned on palm oil footprint
- Success depends on multilateral discussion on standardized methodologies
- Newer ISO C standards being developed
- Palm oil industry on way to low carbon economy

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Expert Consultation on:

"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

20-22 November 2008, Kuala Lumpur, Malaysia

ANNEX 2

TROPICAL LOWLAND PEATS: TO CONSERVE OR DEVELOP THEM

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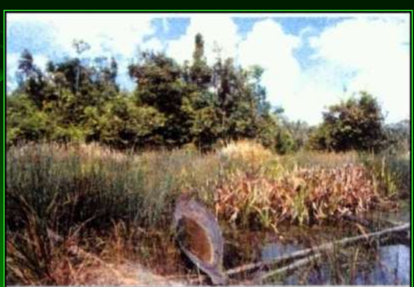
Tropical Lowland Peats – Fragile Waterlogged Ecosystem

Aerial-view of Tasek Bera

Pandanus



Sedges

Swamp forest

Environmental Groups: Logging and development results in:

- Loss of Biomass (above ground)
- Habitat loss – *orang utan*, sumatran tiger, elephants
- Subsidence and Decomposition
- Increase GHG emissions
- Increase incidence of fires

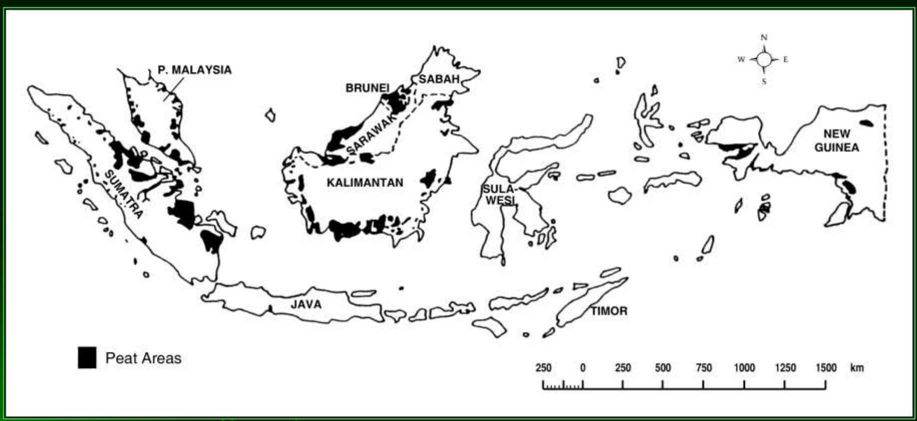
Government and Plantations:

- Need to eradicate poverty
- Uplift incomes of native communities
- Water control – minimal subsidence and GHG emissions
- More GHG emissions in natural peat swamps
- Less GHG emission from oil palm if managed well
- Estates – no burn policy

What is the true picture?

Environmental Groups or Government / Plantations?

Distribution of Tropical Lowland Peats (Indonesia / Malaysia)



Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Extent of Lowland Peats in Indonesia / Malaysia

	Riely *et al.*, 1995 (x 1,000)		Tie, 1990 (x 1,000)
	Min.	Max.	
Indonesia	17.00	27.00	26.20
Malaysia	2.25	2.73	2.56

Extent of Lowland Peats in Malaysia

Region	Ha (x 1,000)	% of total land area
P. Malaysia	795.8	6.1
Sabah	200.6	2.6
Sarawak	1,762.6	14.2
Malaysia	2,759.9	10.8

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

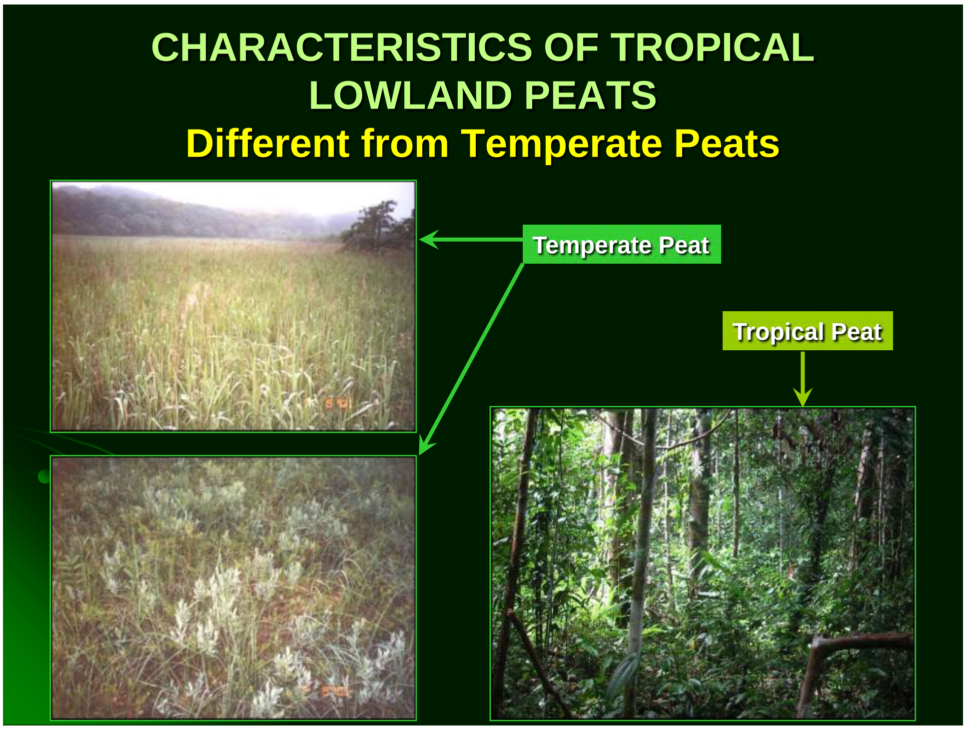
Land Use on Peat in Malaysia

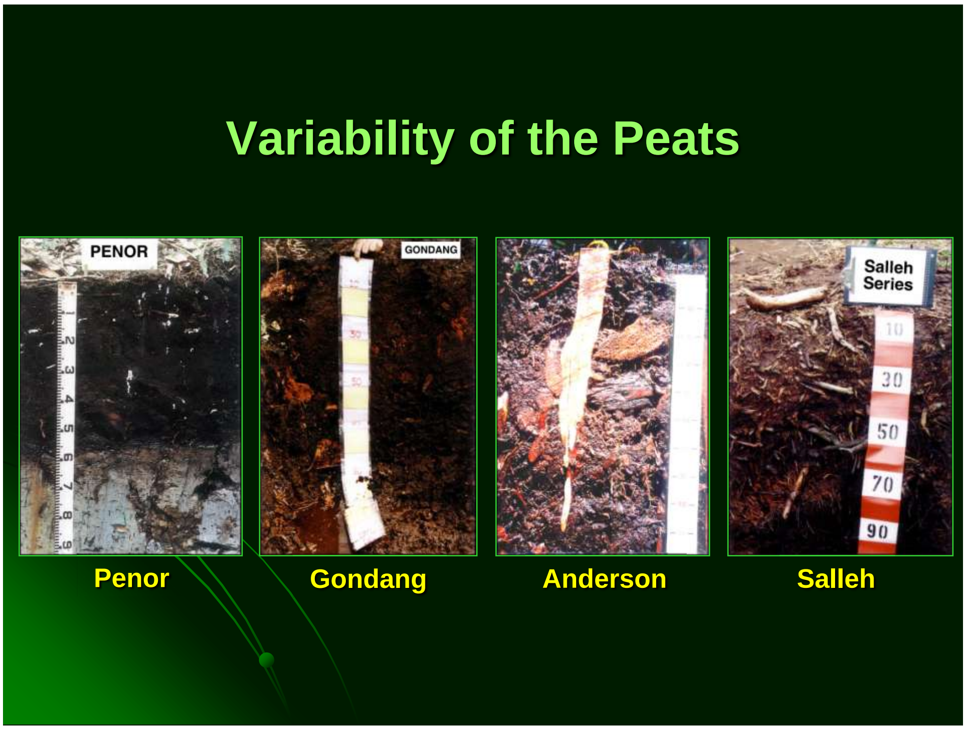
Region	Ha (x 1,000)	% of agricultural area
P. Malaysia	313,600	39.4
Sabah	NA	N.A.
Sarawak	554,800	30.8
Malaysia	868,000	31.4
Total peat area in Malaysia		2.76 mil. ha

Common Crops

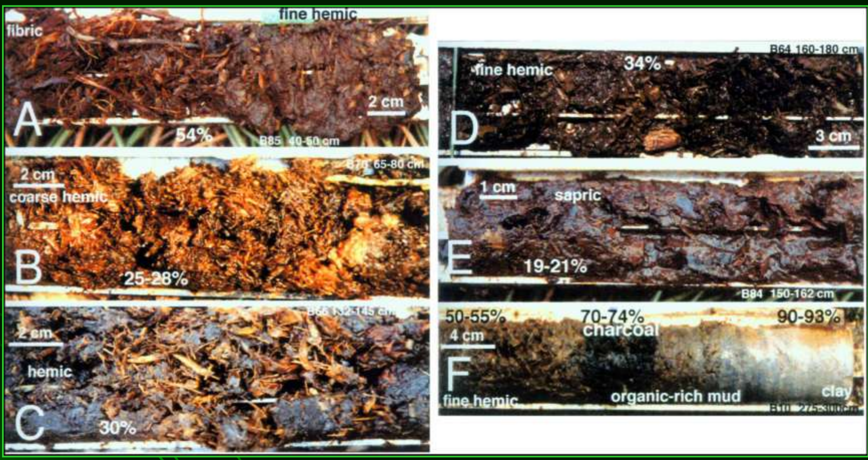
	Extent (ha)	
	Peninsular Malaysia	Sarawak
Oil Palm	146,700	330,700
Sago	-	64,200
Rubber	98,100	23,000

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)


CHARACTERISTICS OF TROPICAL
LOWLAND PEATS
Different from Temperate Peats
Temperate Peat
Tropical Peat

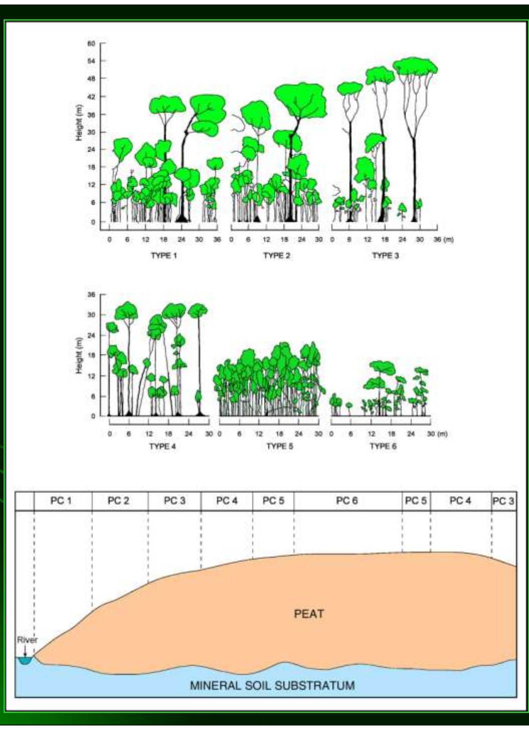

Variability of the Peats
PENOR
GONDANG
Salleh
Series
10
30
50
70
90
Penor
Gondang
Anderson
Salleh

Various peat textures from Tasek Bera
(After Wust, 2001)

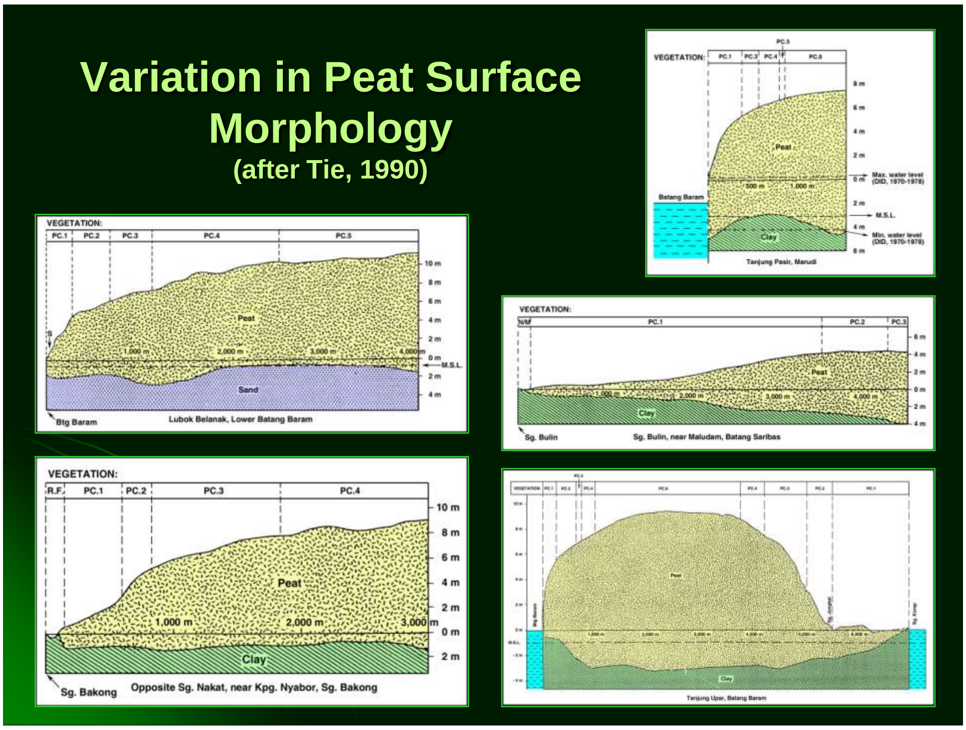


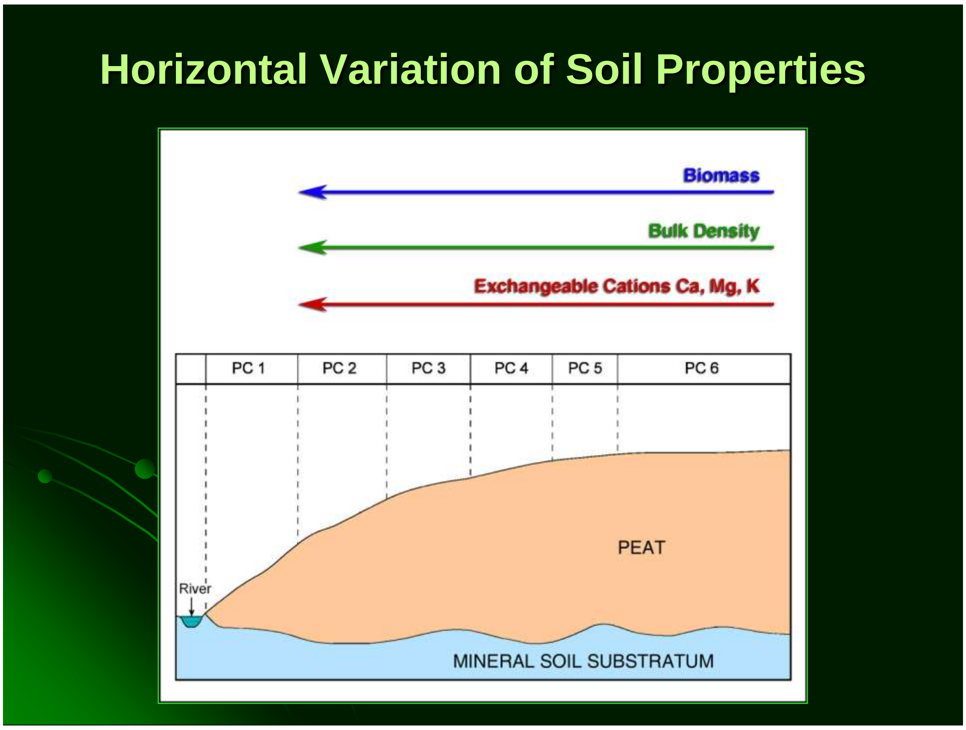
A = Fibric
B = Coarse hemic
C = Hemic peat

D = Fine hemic peat
E = Sapric peat
F = Organic rich clay — kaolinites

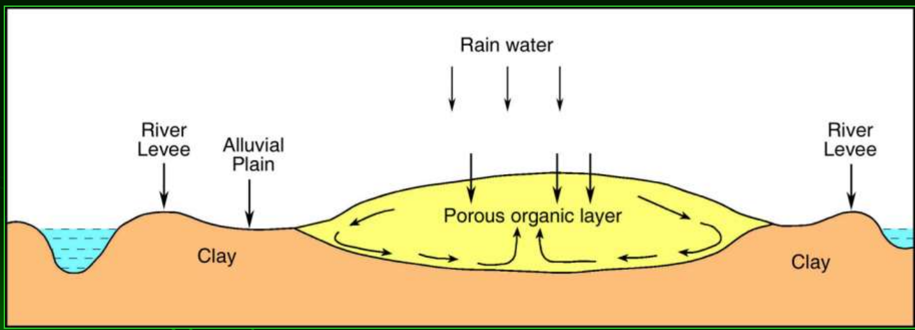


Horizontal Zonality of Vegetation

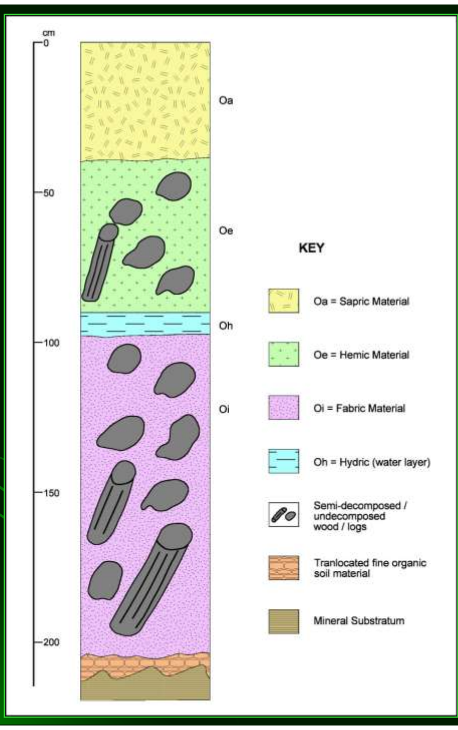

Variation in Peat Surface Morphology
(after Tie, 1990)
VEGETATION:
PC.1 PC.2 PC.3 PC.4 PC.5
Peat
Sand
Btg Baram
Lubok Belanak, Lower Batang Baram
VEGETATION:
R.F. PC.1 PC.2 PC.3 PC.4
10 m
8 m
6 m
4 m
2 m
0 m
2 m
Peat
1,000 m
2,000 m
3,000 m
Clay
Sg. Bakong
Opposite Sg. Nakat, near Kpg. Nyabor, Sg. Bakong
Sg. Bulin
Sg. Bulin, near Maludam, Batang Saribas
Tanjung Pasir, Marudi
Tanjung Upar, Batang Baram


Horizontal Variation of Soil Properties
Biomass
Bulk Density
Exchangeable Cations Ca, Mg, K
PC 1
PC 2
PC 3
PC 4
PC 5
PC 6
PEAT
River
MINERAL SOIL SUBSTRATUM

Hydrology

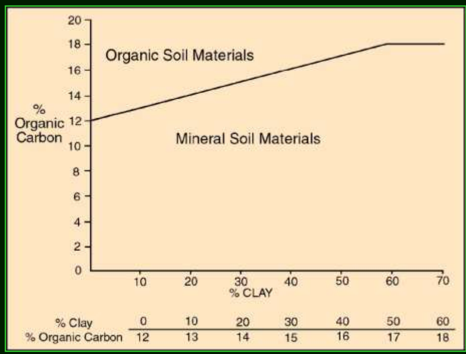


Vertical Layering



Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Current Issues
Lack of Definition



Proposed Definition

- Minimum thickness 50 cm
- Organic soil materials
- Temperature regime Isohyperthermic

Extent

	Riely *et al.*, 1995 (x 1,000)		Tie, 1990 (x 1,000)
	Min.	Max.	
Indonesia	17.00	27.00	26.20
Malaysia	2.25	2.73	2.56

Loss of Biodiversity / Habitat

- Biodiversity less than Lowland Dipterocarp Forest
- Horizontal Zonality – difficult to estimate loss
- Peat swamp not natural habitats of *orang hutan*, sumatran tiger, elephants
- Sufficient wildlife reserves exist?

Carbon Stored in Peat Swamps

	Area (km^2)		Mass C (Gtonnes)	
	Min.	Max.	Min.	Max.
Indonesia	168,250	270,000	10.095	32.4
Malaysia	22,500	27,300	1.35	3.276

Conversion Forest → Logging, Oil palm, Rape seed, Soyabean→ Loss of Biomass (inevitable) → Oil palm replaces large fraction

Source: *International Palm Oil Sustainability Conference 2008 (IPOSC 2008)*

Below Ground Carbon Estimates

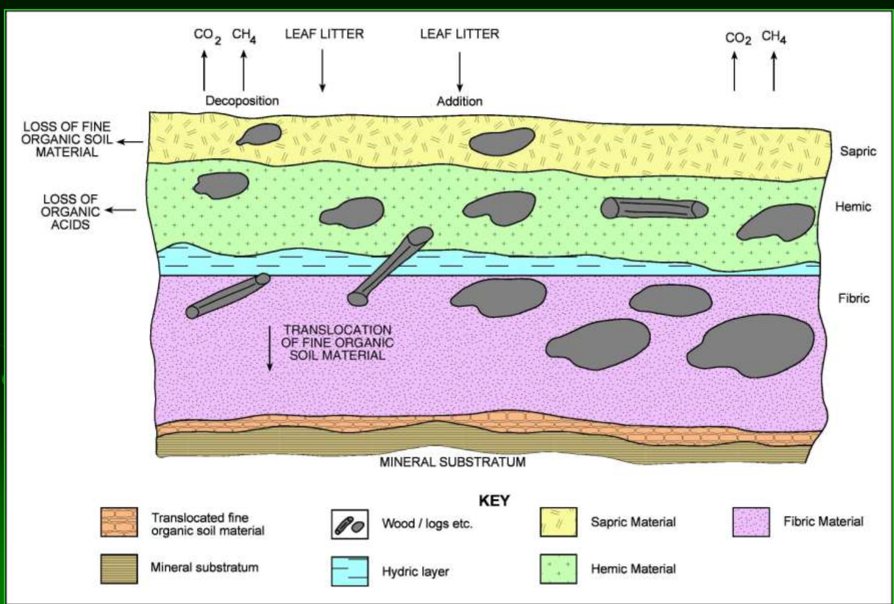
Total Carbon – calculations

- Extent of P.S.
- Depth
- Carbon content
- Bulk density

Does not consider

- Carbon cycle
- Change in B.D. with depth
- Logs
- Water layers
- Variability between / within swamps

Carbon Cycle



Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Subsidence / Decomposition

Assumes subsidence = Decomposition

Past values:

- Drainage with no control
- 100 cm – 1st two years
- 5 cm/year
- 2 cm/year

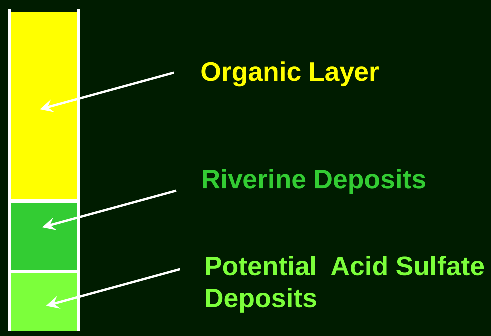
Subsidence More Important Than Decomposition

Kool *et al.* (2006) (Central Kalimantan)

Subsidence : 2.2 → 4.0 m

Decomposition : 2 → 47 cm

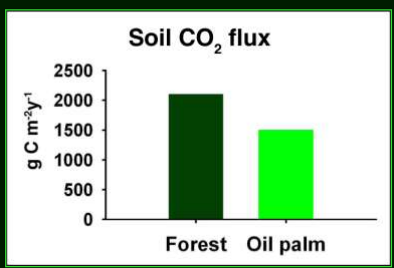
Underlying Acid Sulfate



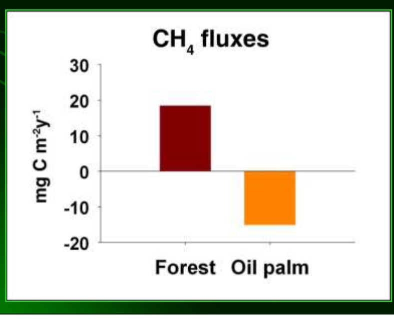
- Acid sulfate soils not a major problem

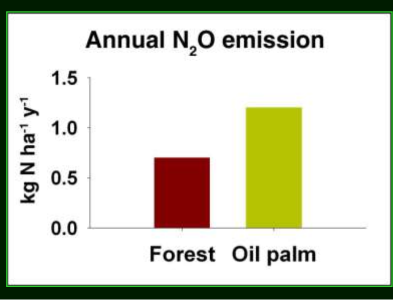
GHG Emissions

(After Melling *et al.*, 2005a, b)



Oil Palm	Forest
Control W.T.	Fluctuate
$CH_4 \rightarrow$ oxidized	CH_4 + CO_2
Mostly CO_2	
More N_2O	





Peat Fires

- No Burn Policy
- Peat Fires – Indonesia – Smallholders – No burn no food
- Need enforcement / Monitoring

Source: Wetlands International

Develop or Conserve?

- Peats > 3 metre depth – No scientific basis
- No replanting of oil palms on peat areas

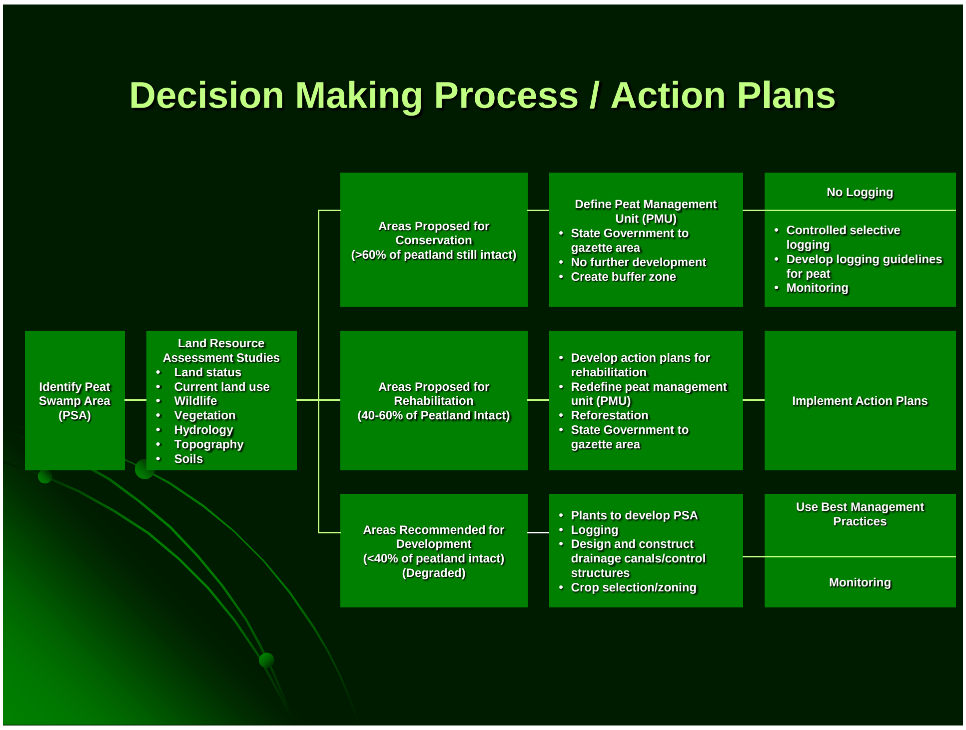
- Need for Peatland Resource Inventory
- National Peatland Policy
- Uniqueness of Individual Peat Swamps

Assessment Criteria

- Definition of PSA
- Current Status and Land Use
- Socio-Economic Survey
- Wildlife / Flora Survey
- Vegetation Survey (PCs)
- Hydrology
- Topography and Soils
- Green House Gas Emissions

Evaluation of land resources characteristics for the conservation of a peat swamp e.g. Common Land Use

Land Resource Characteristic	Highly Suitable (S1)	Moderately Suitable (S2)	Marginal Suitable (S3)	Currently Unsuitable (N1)	Permanently Unsuitable (N2)	Remarks
Current Land Use						
Permanent Crops (%)	<20	20-40	40-60	60-80	>80	Existing Plantation Crops
Cash Crops (%)	<40	40-60	60-80	>80		Extent of smallholders
Fire Damage (%)	<20	20-40	40-60	60-80	>80	Assessed over whole PSA
Decision	Conserve		Rehabilitate	Develop		



Immediate Actions

- Immediate moratorium on alienating new peat areas
- Alienated areas not yet developed be 'put on hold'
- Initiate a programme to collect data
- Formulate a National Peatland Policy
- More data on GHG emissions whole canopy method.

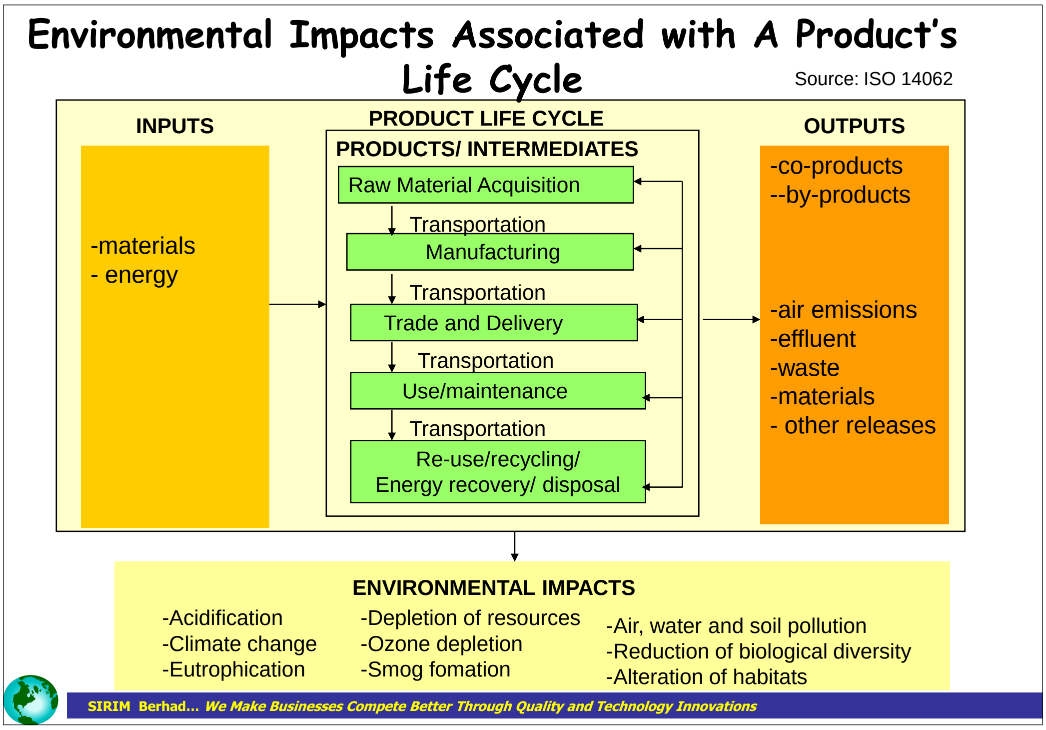
Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Expert Consultation on:

"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

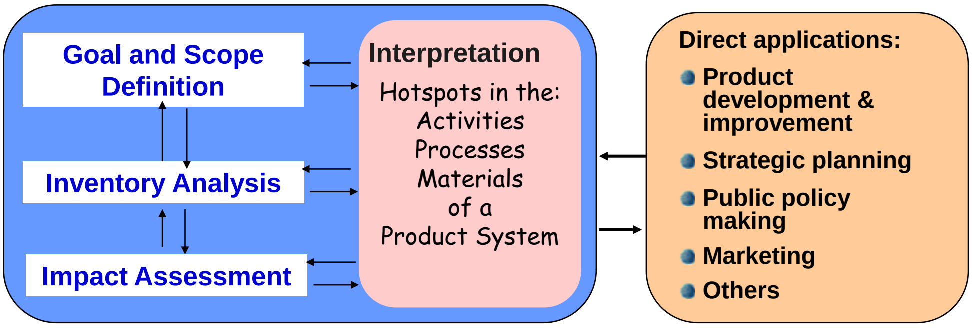
20-22 November 2008, Kuala Lumpur, Malaysia

ANNEX 3



Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

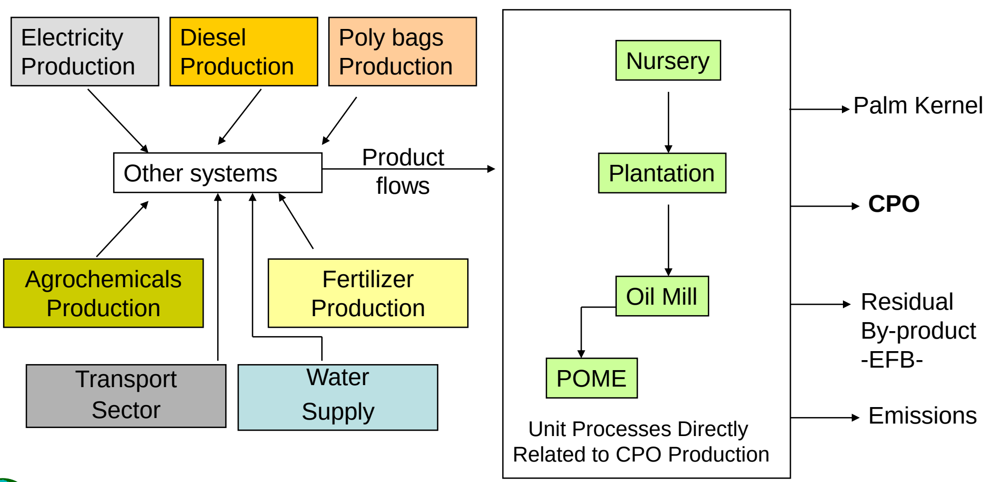
LCA FRAMEWORK (ISO 14040)



LCA is a comprehensive technique as it considers all attributes and aspects within one study in a cross-media perspective, thereby potential trade-offs can be identified and assessed.

- Natural Environment
- Human health
- Resources

SYSTEM BOUNDARY OF LCI FOR PRODUCTION OF 1 TON CPO



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Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

MAJOR UNIT PROCESSES

The major unit processes directly related to CPO production:

- Oil palm agriculture
  - Nursery stage
  - Plantation stage
- Transportation of FFBs to the mills
- Milling stage
  - Palm oil mill effluent (POME) treatment

Unit processes that are related to the palm oil industry:

- Fertiliser production and application
- Electricity generation
- Public water supply
- Polybags production
- Diesel production and use
- Sea transportation for import of fertilisers

Biological processes that are considered within the system boundary:

- Carbon sequestration
- Carbon emission from landuse change of logged-over forest to oil palm plantation

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COMPUTATIONS & ASSUMPTIONS IN DEVELOPING THE LCI

- Palm oil is readily available over the life span of the oil palms
- Input and GHG emission at the nursery stage are apportioned over the 25 life span of oil palms
- CO2 emitted from combustion of biomass in flue gas released from boilers, are carbon neutral
- Agrochemicals are not included in the inventory for GHG emission as their amount is small
- GHG emission refer to CO_2-equivalent that comprise:
  - Direct CO_2 emission
  - CH_4 that is 21 times the global warming potential (GWP) of CO_2 (from the anaerobic treatment systems POME
  - N_2O released from volatisation of nitrogenous fertilisers at 310 times the GWP of CO_2

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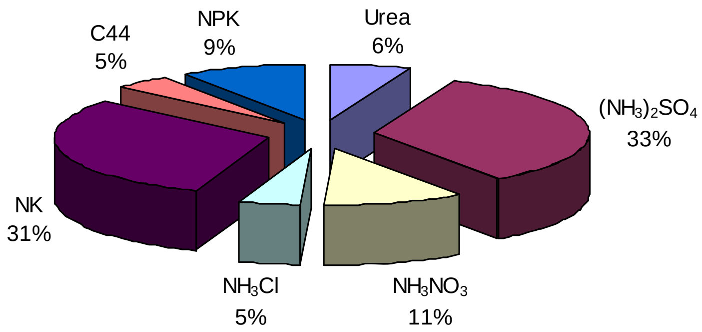
TYPE OF FERTILISERS USED (70 Plantations)



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IMPACT OF FERTILISER APPLICATION (1/2) -From Production Stage-

SIRIM

- **Fertiliser production demands energy and generates GHG, fertiliser production consumers about 1.2% of the world's energy and is responsible for approx. 1.2% of the total GHG emission (Wood et. Al. 2004)**
- **Key nitrogen fertilisers are:**
  - **Ammonium nitrate (AN)**
  - **Calcium ammonium nitrate (CAN) – mixture of AN with a min. of 20% CaCO3, nitrogen content 25 – 28%**
  - **Urea**
  - **Urea ammonium nitrate (UAN)**
- **GHG emission during production per kg N in product**

	kg CO_2/kg N	kg N_2O/kg N	Total kg CO2 equivalent/kg N
NH_4NO_3 (35% N)	1.5 – 2.8	0.013 – 0.017	3.0 – 7.1
CAN	2.6 – 3.2	0.013 – 0.020	3.0 – 9.6
Urea	0.9 – 4.0		0.9 – 4.0
UAN	1.3 – 3.4	0.0073 – 0.0075	2.0 – 5.7

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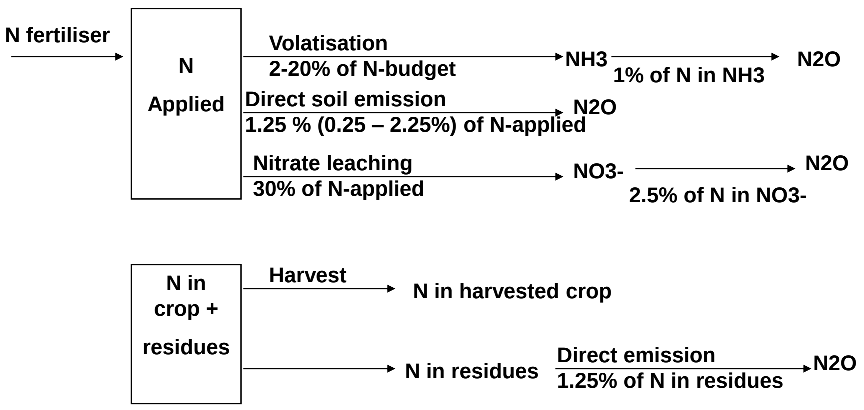
NITROGEN EMISSIONS ACCORDING TO THE IPCC METHOD



EFB is the residual by-product applied back in the plantation as fertiliser, with N content of 1.5%

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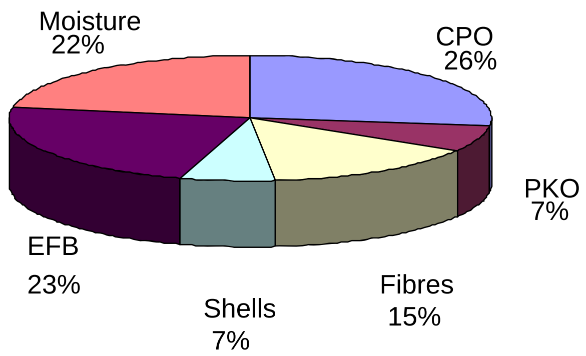
ALLOCATION OF GHG EMISSION BY WEIGHT OF FRESH FRUIT BUNCH (FFB)



ALLOCATION - Partitioning the input or output flows of a process or other product system to the product system under study

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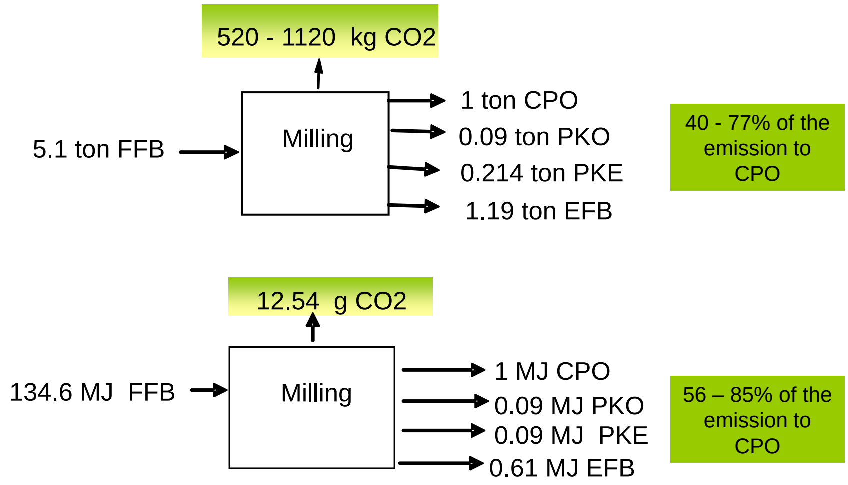
Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

ALLOCATION OF GHG EMISSION TO CPO & OTHER CO-PRODUCTS by WEIGHT & ENERGY



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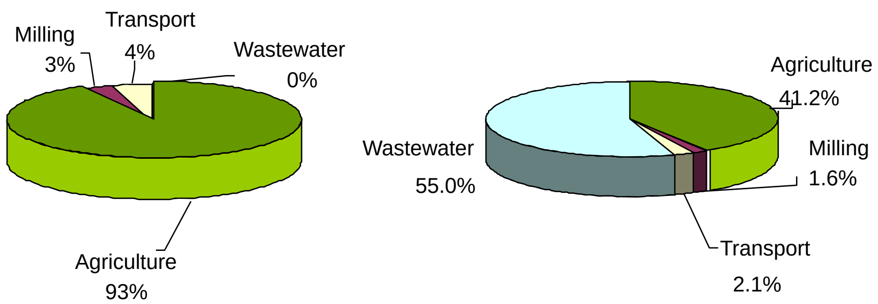
SOURCES OF CO2 EMISSION IN THE PRODUCTION OF CPO FROM SEED TO MILL



CO_2 produced: 210 – 502 kg/ton CPO
Biogas Captured from POME Treatment

CO_2 produced: 460 - 1160 kg/ton CPO
Biogas Released from POME Treatment

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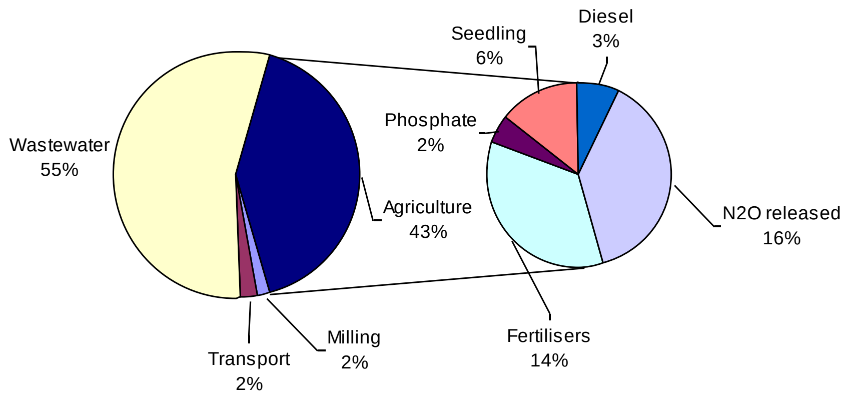
Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

CONTRIBUTORS TO THE GHG EMISSION IN OIL PALM AGRICULTURE



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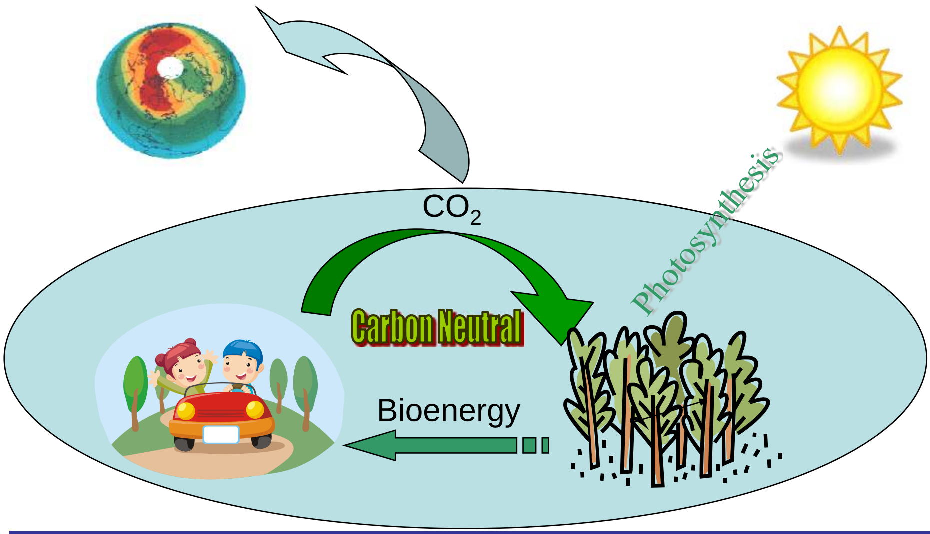
CARBON EMITTED & CARBON SEQUESTERED -The Life Cycle Inventory Approach to Evaluate the Palm Oil Carbon Footprint from Seed to Mill-



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Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

CARBON SEQUESTRATION

- 1980 – 2000 (Henson, 2004)
  Annual rate of carbon sequestration: 3.327×10^6 ton/year

- Assuming the same rate for year 2000 – 2005
  - CO_2 sequestration/land unit area: 3.22 ton/ha/year
  - Average FFB yield/land unit area: 19 ton/ha/year
  - Potential sequestration rate: 0.87 ton CO_2/ton CPO

- The oil palm plantation is a net sink for CPO produced from mills that harness the biogas from POME treatment system at ~0.5 ton CO_2/ton CPO (100% allocation).

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LANDUSE CHANGE

$$L_{conversion} = C_{After} - C_{Before} = 96.7 \text{ t ha}^{-1}$$ (Equation 3.3.8 of IPCC)

- $L_{Conversion}$ = Carbon stock change per area for conversion of logged-over forest to oil palm planting ton ha^{-1}, estimated for a 1-year period)

- C_{After} = Carbon stock in oil palm biomass one year after conversion to oil palm planting @ 4.8 ton C ha^{-1} (based on 40% of above ground living biomass of 3 year old yound palms)

- C_{Before} = Carbon stock in logged-over forest immediately before conversion to oil palm planting @ 103 ton C ha^{-1} (based on 50% of above ground biomass dry matter, IPCC)

IPCC assumed carbon stock right after land conversion is zero. The study assumed there is biomass content as seedlings are transplanted from the nursery to the new converted area.

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PARTITIONING OF EMISSION OVER PRODUCTIVE LIFE SPAN OF PALM

Year	Ha	Ha Change	% change	C emit (t/yr)	C emit/yr over 20 years life span	CO2 emit/yr over 20 yr life span
2000	3376664					
2002	3670243	293579	4.35	2.84E+07	1.42E+06	5.20E+06
2003	3802040	131797	3.59	1.27E+07	6.37E+05	2.34E+06
2004	3875327	73287	1.93	7.09E+06	3.54E+05	1.30E+06
2005	3963430	88103	2.27	8.52E+06	4.26E+05	1.56E+06
2006	4127490	164060	4.14	1.59E+07	7.93E+05	2.91E+06

Year	Ha	Net C sequest (t/year)	Net C sequest (t/ha/yr)	Net CO2 seq (t/ha/yr)	Net CO2 sequest (t/t FFB)	Net CO_2 seq (t/t CPO)
2000	3376664					
2002	3670243	1.91E+06	5.20E-01	1.91	0.10	0.51
2003	3802040	2.69E+06	7.07E-01	2.59	0.14	0.70
2004	3875327	2.97E+06	7.67E-01	2.81	0.15	0.75
2005	3963430	2.90E+06	7.32E-01	2.68	0.14	0.72
2006	4127490	2.53E+06	6.14E-01	2.25	0.12	0.60

Ave sequestration rate: 0.66 ton CO_2/ ton CPO

CONCLUSION

- The LCA technique enabled comparison of different agriculture and industry practices and identify hotspots that contribute to the carbon footprint from field to mill per ton of CPO.
- The LCA principles and methodology provided an objective approach to compare the quantum of reduction achievable with the different mitigation steps and activities.
- The generation of GHG is evident but with appropriate management and technological practices, the LCA methodology has shown the oil palm plantation can be a net CO_2 sequester for every ton of CPO produced.

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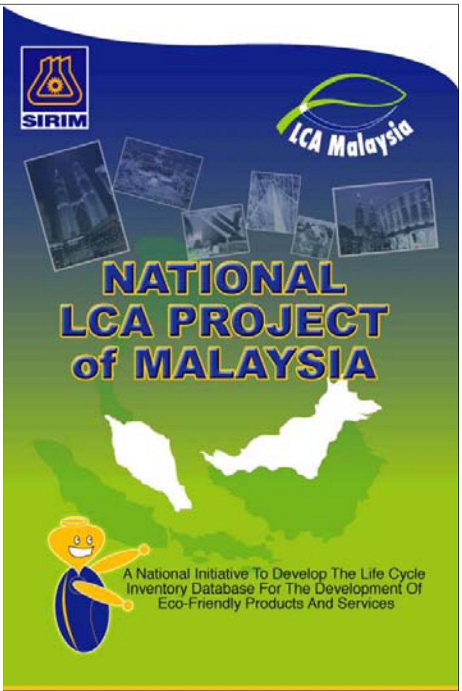
SIRIM LCA Study Team
- Production of CPO from Seed to Mill-

- Chen S.S.
- Hasnah Mohd Zin
- Letchumi Thannimalay
- Mohd Nazri Ahmad
- Norshidah Baharuddin
- Tan Yong Nee
- Wan Mazlina Wan Hussein
- Yati Kamarudzaman



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Expert Consultation on:

"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

20-22 November 2008, Kuala Lumpur, Malaysia

ANNEX 4

CARBON SOLUTIONS

Comparative LCA Analysis of Different Edible Oils and Fats

Kota Kinabalu

April 15th 2008

CARBON SOLUTIONS

Background to the studies

- Sustainability criteria under development in EU and member states;
- EU sets renewable energy and transport targets (20% and 10% by 2020);
- EU determines what counts as "sustainable"
- Member states give subsidies to achieve targets
- Carbon Balance is an important part of sustainability criteria;
- In current directive proposal: 35% minimum;
- Default value for palm oil at 17% - 51%, depending on methane capture
- CO_2 balance to be assessed for <u>individual</u> supply chains

Research questions

Initial questions:

- What is the carbon balance of "typical" Malaysian palm oil like ?
- What room for improvement is there ?

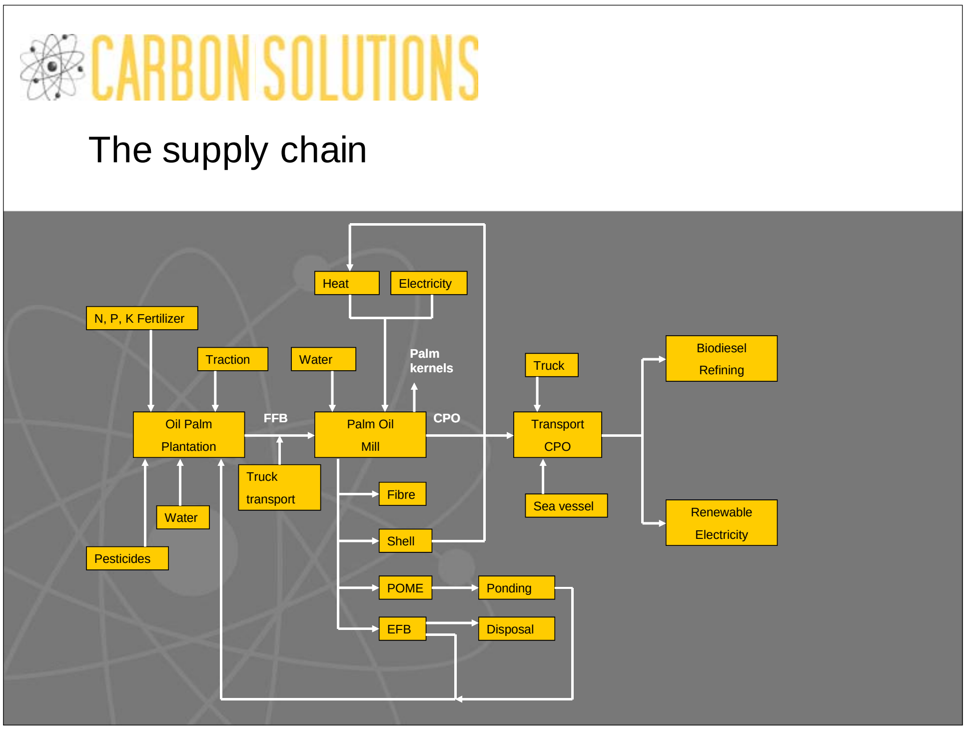
In a second study:

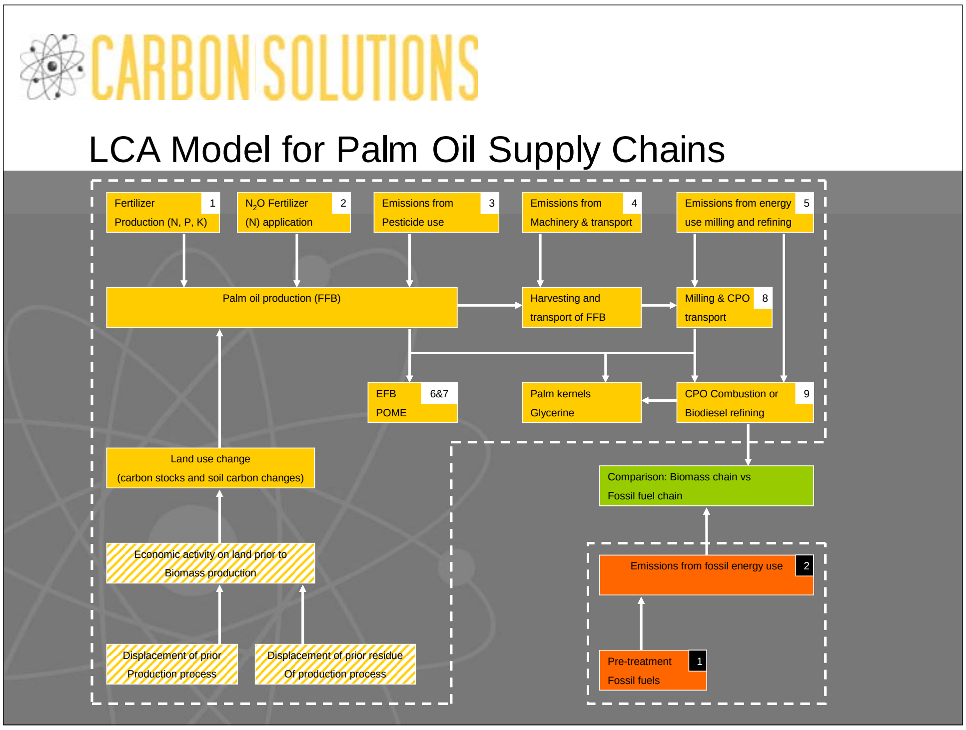
- How does palm oil based biodiesel compare to other vegetable oils ?

Basic parameters

- Carbon balance based on typical supply chain data;
- Two supply chains:
  - Biodiesel with CPO as feedstock;
  - Renewable energy production from direct CPO combustion
- Allocation based on market value of products;
- Average yield: 3.9 t/ha/a
- Land use data over 2000 - 2004

$$CO_2 \text{ reduction} = \frac{(CO_2 \text{ emissions fossil chain} - CO_2 \text{ emissions biofuel chain})}{CO_2 \text{ emissions fossil chain}}$$





Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

CARBON SOLUTIONS

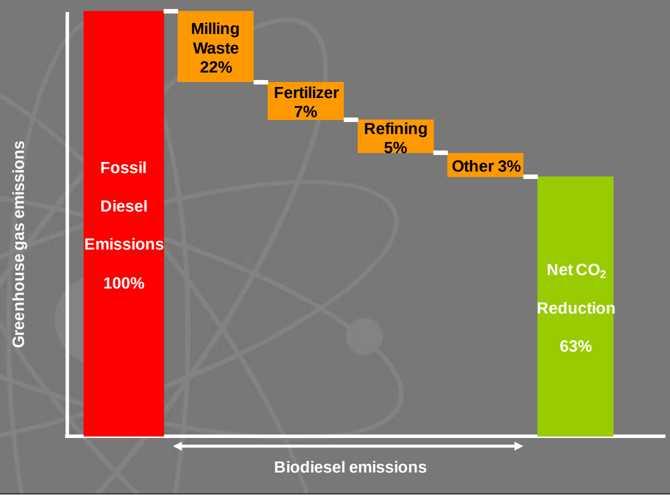
Results average Malaysian palm oil (excluding land use)

Application	Net CO_2 Reduction	%	Net Energy Reduction	%
Biodiesel	2,634 kg CO_2/t biodiesel	62%	43.14 GJ/t	78%
Renewable energy	1,813 kg CO_2/t CPO	60%	34.44 GJ/t	83%

- Per hectare of plantation land: 7 – 9,5 t CO2/ha/a
- Energy balance more positive than carbon balance
- Caused by CH_4 and N_2O emissions

CARBON SOLUTIONS

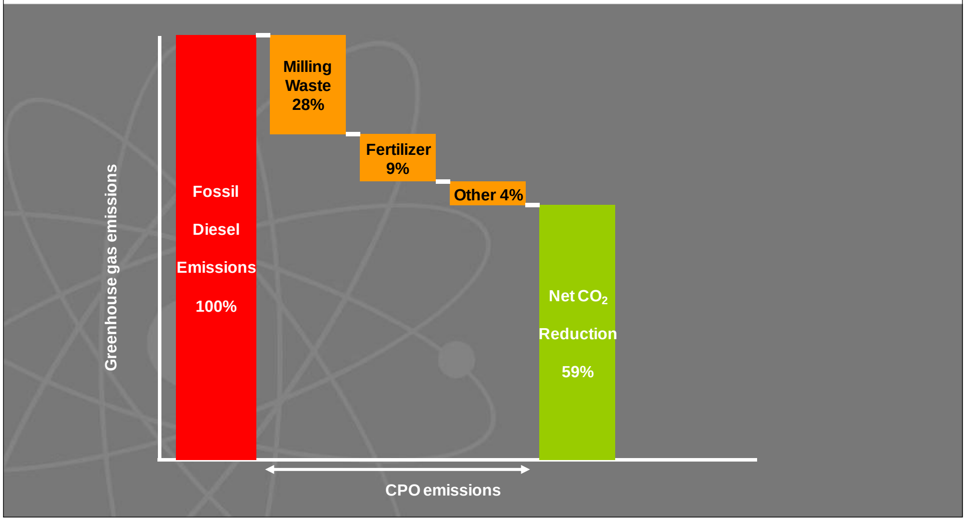
Breakdown of Results Biodiesel



Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

CARBON SOLUTIONS

Breakdown of Results Renewable Energy



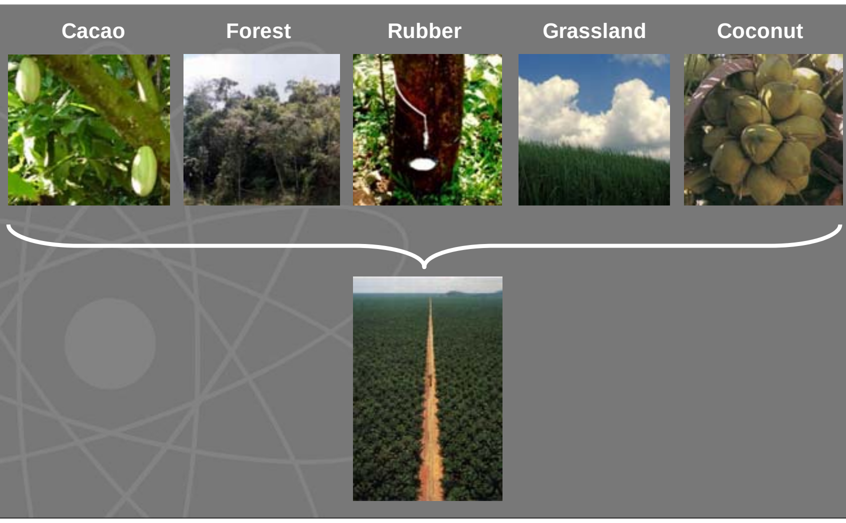
CARBON SOLUTIONS

Land use issues

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

CARBON SOLUTIONS

Land use conversion



CARBON SOLUTIONS

Carbon sequestration cycles

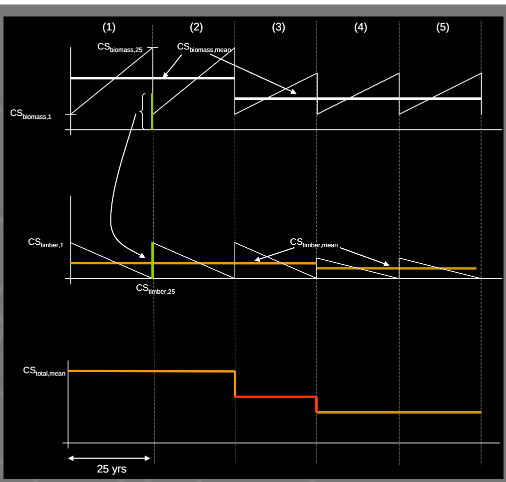
- Comparison of mean standing biomass stock;
- Time scales > 1 rotation cycle

- Carbon to soil (e.g. necromass);
- Carbon in harvested timber
- Emissions to air within 1 rotation cycle

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

CARBON SOLUTIONS

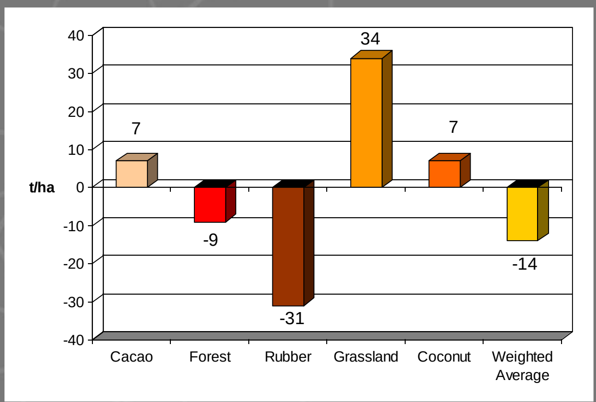
Incorporating carbon sequestration



CARBON SOLUTIONS

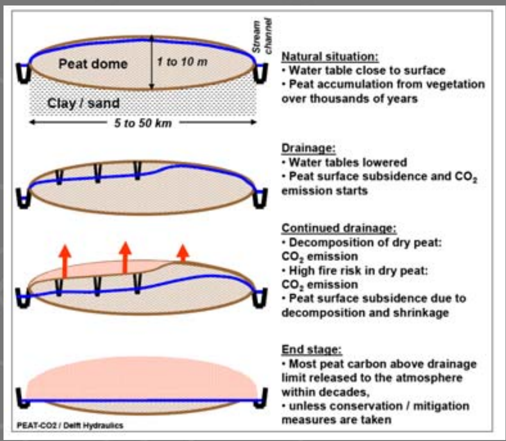
Carbon effects of land use conversion

- Based on land use data 2000 - 2004



CARBON SOLUTIONS

What about peat soil drainage ?



Wetlands International:

1 Meter drainage depth

↓

90 t CO_2/ha/a

↓

Plantation on drained peat

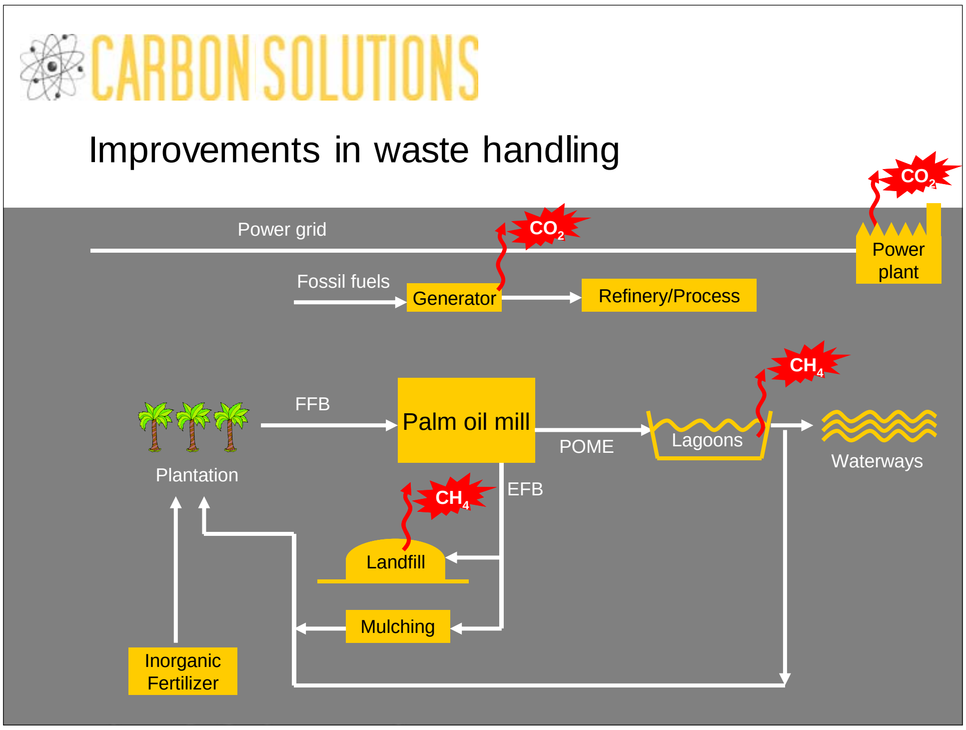
↓

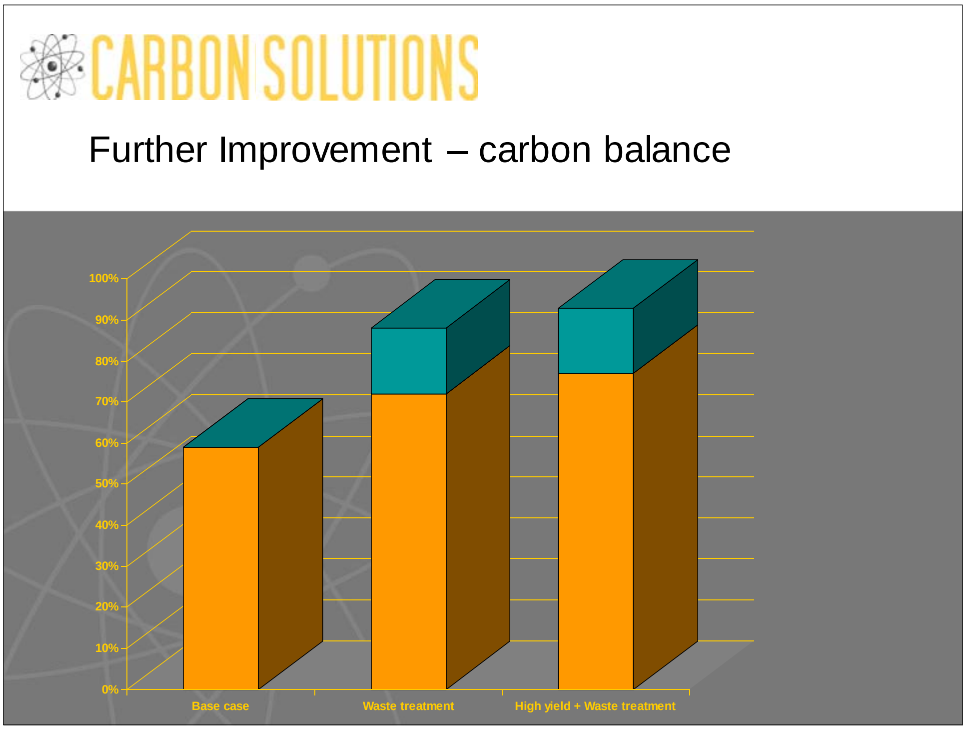
Negative carbon balance

But… what is the influence from soil respiration ?

CARBON SOLUTIONS

Room for improvement ?

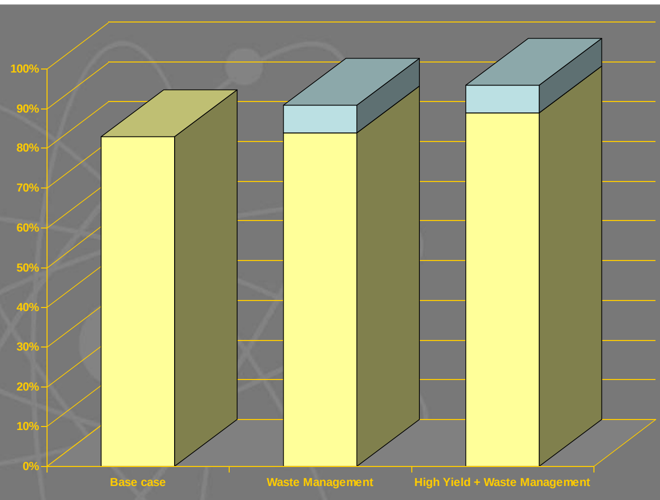




Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

CARBON SOLUTIONS

Further improvement – energy balance



CARBON SOLUTIONS

Further improvement – Yield increase

- Industry CPO average: 3.9 t/ha/a
- Leading plantations: 6.7 t/ha/a

- Direct effect on carbon and energy balance: + 5%
- In combination with waste handling: 80% – 95%

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

CARBON SOLUTIONS

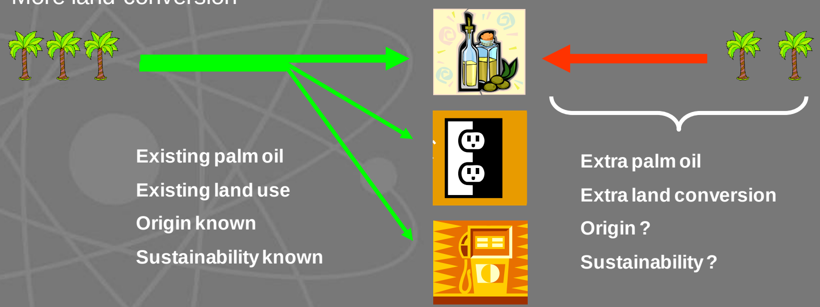
Weighing the options

	Applicability	Implementation speed	Barriers to implementation	Overall sustainability
Yield increase	++	-	Knowledge	++
EFB combustion	-	+	Business case & Logistics	+
POME biogas	+/-	+	Business case	+
Composting	++	+	Technology	++

CARBON SOLUTIONS

Europe’s dilemma

- New (EU) demand for palm oil
- More palm oil production
- More land conversion



CARBON SOLUTIONS

Comparison with other biofuels

"I do feel a lot better since we switched to the trans-fat free oil."

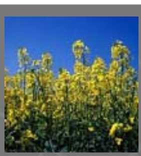
CARBON SOLUTIONS

General modelling parameters

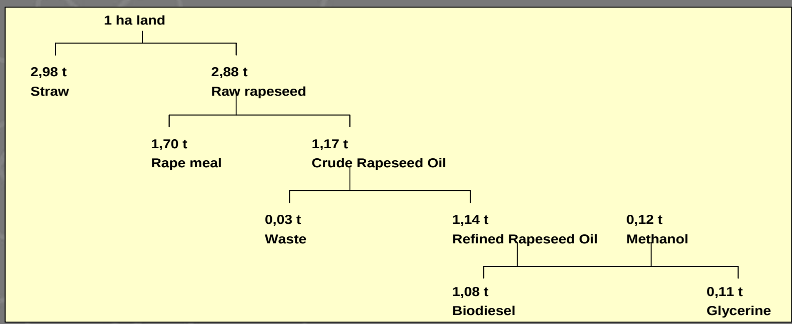
- Biodiesel delivered to Rotterdam harbour;
- Crushing and trans-esterification based on existing vegetable oil supply chains;
- Replacement of fossil diesel;
- Dominant fertilizer use for each vegetable oil

CARBON SOLUTIONS

Biodiesel production from rape seed

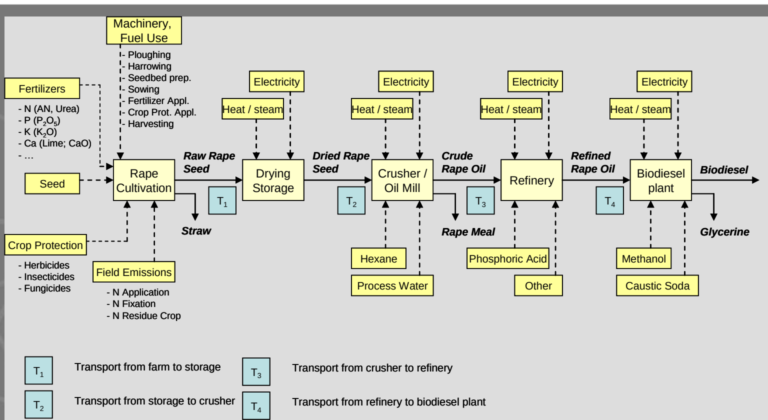


- Grown in temperate climates
- Spring and winter plantings
- Plants grow 1 metre high



CARBON SOLUTIONS

Supply chain for rape seed oil



T1 = 250 km
T2 = 0

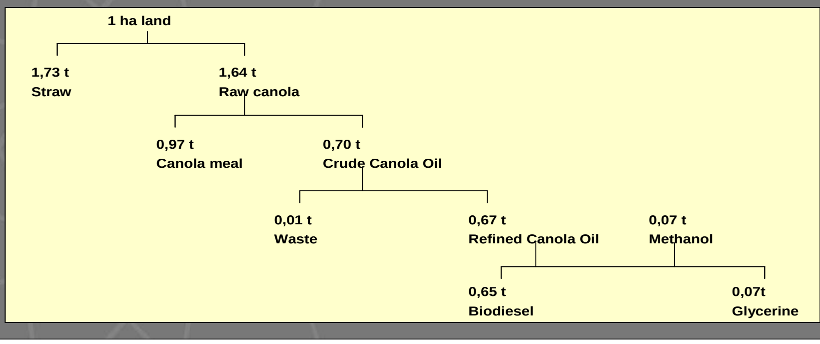
T3 = 0
T4 = 250 km

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

CARBON SOLUTIONS

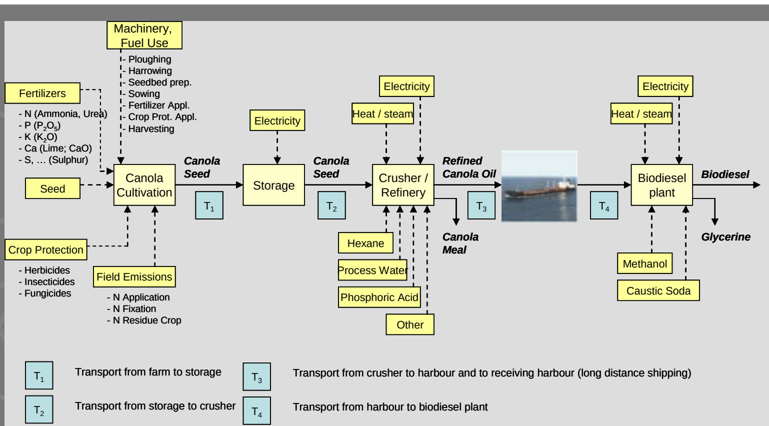
Biodiesel production from canola seed

- Grown in Canada and Australia
- Low moisture content
- Related to rape seed
- Summer harvest



CARBON SOLUTIONS

Supply chain for canola oil



T1 = 250

T2 = 0

T3 = 12500

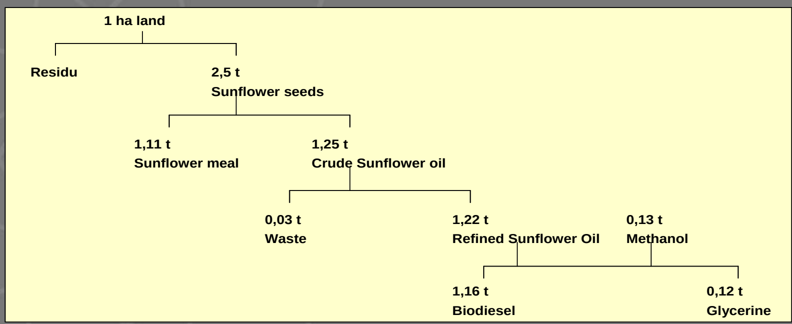
T4 = 100

Source: *International Palm Oil Sustainability Conference 2008 (IPOSC 2008)*

CARBON SOLUTIONS

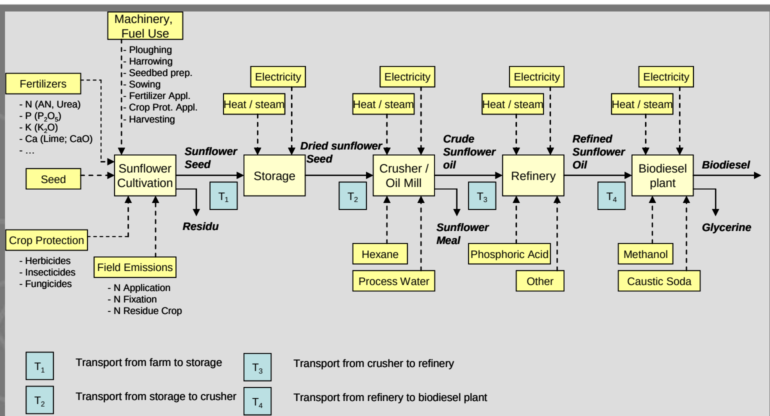
Biodiesel production from sunflower seed

- Grown worldwide
- Requires much mulch
- Heights 2.5 – 3.5 metres



CARBON SOLUTIONS

Supply chain for sunflower oil



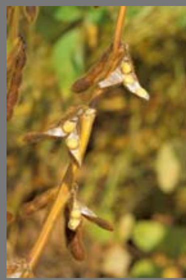
T1 = 250 km
T2 = 0
T3 = 0
T4 = 500 km

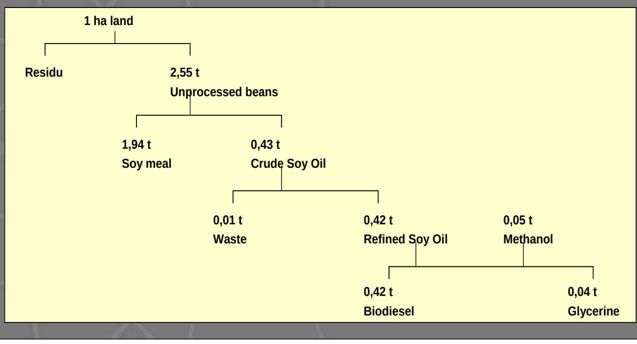
Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

CARBON SOLUTIONS

Biodiesel production from soy bean oil

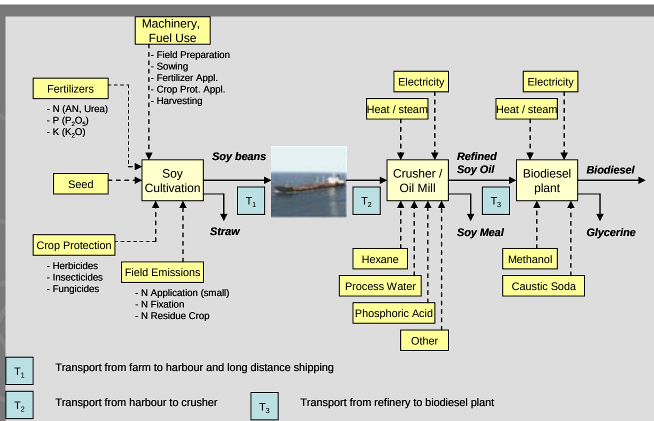
- Grown in North and South America
- Strong Nitrogen fixation
- Hot summers required for growth





CARBON SOLUTIONS

Supply chain for soy bean oil

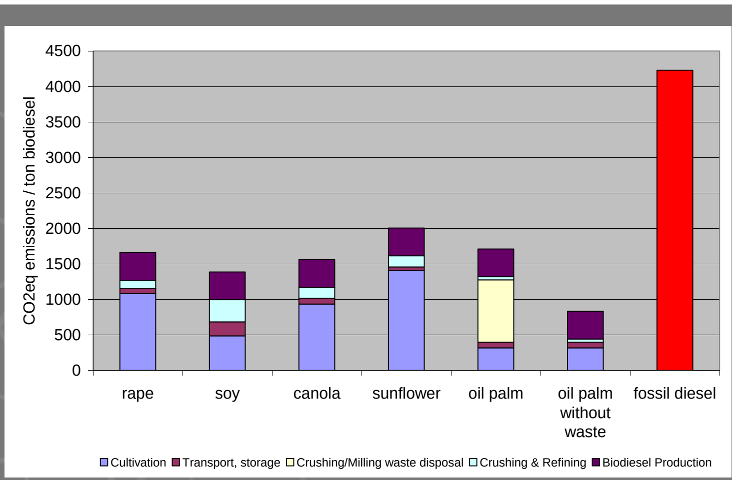


T1 = 12850 km T3 = 0
T2 = 0

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

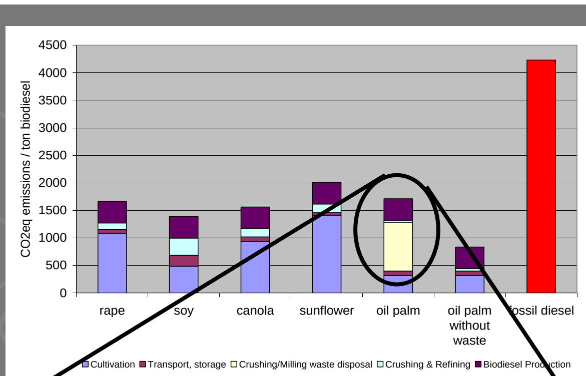
CARBON SOLUTIONS

Results carbon balances



CARBON SOLUTIONS

Comparison with palm oil



Potential of waste reduction techniques, composting, mulching, etc.

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

CARBON SOLUTIONS

Conclusions

- Different vegetable oils have roughly the same carbon balances (~ 50 – 60% net reduction)
- Typical Malaysian palm oil also is comparable, but…
- Potential for palm oil is much greater:
- How ?
  - Increasing yields;
  - Reducing waste emissions;
- Under the condition of:
  - Responsible land use

CARBON SOLUTIONS

Wrap up

- Good carbon balance average Malaysian palm oil;
- Waste handling + yield improvements → > 80%;
- Land use effects mixed;
- Sustainability challenge: Managing land conversion arising from EU demand for palm oil;
- Raising yields is essential !

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Expert Consultation on:

“Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia”

20-22 November 2008, Kuala Lumpur, Malaysia

ANNEX 5

Estimation of soil carbon stocks in Malaysian soils and the implication on the carbon balance in oil palm cultivation

Yew Foong Kheong

Presentation

- Common Malaysian mineral soils cultivated with oil palm and main characteristics
- Their global and regional classification
- Amount of carbon stocks in these soils
- Carbon stock variation with soil depth
- Amount of carbon stocks in oil palms
- Carbon stock ratios (soil: plant)
- Oil palm cultivation increases soil carbon stocks
- Conclusions

Choice of soils

- 12 soils with at least 15 profiles each (Law and Tan: Department of Agriculture)
- Mean soil carbon values used in estimation of soil carbon stocks
- Mineral soils
- Common oil palm growing soils
- Variety of soils
- Coastal to interior upland soils

COASTAL

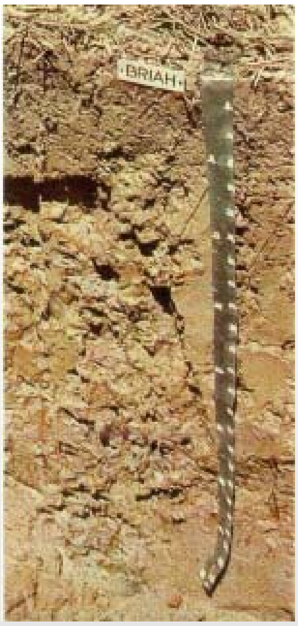
Soil Taxonomy: Tropaquept

FAO Legend: Gleysol

Sabah: Metah

Sarawak: Samarahan

Features: flat marine alluvial plains, clay, imperfectly drained



Soil Taxonomy: Fluvaquent

FAO Legend: Gleysol

Sabah: Weston

Sarawak: Punda

Features: mouth of large rivers meeting sea, mixed riverine and marine alluvial clays, clay, imperfectly to poorly drained

RIVERINE

Soil Taxonomy : Paleaquult

FAO Legend: Acrisol

Sabah: Inanam

Sarawak: Bijat

Features: low lying river terraces, clayey, deep, fluctuating high water table

Soil Taxonomy: Paleudult

FAO Legend: Nitosol

Sabah: Pegalan

Sarawak: Kayan

Features: flat riverine alluvium, sandy clay loam, deep, somewhat excessively drained

Soil Taxonomy: Paleudult

FAO Legend: Nitosol

Sabah: Kinabutan

Sarawak: Abok

Features: upland soil, granite, deep, sandy clay to clay, well drained

Soil Taxonomy: Hapludult

FAO Legend: Acrisol

Sabah: Kumansi

Sarawak: Jakar

Features: upland soil, sedimentary rock, clay, deep, moderately well drained

Soil Taxonomy: Paleudult

FAO Legend: Nitosol

Sabah: Tanjong Lipat

Sarawak: Bekenu

Features: upland soil, sandstone, sandy loam, deep, somewhat excessively drained

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Soil Taxonomy: Haplorthox

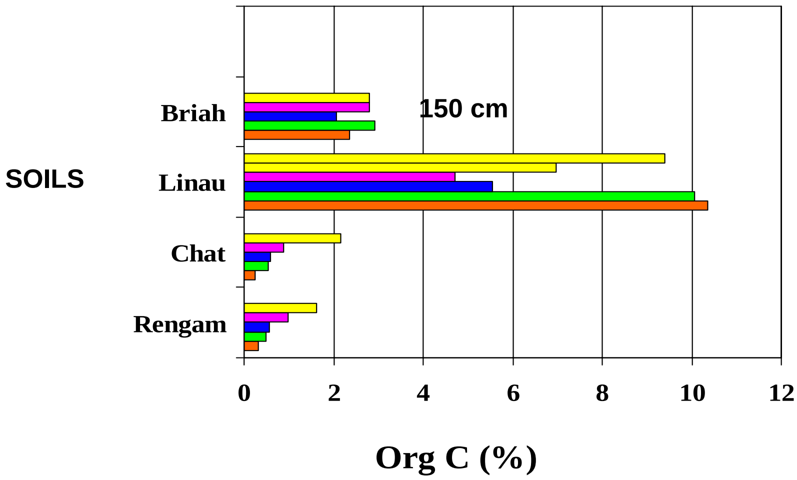
FAO Legend: Ferralsol

Sabah: -

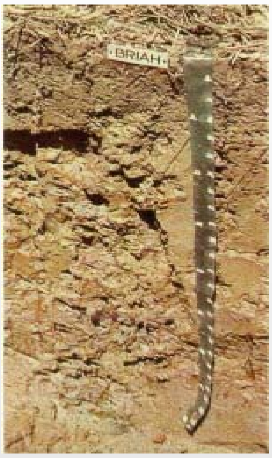
Sarawak: -

Features: shallow, lateritic, clay, well drained

Variation of Soil Carbon Content with Soil Depth



Range of soil carbon stock values



192 t C/ha

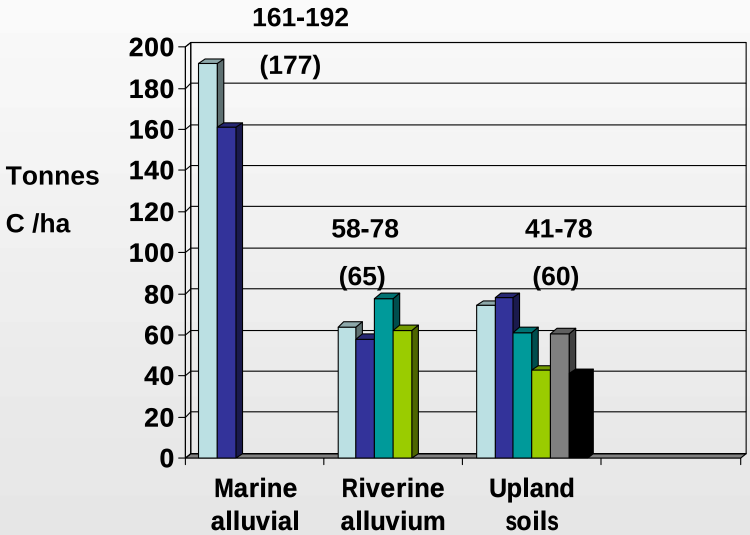
192 Mg C/ha

Coastal

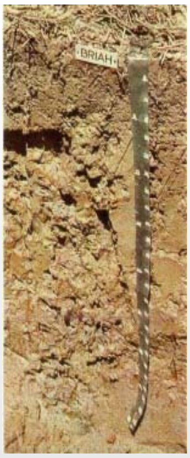
41 t C/ha (5 X)

Lateritic upland

Carbon stocks in Malaysian soils



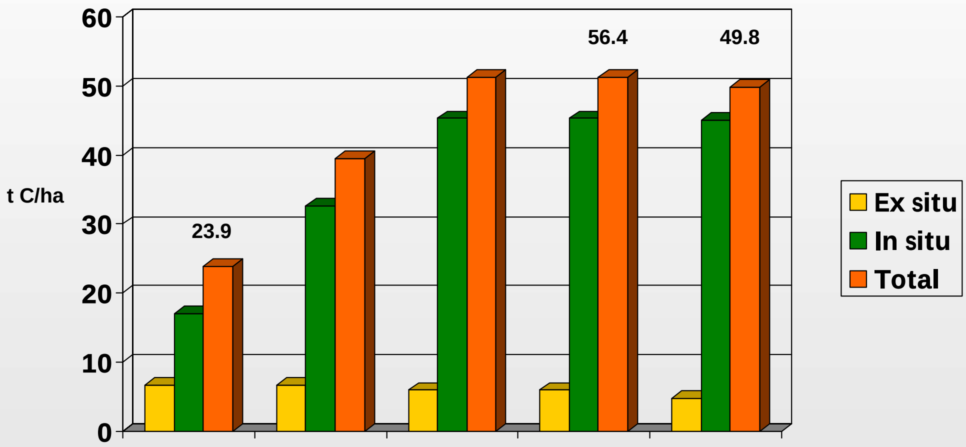
Range of soil carbon stock values (t C per ha)



Coastal	Riverine	Upland
161-192	58.0-77.7	41.2-77.9
(177)	(65.4)	(59.7)

MPOC

Carbon stocks in oil palms (tonnes C per ha)



Henson's model In situ contributes to soil C

MPOC

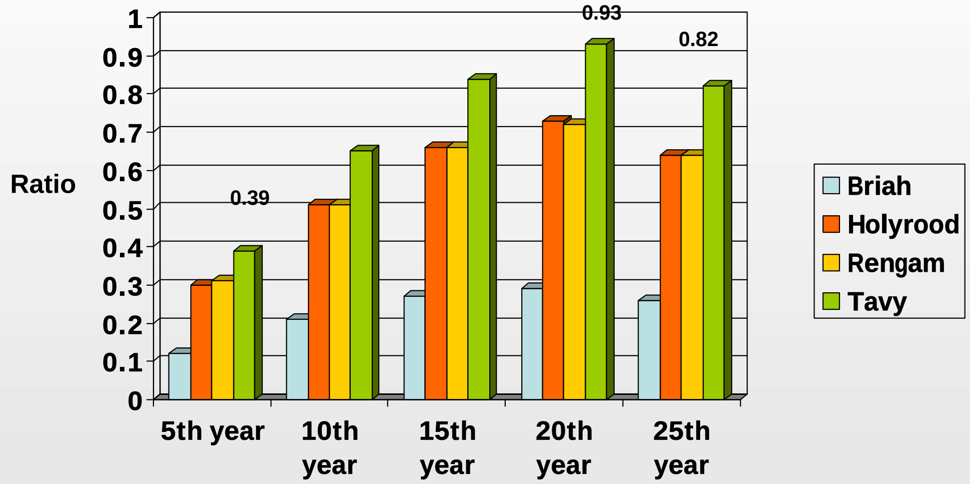
Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Comparison of oil palm with agroforestry

Crop and region	Plant C stock (t C per ha)
Oil palm (5th YAP)	23.9
Oil palm (20th YAP)	56.4
Agroforestry (semiarid)*	3
Agroforestry (subhumid)*	21
Agroforestry (humid)*	50
Agroforestry(temperate)*	63

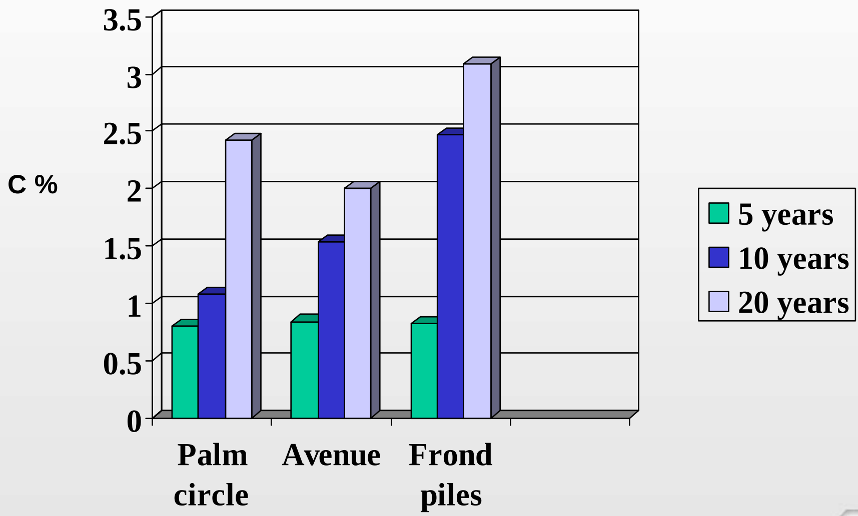
***Source: Montagnini and Nair**

Ratio of C stocks (oil palm to soil)



Avenue 65% Palm circle 15% Frond area 20%

Soil C content



Source: *International Palm Oil Sustainability Conference 2008 (IPOSC 2008)*

Source: International Palm Oil Sustainability Conference 2008 (IPOSC 2008)

Increase of soil carbon stock with oil palm cultivation

Years after planting	Carbon stocks (t C per ha)
5	14.94
10	29.70 (2 x)
20	41.04 (3 x)

MPOC

Source: *International Palm Oil Sustainability Conference 2008 (IPOSC 2008)*

Oil palm cultivation enriches soil carbon stocks

- Time
- Least disturbance (No tillage or minimal tillage practices)
- Some erosion losses and loss of carbon stock which is richest in top soil particularly with heavy tropical rain
- Oil palm is perennial - land clearing and soil disturbance once every 25-30 years

Conclusions

- Carbon stocks of wide range of mineral soils from the coast to interior (upland) studied
- Soil carbon stock varies from 41 t C per ha (lateritic soil) to 192 t C per ha for coastal marine soil
- Mean soil carbon stocks (t C per ha) are coastal 177, riverine 65 and upland 60
- carbon stocks decrease with depth for upland but not for coastal soils

Conclusions

- Carbon stocks of oil palm increase with age due to increasing biomass and yield
- Peaks at 20th YAP
- Most carbon stock of OP found in situ (standing biomass, pruned fronds)
- Therefore has great potential to increase soil C stock
- 23.9 t C per ha at 5th year to 45.3t C per ha at 20th year

Conclusions

- Ex situ OP carbon stock varies with FFB yield
- 6.8 to 6.0 t C per ha at 5th and 20th year respectively
- OP: soil carbon ratio increases with age
- Soils with high C: ratio increases from 0.1 to 0.3 during period
- Soils with lower C, ratio increases from 0.3-0.93
- Major inland soils, ratio 0.3-0.70
- In OP ecosystem, OP contains almost as much C stock as soil

Conclusions

- Soil carbon stock increases with time in oil palm plantation
- Highest soil carbon increase in frond rows
- Oil palm is perennial tree (25-30 years life cycle)
- Does not need annual land preparation and removal of top soil (highest C content)
- Oil palm cultivation can increase soil carbon stock

Expert Consultation on:

"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

20-22 November 2008, Kuala Lumpur, Malaysia

ANNEX 6

Overview of Global Oils and Fats
&
the Malaysian Palm Oil Industry

Presentation for Members of European Parliament
by

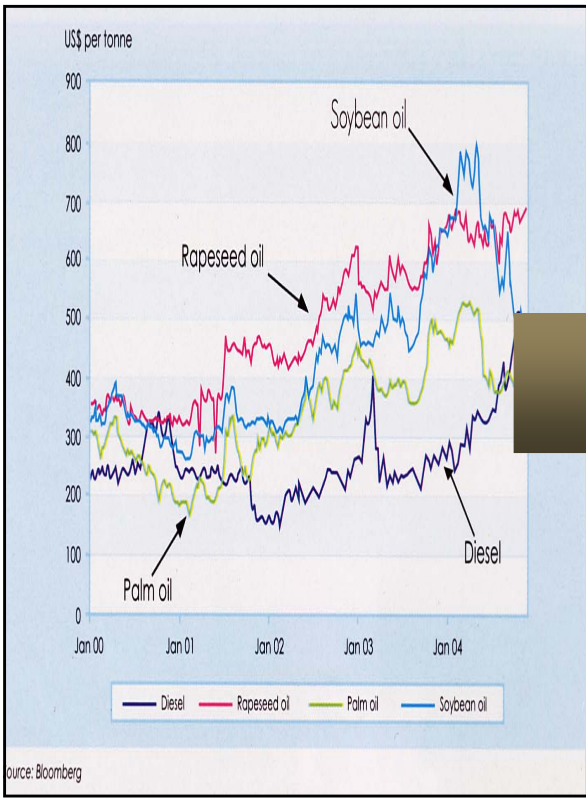
Dr. Yusof Basiron
Chief Executive Officer

MPOC

Presentation Outline

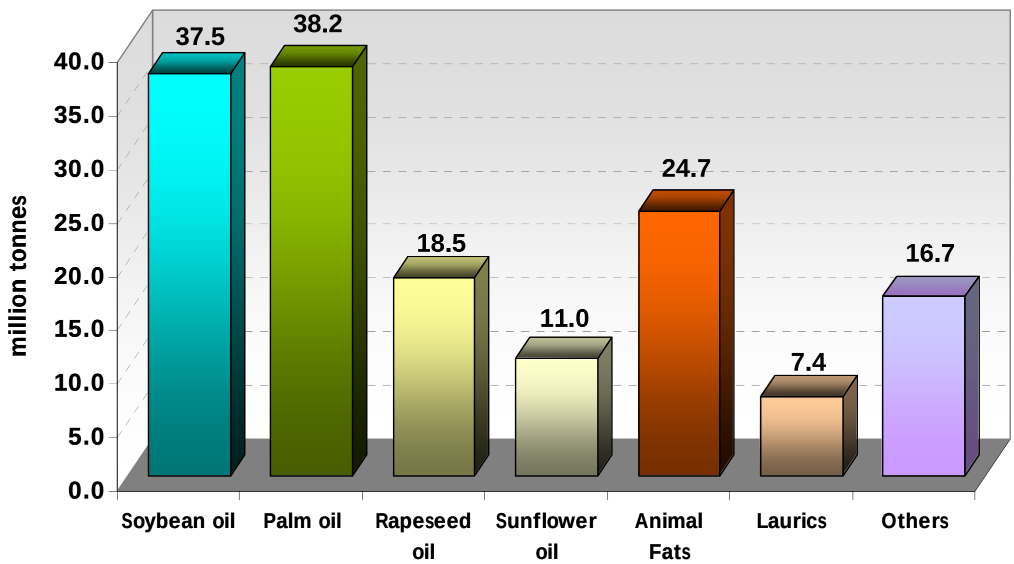
Overview of:

- Global oils & fats scenario
- The Malaysian palm oil industry
- Issues related to environment, social aspects & sustainability



Global Oils & Fats Scenario

Total Production 2007 = 154 mil tonnes



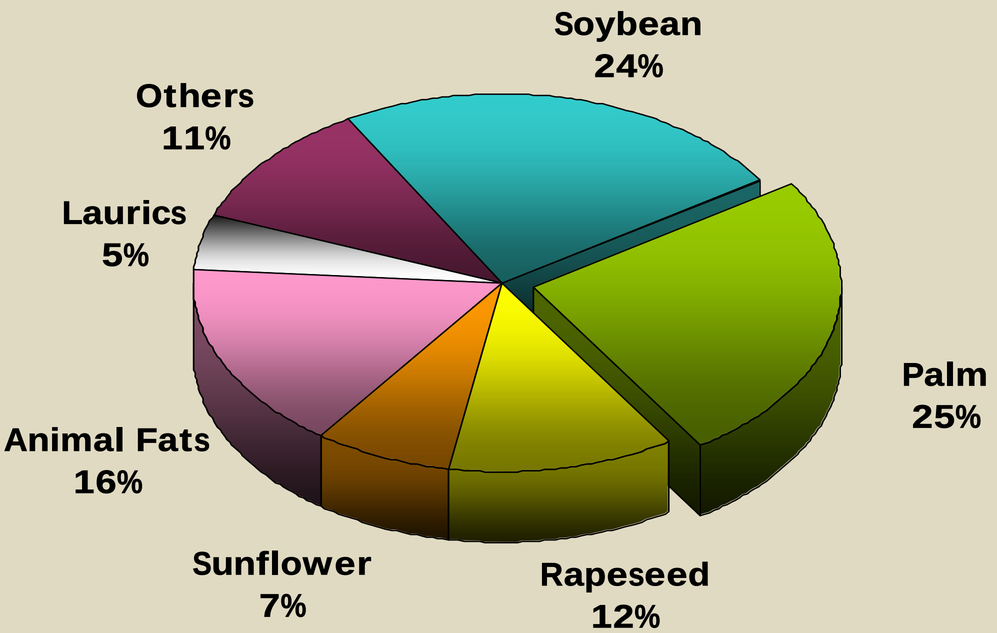
Production in 2006 = 150 mil tonnes

Source: Oil World

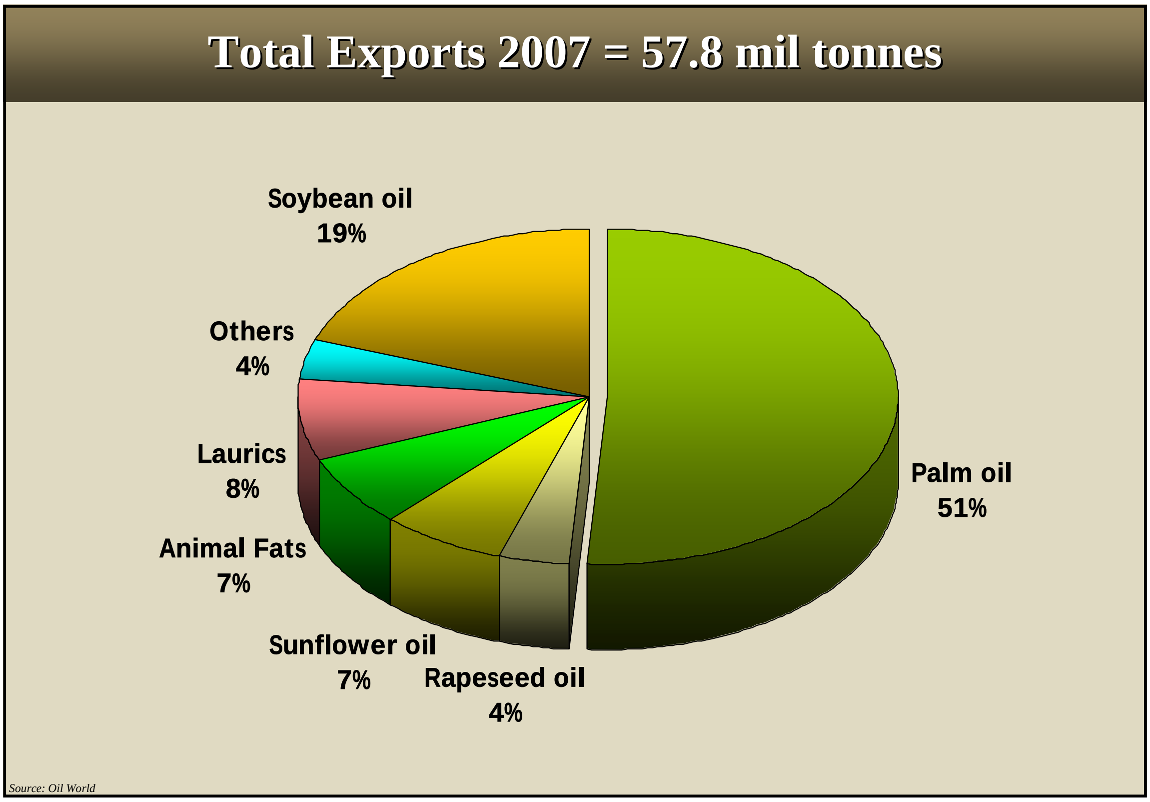
Production Average Growth

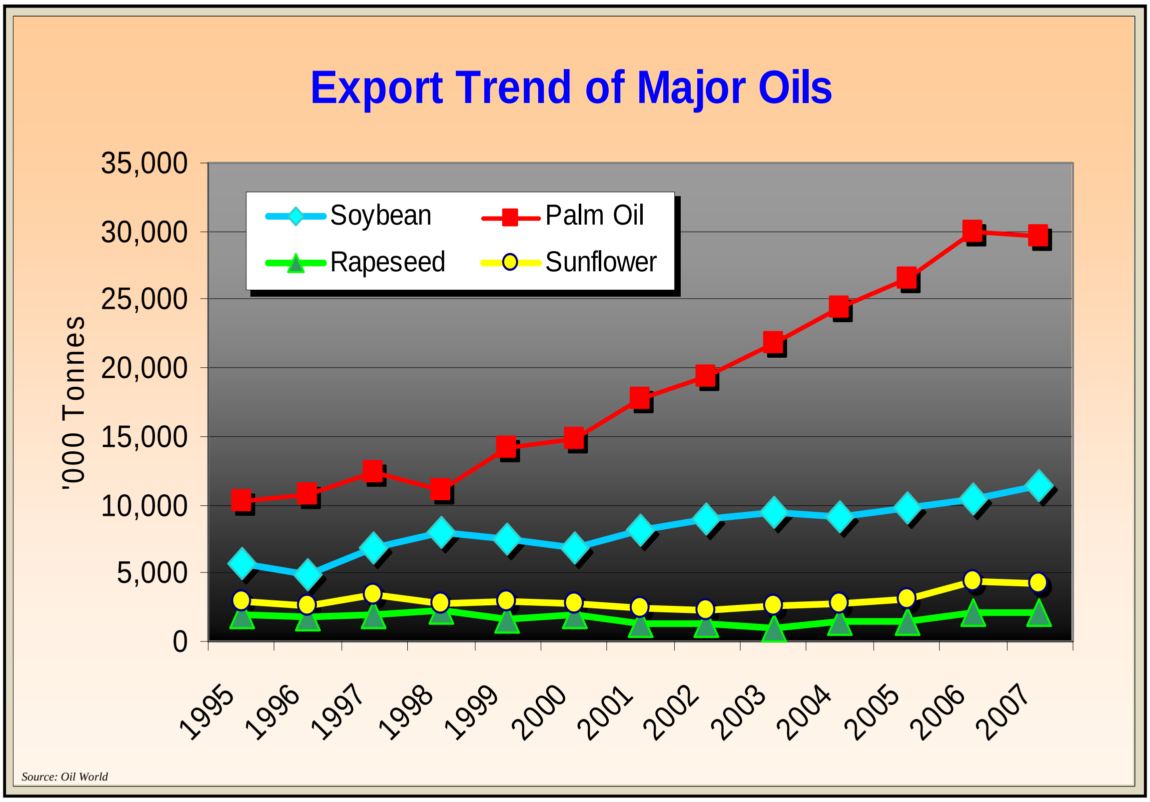
- Annual global production growth during 2002-07 was 5% per annum
- Palm oil had the highest growth rate at 8.5% per year during this period. Soybean and rapeseed growth rates were at 4.7% and 6.8%, respectively
- In 2007, average growth of all oils estimated at 2.6%, with palm oil at 2.7%, soybean at 6.2% and rapeseed at 0.1%.

World Oils & Fats Production Share

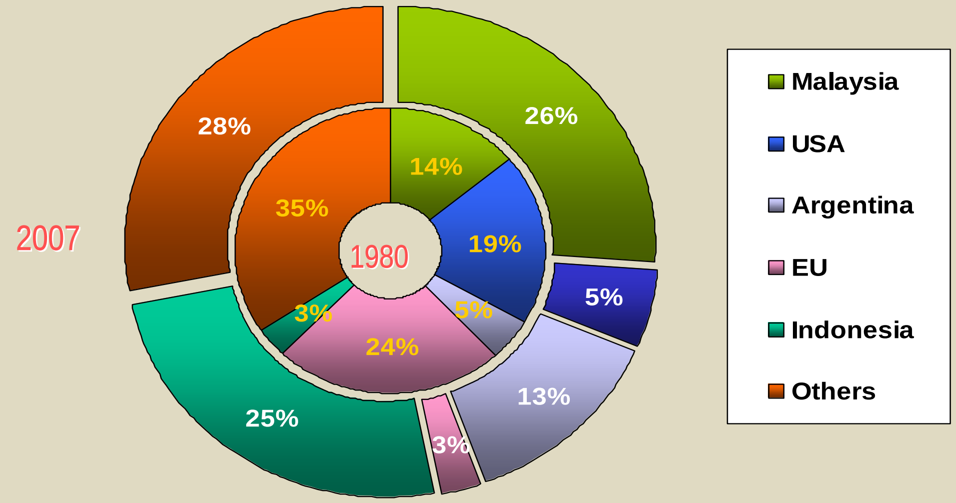


Source: Oil World


Total Exports 2007 = 57.8 mil tonnes
Soybean oil
19%
Others
4%
Laurics
8%
Animal Fats
7%
Sunflower oil
7%
Rapeseed oil
4%
Palm oil
51%
Source: Oil World

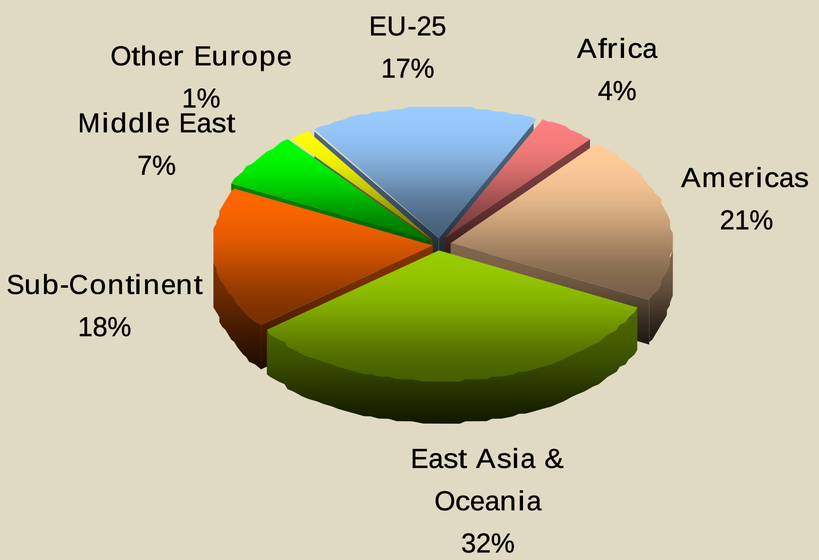

Export Trend of Major Oils
'000 Tonnes
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Soybean
Palm Oil
Rapeseed
Sunflower
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Source: Oil World

Market Share in Export Trade 1980 vs 2007



Source: Oil World

Oils & Fats Consumption by Region



Source: Oil World

Sufficiency of Oils & Fats

Oils and Fats Balance 2006 ('000 MT)					
	Production	Disappearance	Imports	Exports	Net Exports / (Imports)
Malaysia	**18,139**	**3,662**	**1,287**	**15,535**	**14,248**
Indonesia	**18,366**	**4,504**	**86**	**13,761**	**13,675**
Argentina	**8,222**	**942**	**17**	**7,374**	**7,357**
Brazil	**7,022**	**4,803**	**224**	**2,558**	**2,334**
Ukraine	**2,362**	**955**	**244**	**1,676**	**1,432**
Canada	**2,488**	**1,377**	**434**	**1,567**	**1,133**
Philippines	**1,533**	**698**	**268**	**1,084**	**816**
Thailand	**1,119**	**997**	**105**	**272**	**167**
Australia	**944**	**769**	**287**	**449**	**162**
Colombia	**867**	**824**	**237**	**272**	**35**
USA	16,699	16,202	2,637	2,596	(41)
Russia	3,169	3,444	923	671	(252)
Taiwan	513	812	312	16	(296)
Nigeria	1,416	1,763	367	13	(354)
Rep of S. Africa	450	1,116	733	34	(699)
South Korea	412	1,160	760	9	(751)
Japan	1,940	2,859	926	13	(913)
Mexico	1,667	2,788	1,101	30	(1,071)
Bangladesh	199	1,318	1,102	0	(1,102)
Egypt	295	1,431	1,192	48	(1,144)
Iran	306	1,531	1,282	78	(1,204)
North Africa *	507	1,758	1,642	313	(1,329)
Turkey	1,231	2,519	1,691	323	(1,368)
Pakistan	1,666	3,312	1,750	115	(1,635)
India	9,161	13,741	4,949	299	(4,650)
China PR	19,640	27,143	7,943	418	(7,525)
EU-25	18,072	26,294	9,800	1,384	(8,416)
Others	11,211	19,541	13,540	5,134	(8,406)
World Total	**149,616**	**148,263**	**55,839**	**56,042**	**203**

** North Africa=Algeria, Libya, Morrocco, Tunisia*

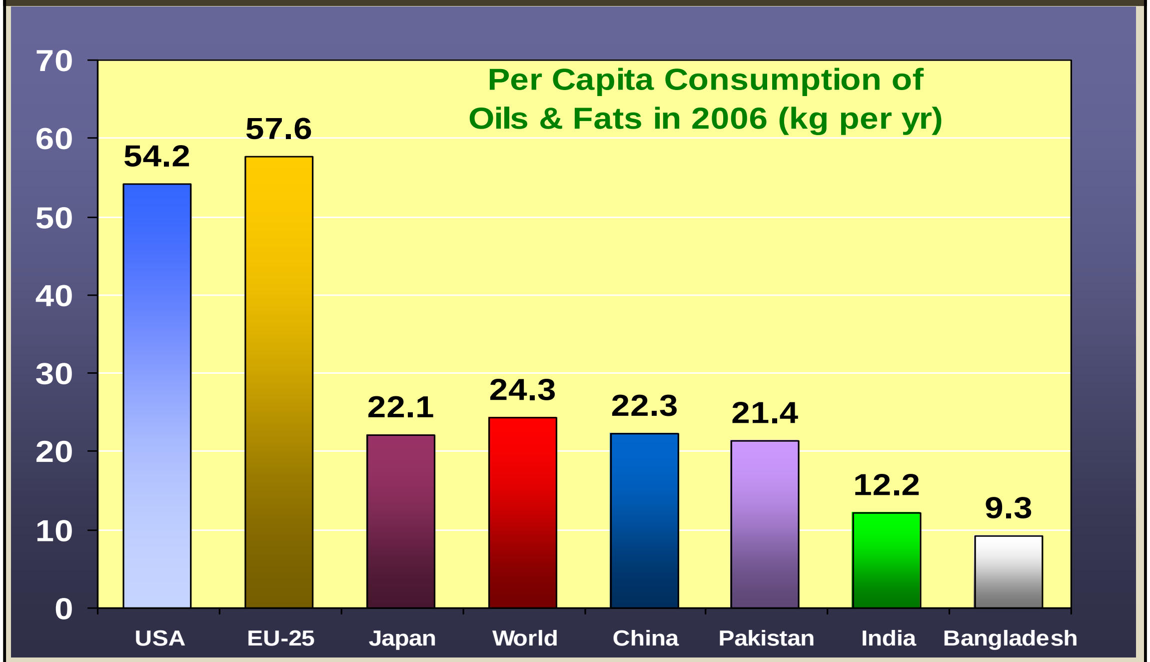
Source: Oil World

Future Outlook

Demand & Supply Drivers

- World population is expected to rise exponentially to another 1.5 billion people by 2020.
- Expansion of global economy – P.R of China, India, ASEAN
- Improved technologies & biotechnology
- Agricultural and free trade policies
- Scarcity of land – Expansion vs Productivity vs Environmental Concerns

Potential of Highly-Populated Countries

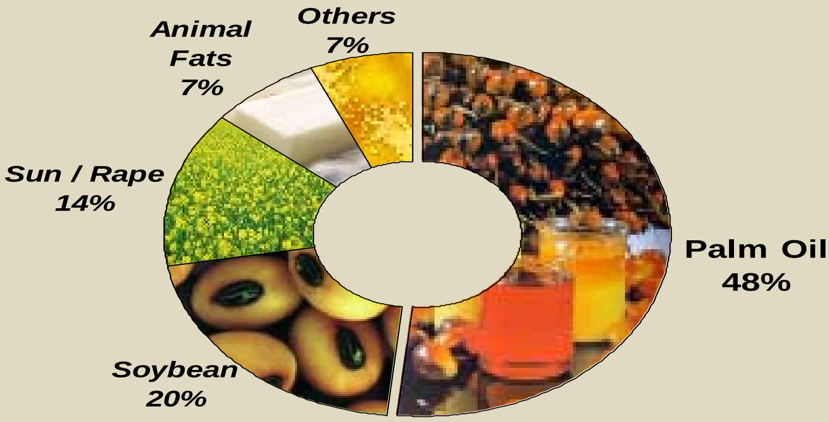


Total Oils & Fats Demand (million tonnes):

1996/2000	103.4
2001/2005	121.2
2011/2015	156.4
2016/2020	175.3

Source: Oil World 2020

Future Export Market
58 mil tonnes (average 2011-15)



Malaysian Palm Oil Industry

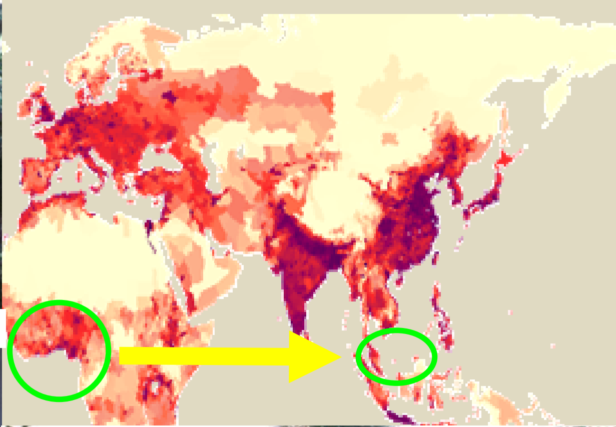
Malaysian Palm Oil Industry

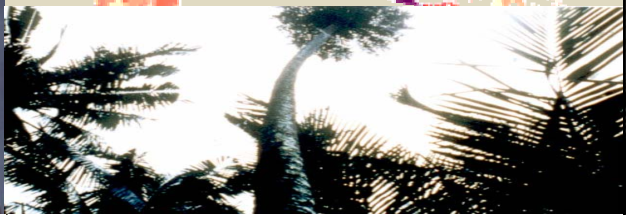
- Total area under oil palms = 4.30 mil ha or 13.1% of total land area
- 10.3% of world's total oils & fats production
- 42% of global palm oil production and 46% of global palm oil trade
- Provides direct employment to 570,000 people, excluding other multiplying effects and spin-off activities.
- Malaysia alone produces 12% of the global vegetable oils and supplies 26% of the export trade in oils & fats. This is carried out on 4.3 mil ha or less than 2% of the total area (233 mil) under global oilseed cultivation.
- Significant foreign exchange earner: An average of RM 35 billion or € 7.51 billion for the past 3 years
- Malaysian palm oil is consumed in over 150 countries worldwide
- Backbone of country's development especially rural development and political stability

The Journey from West Africa to Malaya

Oil palms in the wild mangroves in Africa

The 5 original steps used to extract palm oil



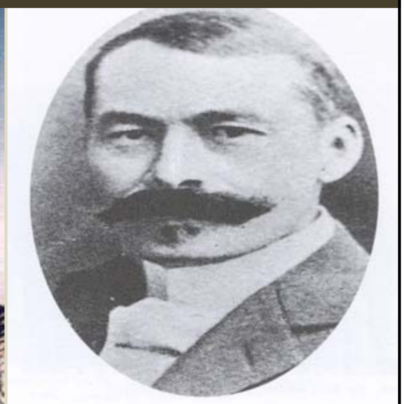


One of the four Bogor palms planted in 1848

The 'British Connection' – English, Scottish, Irish

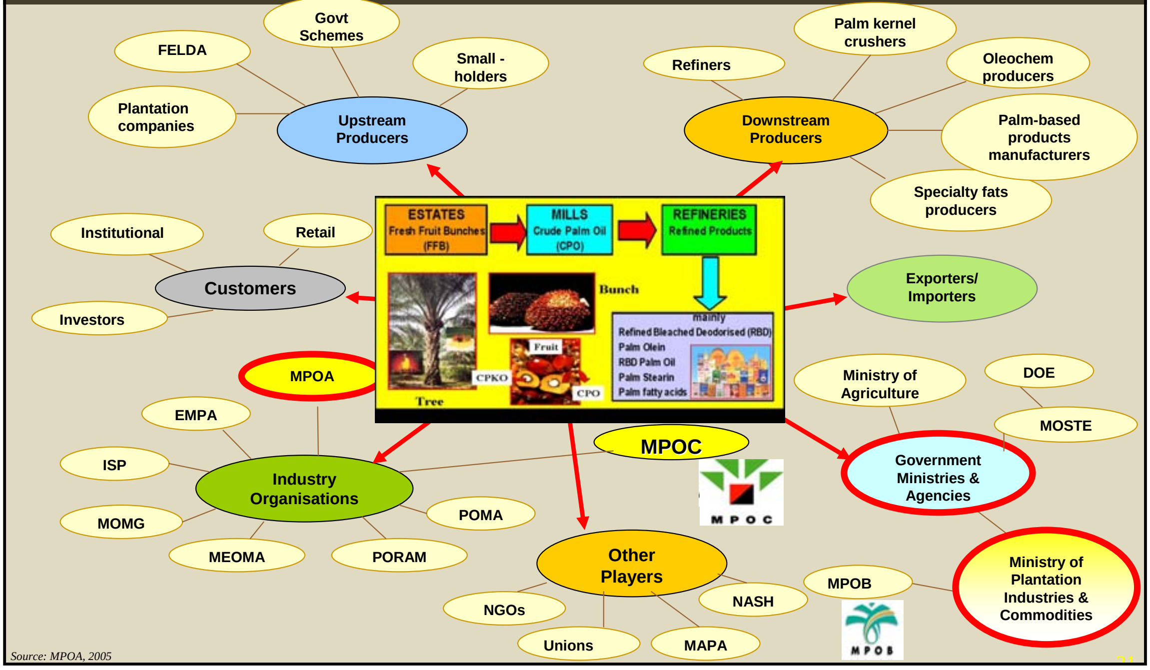
John Middleton Sime,
together with Henry Darby,
founded the first
Sime Darby estate
in Malacca in 1910

Alexander Guthrie:
Founder of Guthrie
Plantation Group in 1821



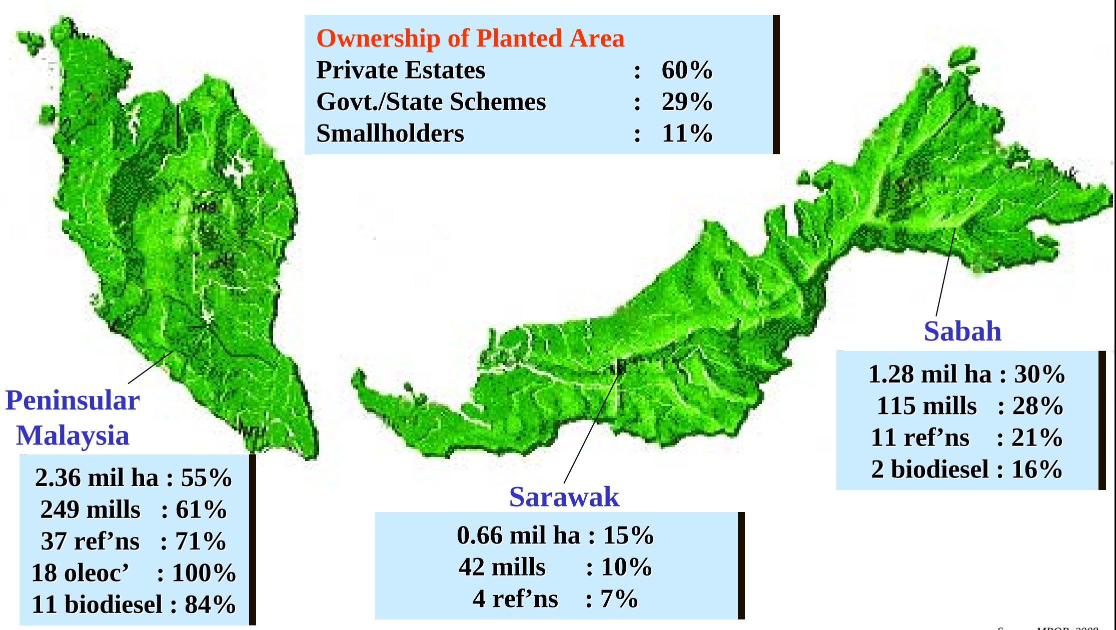
Sir Frank Swettenham:
Colonial official and schemer

Stakeholders involved in the MPO industry



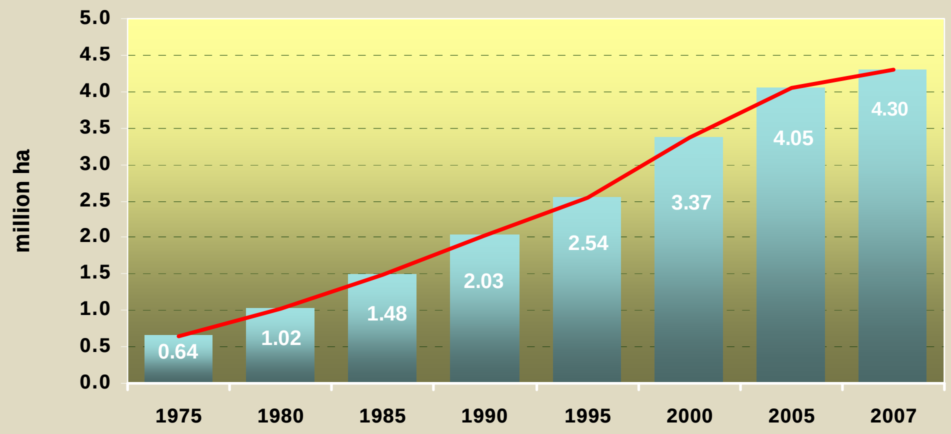
Source: MPOA, 2005

Distribution of the Malaysian Oil Palm Business & Ownership in 2007



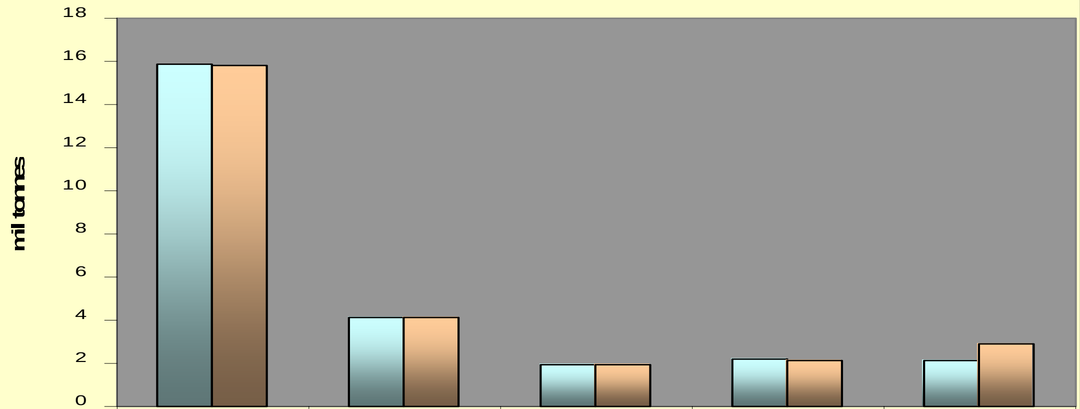
Source: MPOB, 2008

Oil Palm Planted Area (mil ha)



Source: MPOB, 2008

Production (Mil Tonnes)



	Crude Palm Oil	Palm Kernel	Crude Palm Kernel Oil	Palm Kernel Cake	Oleochemical Products
2006	15.88	4.13	1.96	2.20	2.10
2007	15.82	4.10	1.91	2.15	2.93

Source: MPOB, 2008

Factors for the marginal decrease were flood damage and biological stress, both of which affected palm's production in 2007.

Exports (Mil Tonnes)

Product	2006	2007	Difference (%)
Palm Oil	14.42	13.74	-4.8
Palm Kernel Oil	0.93	1.06	14.1
Palm Kernel Cake	2.13	2.09	-1.9
Oleochemical Products	2.16	2.23	3.4
Finished Products	0.42	0.35	-16.5
Others	0.09	0.08	-6.1
TOTAL	20.16	19.56	-3.0

Source: MPOB, 2008

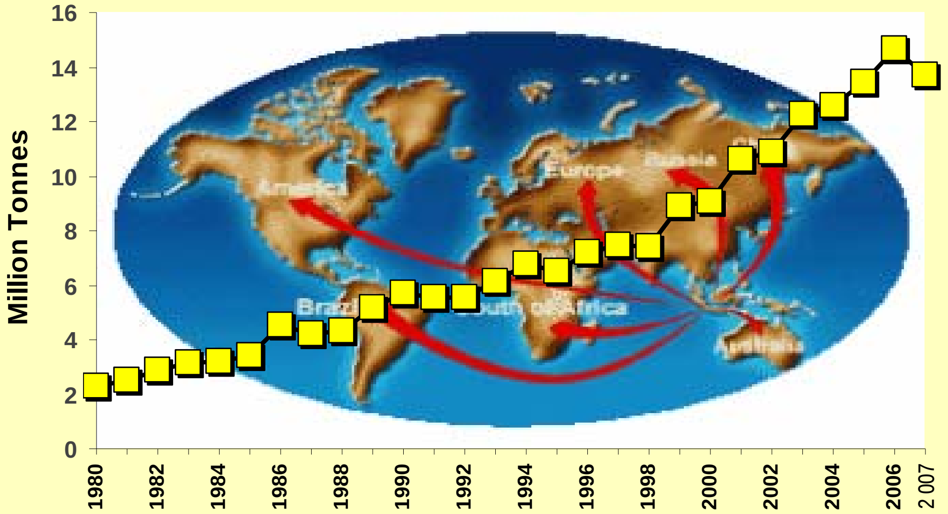
Export Revenue (RM Billion)

Product	2006	2007	Difference (%)
Palm Oil	22.65	33.15	46.4
Palm Kernel Oil	2.16	3.11	43.9
Palm Kernel Cake	0.42	0.76	80.4
Oleochemical Products	5.60	6.91	23.3
Finished Products	0.90	1.10	22.7
Others	0.079	0.083	4.0
TOTAL	31.81	45.11	41.8

Source: MPOB, 2008 *Average exchange rate 2007 : RM 4.66 = € 1*

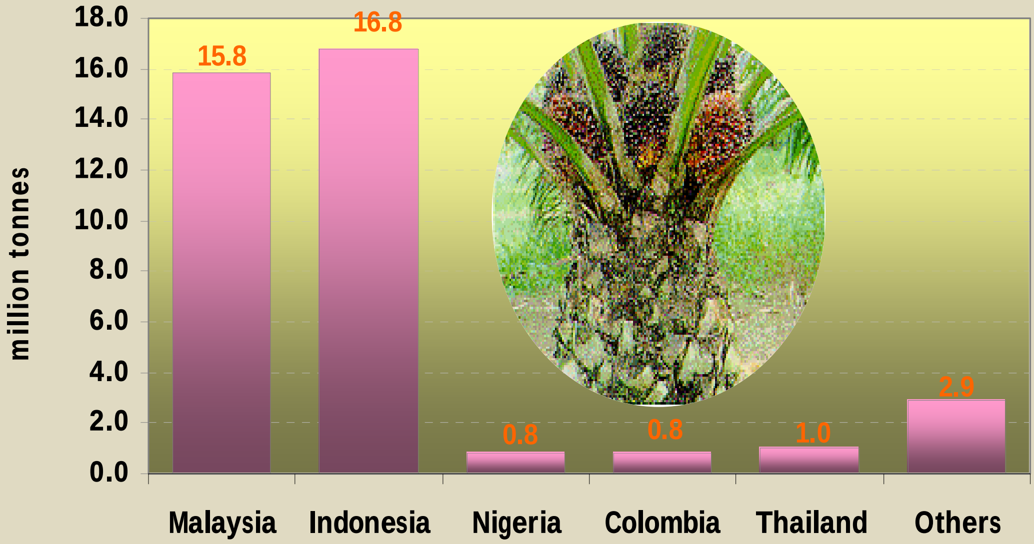
Total export revenue for 2007 is RM 45.11 bil or approx **€ 9.68 bil**

Export Growth of Malaysian Palm Oil



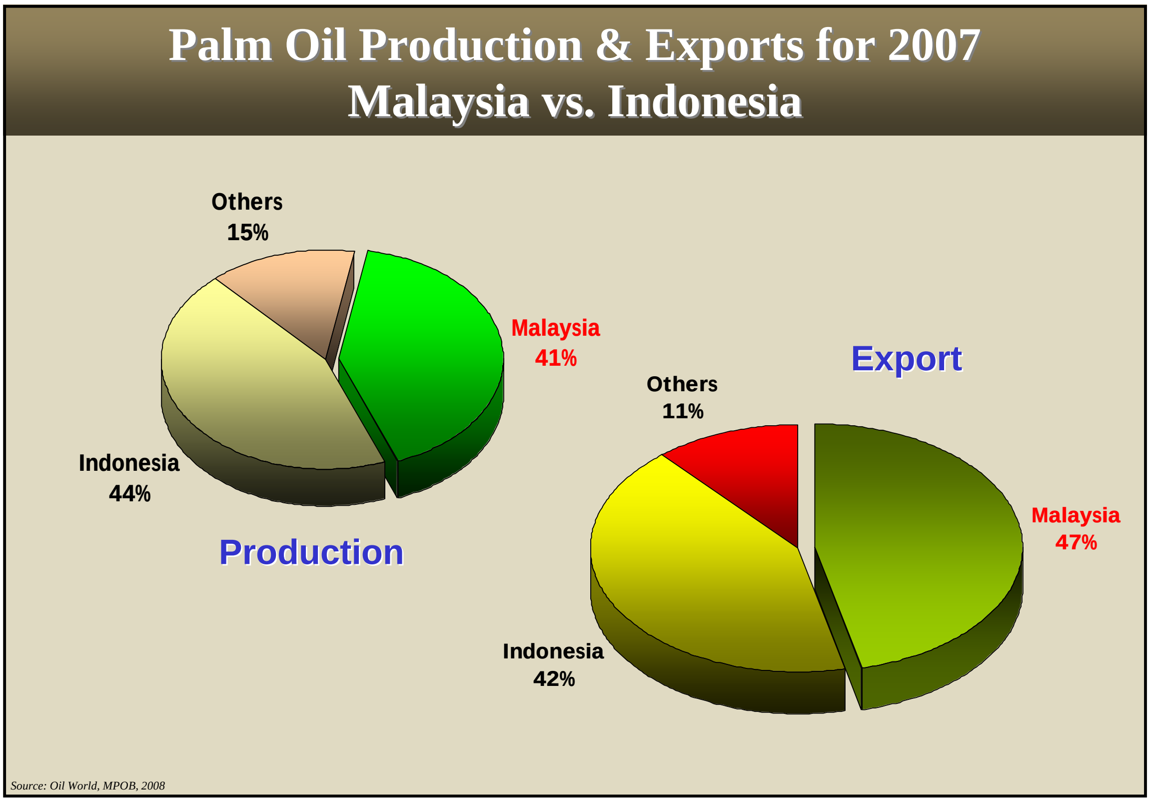
Source: MPOB, 2008

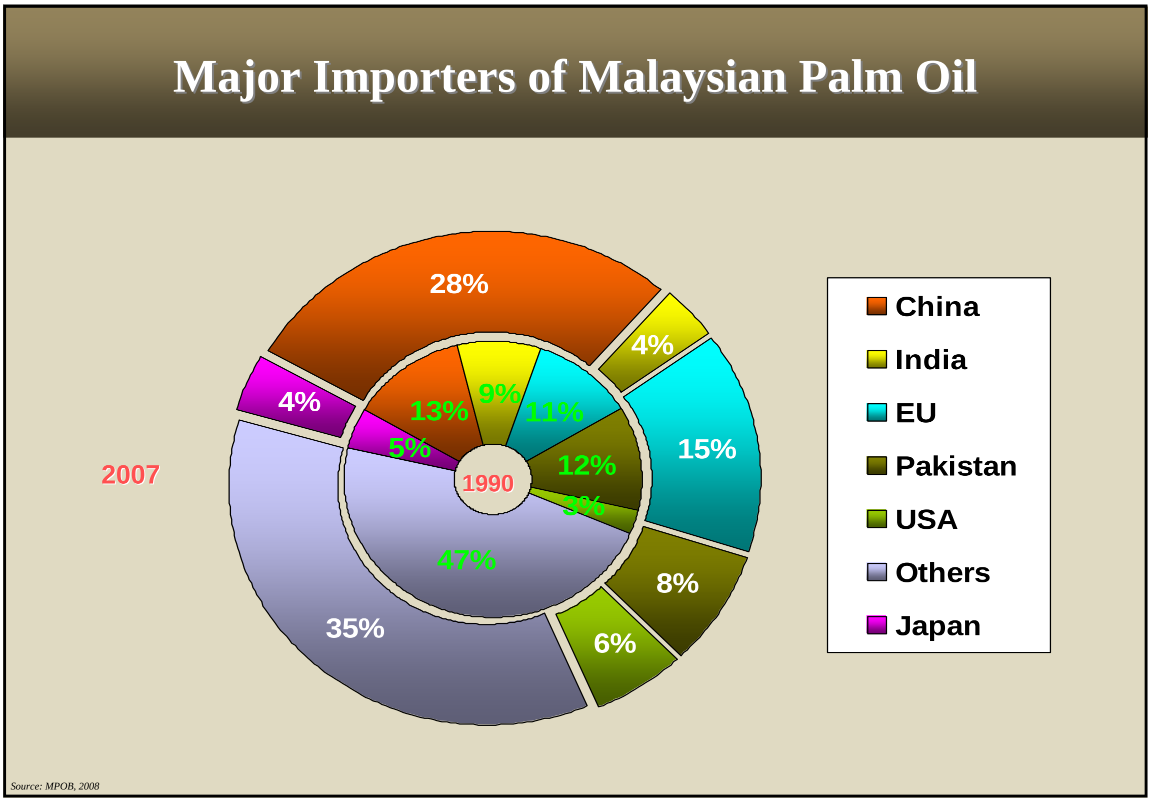
Comparison between Malaysia and Other Palm Oil Producers in 2007

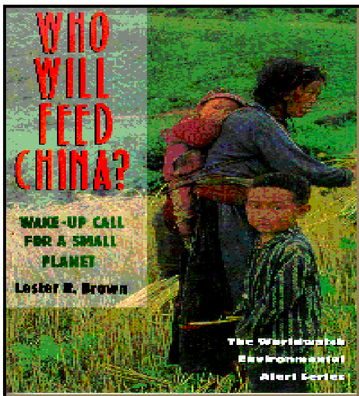


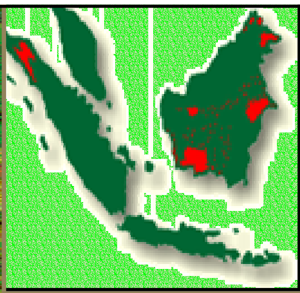
Total Output = 38.2 mil tonnes

Source: Oil World, MPOB, 2008

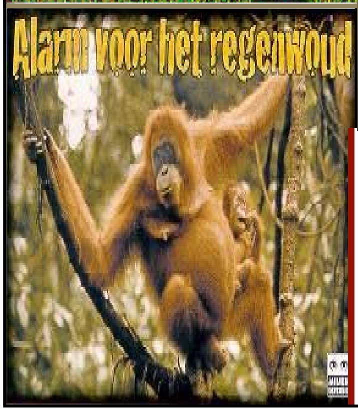

Palm Oil Production & Exports for 2007
Malaysia vs. Indonesia
Others
15%
Malaysia
41%
Indonesia
44%
Production
Export
Others
11%
Malaysia
47%
Indonesia
42%
Source: Oil World, MPOB, 2008


Major Importers of Malaysian Palm Oil
2007
1990
28%
4%
15%
8%
6%
35%
4%
13%
9%
11%
12%
3%
47%
5%
China
India
EU
Pakistan
USA
Others
Japan
Source: MPOB, 2008





Issues related to Environment, Social Aspects & Sustainability



Issues of concern

- **Environment:**

  a) Deforestation

  b) Global warming – CO_2 emission

  c) Loss of biodiversity & wildlife especially *orang utan*

- **Social:**

  a) Customary rights of native people

  b) World's **poverty & hunger** – ***rarely mentioned!!***

- **Sustainability:**

  a) Food vs Non-food Requirements

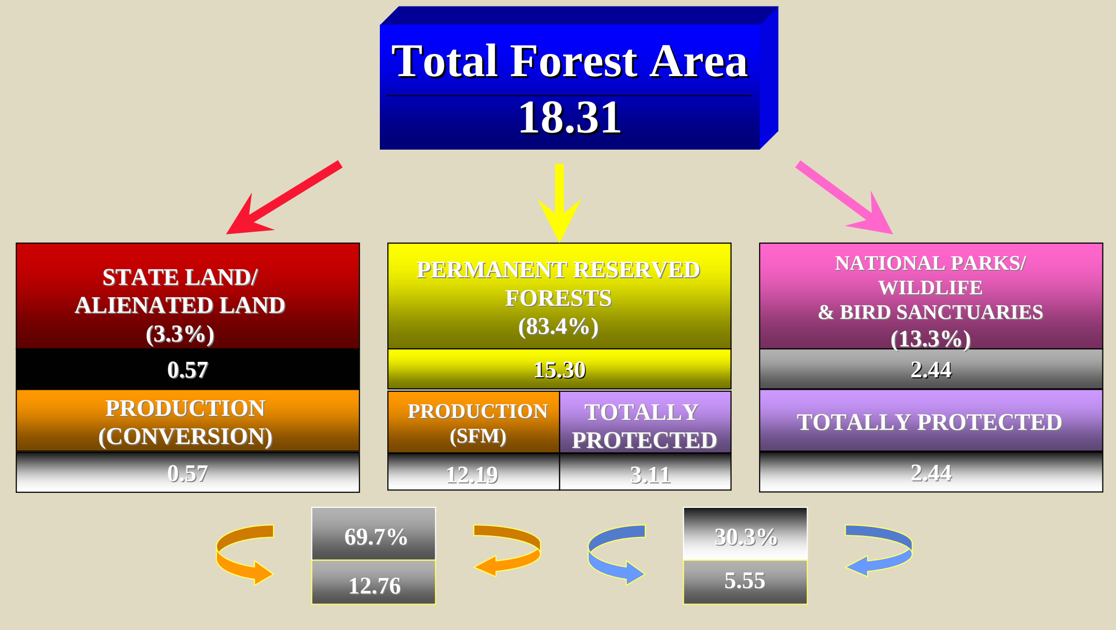
National Agricultural Policy 3 (2000 – 2010)

- Formulated to ensure that the capability of the agricultural sector's strategic role in national development is sustained and enhanced in light of new and emerging challenges facing agricultural development
- In the NAP 3, two new strategic approaches are adopted

a) agroforestry approach: aimed at addressing the increasingly scarce resources including land and raw material availability

b) product-based approach: adopted to reinforce and complement the cluster-based agro-industrial development as identified in the Second Industrial Master Plan 1996-2005 through strengthening both inter and intra-sectoral linkages including the development and expansion of intermediate and supporting industries

Forest Land Use In Malaysia, 2005 (million ha)



Source: Thang C.H.

Forest Cover Change in Malaysia from 1995 – 2005 (mil ha)

Forest Cover Type	1995	2000	2005
Permanent Reserved Forest (PRF)– Protected	3.43	3.84	3.11
PRF– Sustainable Forest Management	10.85	10.60	12.19
National Parks, Wildlife & Bird Sanctuaries and Nature Reserves – Totally Protected	2.12	1.87	2.44
Stateland/Alienated Land Forest – Conversion Forest	**4.19**	**3.93**	**0.57**
TOTAL	**20.59**	**20.24** (-1.7%)	**18.31** (-9.5%)

Source: FAO, 7th, 8th and 9th Malaysian Plans, Forestry Department of Malaysia, Ministry of Plantation Industries & Commodities, Satoshi Tachibana,S. Sothi Rachagan, and Thang H.C.

1) **Deforestation mainly occurs in the stateland/alienated land which has been earmarked for economic development**

2) **Changes in the acreage of PRFs and national parks, wildlife & bird sanctuaries and nature reserves are due to reclassification.**

Malaysia is a signatory to

1) *The Convention on Biological Diversity 1992*

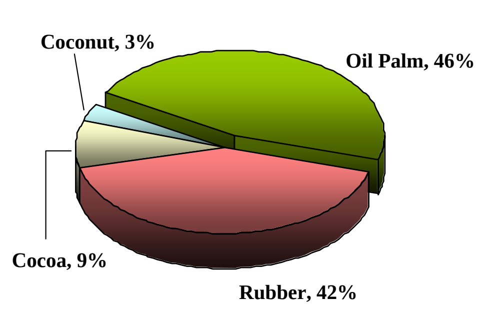
2) *International Tropical Timber Agreement, and*

3) *Charter of the Indigenous-Tribal Peoples of Tropical Forests*

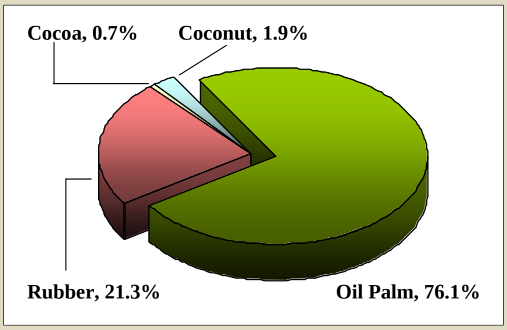
Malaysia is committed to preserving its forest resources through Sustainable Forest Management (SFM)

Chart 7: Changes in Land Use of Selected Tree Crops in Malaysia

1990 = 4.39 million ha



2007 = 5.65 million ha



Crop	1990	2007
Oil Palm	2.029	4.3
Rubber	1.836	1.2[e]
Cocoa	0.393	0.038[e]
Coconut	0.134	0.109[e]
Total	**4.392**	**5.647**

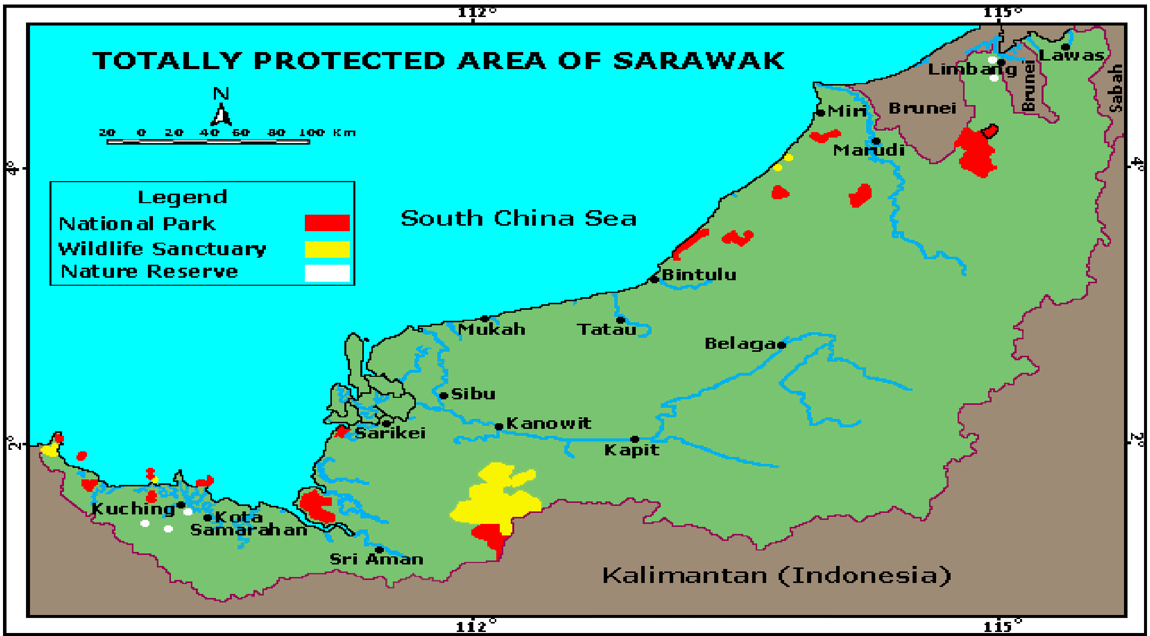
Collectively, other agriculture crops lost 1.02 mil ha which were mainly converted to oil palm from 1990 to 2007

Note: e estimates
Source: MPOB, Malaysian Rubber Board, Agriculture Department, Malaysian Cocoa Board

Oil Palm Areas & Orang Utan in Wild Population in Malaysia in 2007

Location	Land Area (mil ha)	Oil Palm Area (mil ha)	% of Area under oil palm	No. of orang utan in wild population
Peninsular	13.16	2.36	17.93%	Never existed
Sarawak	12.33	0.66	5.35%	2,500 – 3,000*
Sabah	7.37	1.28	17.37%	10,000 – 15,000*
Malaysia	32.86	4.3	13.09%	12,500 – 18,000*

*Note: * estimated*
Source: MPOB, Sarawak Forestry Council, Forestry Department of Sabah (2007)



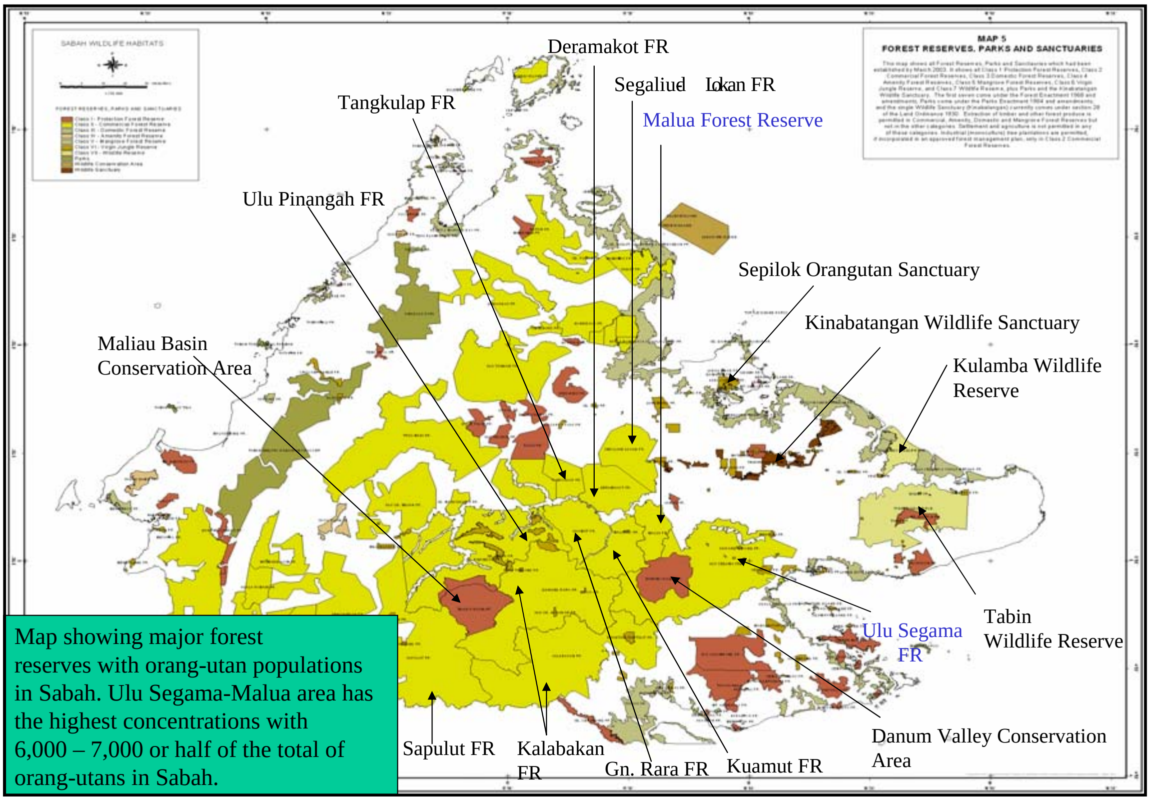
Oil palms areas in Sarawak are mainly concentrated in the coastal areas where no orang utans are found. Indeed, the areas at borderline with Kalimantan, where most of the orang utans in the state are found, are not suitable for oil palm cultivation.

Sarawak Government's Policy

The state government through Sarawak Forestry Council continues to identify its forest areas for high populations of orang utans. If such areas have been identified, the state government will gazette the areas as a wildlife sanctuary or national park. Current areas that have been gazetted are in the table on the right.

No.	Location in Sarawak	Estimated Orang Utan Populations
1	Lanjak Entimau Wildlife Sanctuary	1,400
2	Batang Ai National Park	300
3	Ulu Sebuyau National Park	300
4	Semenggoh & Matang Rehabilitation Centers	35
	TOTAL	**2, 035**

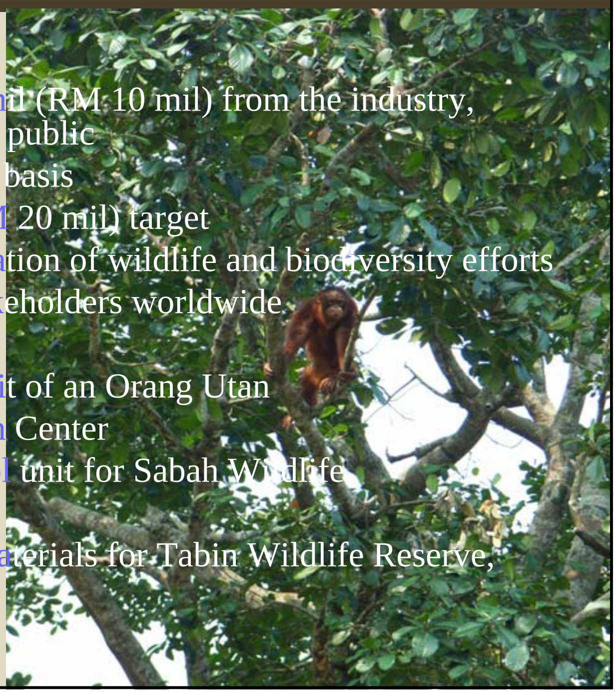
Source: *Sarawak Forestry Council (2007)*



Map showing major forest reserves with orang-utan populations in Sabah. Ulu Segama-Malua area has the highest concentrations with 6,000 – 7,000 or half of the total of orang-utans in Sabah.

Malaysian Palm Oil Conservation Fund

- Launched in 2006
- Initial contribution of € 2.2 mil (RM 10 mil) from the industry, government agencies and the public
- Operated as 'matching grant' basis
- To achieve € 4.3 million (RM 20 mil) target
- Aimed at enhancing conservation of wildlife and biodiversity efforts
- Beneficial to all palm oil stakeholders worldwide
- Approved projects include:
  a) upgrading of the infant unit of an Orang Utan Research & Rehabilitation Center
  b) establishing a jungle patrol unit for Sabah Wildlife Department
  c) developing information materials for Tabin Wildlife Reserve, Sabah



Carbon Sequestration: Oil Palm vs. Soyabean

Crop	Total Planted Area[a] (mil ha)	CO_2 absorbed (mil t/year)	O_2 released (mil t/year)	Average CO_2 absorbed (t/ha/year)	Average O_2 released (t/ha/year)
Soyabean	94.15	331.4	241.0	3.52	2.56
Oil Palm	10.55	309.1	224.7	29.3	21.3

Note: a 2007 figures
Source: Oil World Dec 2007, Chan 2002

Oil palm is more effective than soybean in reducing the effects of global warming

Oil Palm Plantations: Biodiversity, Riparian Reserves & Wildlife Corridor

Biodiversity

Riparian Reserves

Wildlife Corridor

Malaysian Palm Oil Industry

- *Adopting Good Agricultural & Management practices*
- *"Zero" burning policy*
- *Natural fertilizers*
- *Erosion control*
- *Moisture retention*
- *Integrated Pest Management*
- *Recycling of biomass*

Examples of Good Agricultural Practices

Leguminous Cover Crop

Recycling of Biomass

'Beneficial' Plants

'Zero' Burning

Integrated Pest Management

Integrated Pest Management (IPM) using biological control is increasingly practiced in the plantations

Input-Output Analysis of Intensive Oilseeds & Oil Palm Cultivation (per tonne of oil)

Items (unit)	Soyabean Oil	Sunflower Oil	Rapeseed Oil	Palm Oil
Inputs				Source: FAO (1996)
Seeds for planting (kg)	150	6.3	2.5	
Nitrogen (kg)	315	96	99	47
Phosphates (kg)	77	72	42	8
Pesticides/ Herbicides (kg)	29	28	11	2
Others (kg)	117	150	124	88
Energy (GJ)	2.9	0.2	0.7	0.5
Outputs				
Oilseed/fruits (kg)	5000	2500	2500	4540
Emissions to soil and water (kg)				
-Nitrogen	32	10	10	5
-Phosphates	23	22	13	2
-Pesticides/herbicides	23	22	9	0.4
Emissions to air (kg)				
-NO_X	4	0.3	0.8	0.5
-SO_2	2	0.1	0.4	0.2
-CO_2	205	16	50	32
-Pesticides/herbicides	6	6	2	0.1

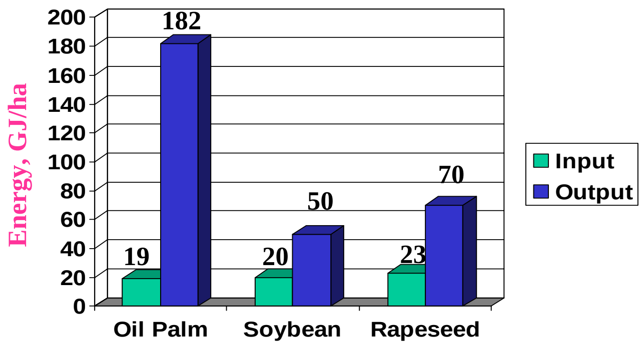
Oil palm biomass recycled on land and its contribution to the carbon economy of the soil (during the course of one generation of palms

From fronds during regular pruning rounds		
Dry matter per hectare	=	10 tonnes x 22 years
	=	220 tonnes
Carbon equivalent per hectare	=	88 tonnes
(@40% C to organic matter)		
From trunks and fronds at replanting		
Dry matter per hectare	=	100 tonnes
Carbon equivalent per hectare	=	40 tonnes
(@40% C to organic matter)		
From male to flowers that decay and fall to the ground		
Dry matter per hectare	=	27 tonnes
Carbon equivalent per hectare	=	10.8 tonnes
(@40% C to organic matter)		
From empty fruit bunch mulching (EFB)		
Dry matter per hectare	=	30 tonnes
Carbon equivalent per hectare	=	12 tonnes
COMBINED BIOMASS RECYCLED ON LAND DURING THE COURSE OF ONE GENERATION OF OIL PALM		
Dry matter per hectare	=	220 + 100 + 27 + 30
(organic matter)	=	377 tonnes
Carbon equivalent per hectare	=	150.8 tonnes

Source: Dr Gurmit Singh/UP Plantations (1999)

Energy-efficient Crop

Oil palm is an energy efficient crop that requires less energy input to produce 1 tonne of oil



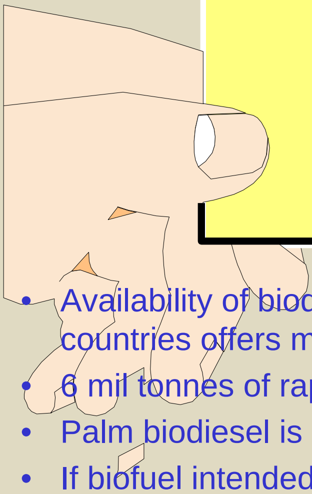
Source: Wood & Corley, 1991

•The energy expressed by the ratio of energy output to input is wider for oil palm than any other commercially grown oil crops.

•The oil palm's cultivation and processing requires lower inputs of agrochemicals (pesticides), fertilizers and fossil fuels to produce one tonne of oil, with fewer resulting emissions and pollutants


Highly-Regulated Industry
1) Land Acquisition Act 1960
2) Land Conservation Act 1960 revised in 1989
3) National Land Code 1965
4) Protection of Wildlife Act 1972
5) Environmental Quality Act 1974 (Environmental Quality) (Prescribed Premises) (Crude Palm Oil) Regulation 1977
6) Environmental Quality (Clean Air) Regulation 1978
7) Labor Law
8) Workers' Minimum Standard of Housing & Amenities Act 1990
9) Occupational Safety & Health Act 1977
10) Pesticides Act 1974 (Pesticides Registration) Rules 1988
11) Pesticides (Licensing for sale & storage) Rules 1988
12) Pesticides (Labeling) Regulations 1984
13) Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987
14) Factories & Machinery (Noise Exposure) Regulations 1989


Socially Responsible
• Sarawak State Government enforces customary rights of its native people
• Oil palm industry is a major employer with > 0.5 mil people employed directly
• Help reduce migration and instrumental in the development of secondary towns and centers in rural areas
• Provides places of worship, houses, schools, clinics, and other basic necessities in estates



The EU Target on Biofuel (% of total fuel share):

2005	2%	
2010	5.75%	(9.0 mil tonnes)
2010 (Revised)	10.0%	(15.7 mil tonnes)

- Availability of biodiesel to supply shortages in the EU and other countries offers mutual benefits
- 6 mil tonnes of rapeseed in EU can't cope with demand
- Palm biodiesel is best positioned to fill the 40% gap
- If biofuel intended use is to reduce global warming, palm biodiesel is a viable option

National Biofuel Policy

- Malaysia has initiated steps to blend the commodity with diesel to power up the domestic transportation and industrial sectors.
- National Biofuel Policy launched in May 2006 to mandate the blending of diesel with processed palm oil.
- A 5% palm-diesel mixture (B5) has been set as the winning formula.
- The B5 is expected to use up an additional 0.5 mil tonnes of palm oil per year. This will augur well for the average price of palm oil.

Why is Palm Oil the Ideal Choice?

fulfills the 3 indicators of sustainability

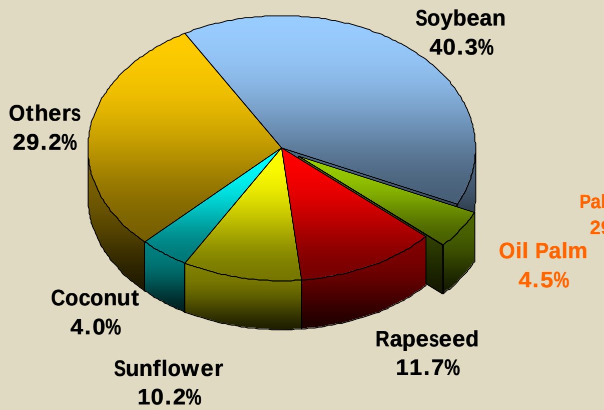
. People

. Planet

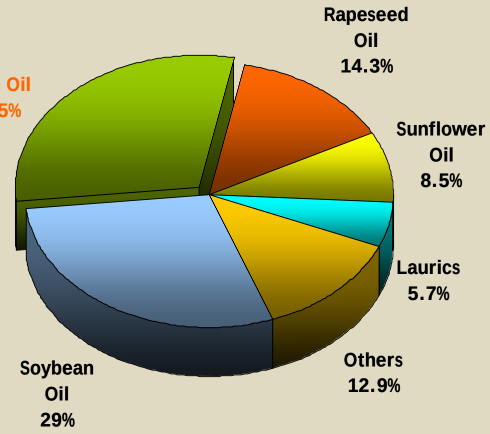
. Profits

Oil Palm: Highest Oil Output on Least Land

Total Area: 233 mil ha



Total Vegetable Oil Output
129.3 mil MT



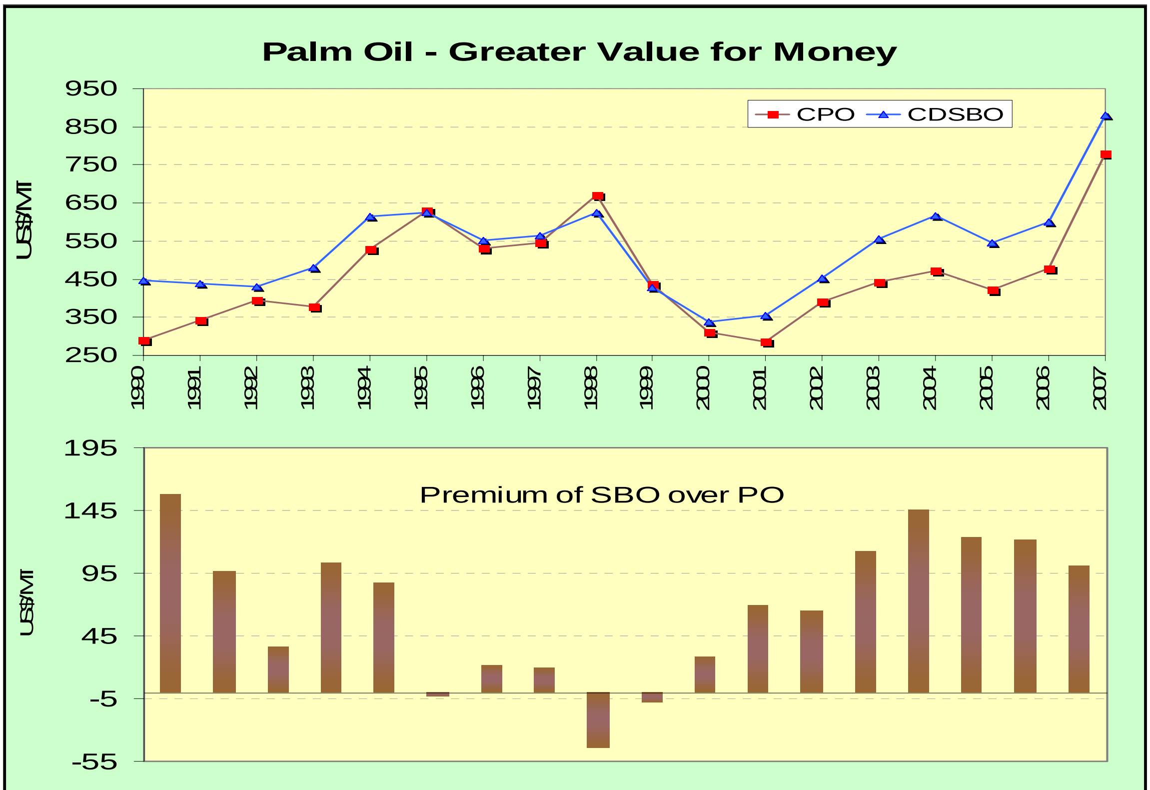
Source: Oil World

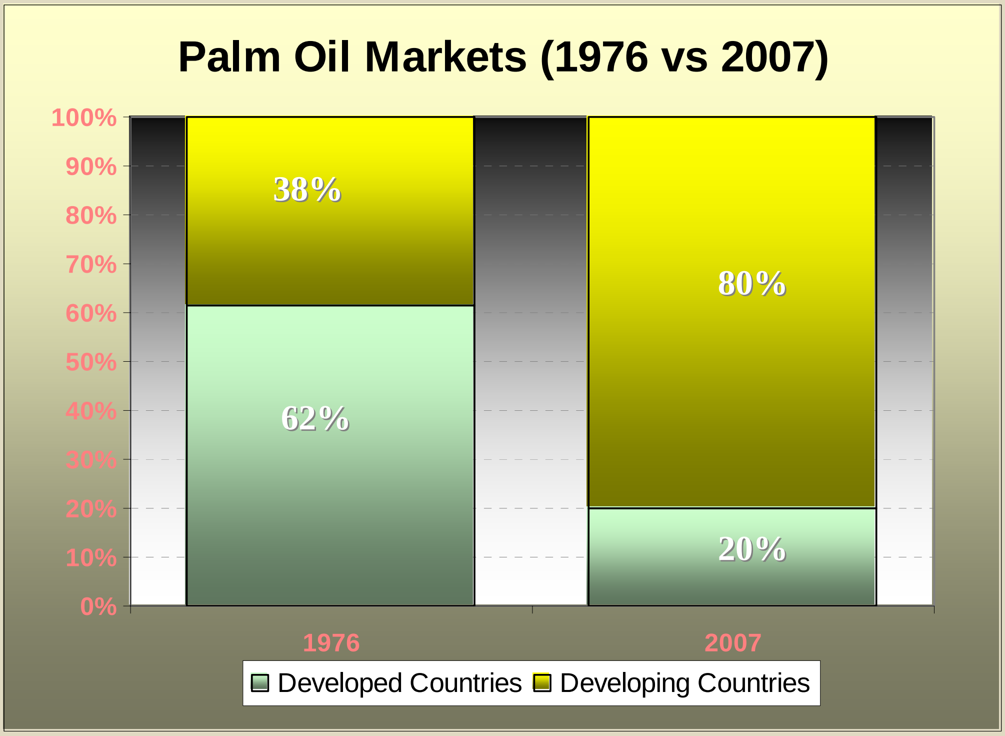
Oil Palm vs. Other Oilseed Crops

Oil Crop	Production (mil tonnes)	% of Total Production	Average Oil Yield (t/ha/year)	Total Area (mil ha)	% Area
Soybean	37.48	31.91	0.40	94.15	42.52
Sunflower	11.00	9.36	0.46	23.91	10.80
Rapeseed	18.52	15.77	0.68	27.22	12.29
Oil Palm	38.16[a]	32.48	3.62	10.55	4.76
TOTAL[b]	117.47			221.45	

Note: [a]only for palm oil
[b]only for the 7 major oils (groundnut, coconut, cottonseed and the above oils)

Source: Oil World Dec 2007

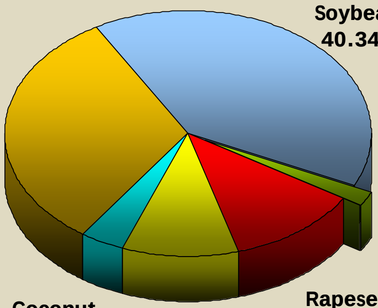




Attacks by NGOs:
What is the reality?

Malaysian Agricultural Area vs. World Agricultural Area

World Oilseed Area in 2007: 233 mil ha



Source: Oil World 2007

Comparison of Agricultural Areas in 2005 (mil ha)

World	Malaysia	Malaysian Oil Palm
4,967.5	7.87	4.05

Source: FAO 2005

In 2005, Malaysia utilized only 4.05 mil ha of its land for oil palm or 0.08% of the world's total agricultural land.

Comparison on Population

- In 2007, the world population was recorded at about 6.6 billion whereas Malaysia recorded a population of 24.8 million.
- Malaysia's population only represents about 0.38% of the world's

The Real Culprit in CO_2 Emissions

- Every 10 new cars produced during their lifetime will emit CO_2 equivalent to that emitted by deforestation of one hectare of rainforest
- Yearly production of 15 million new cars by EU will emit GHGs equivalent to the deforestation of 1.5 million hectares of rainforest.
- Is oil palm the cause of CO_2 emission?

  In three years, the EU's introduction of new cars alone would emit CO_2 equivalent to 4.5 million hectares of rainforest being destroyed.
- In comparison, the total oil palm area in Malaysia has only managed to reach 4.3 million hectares presently after over 90 years of development since the industry was first established in 1917.

Expert Consultation on:

"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

20-22 November 2008, Kuala Lumpur, Malaysia

ANNEX 7

Life Cycle Analysis (LCA) of palm oil biodiesel (PME)

Nils Rettenmaier

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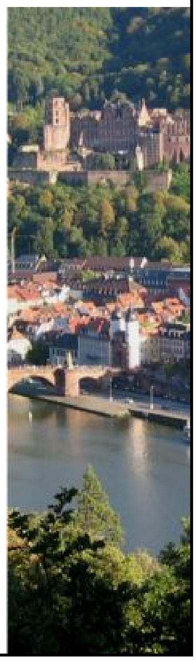
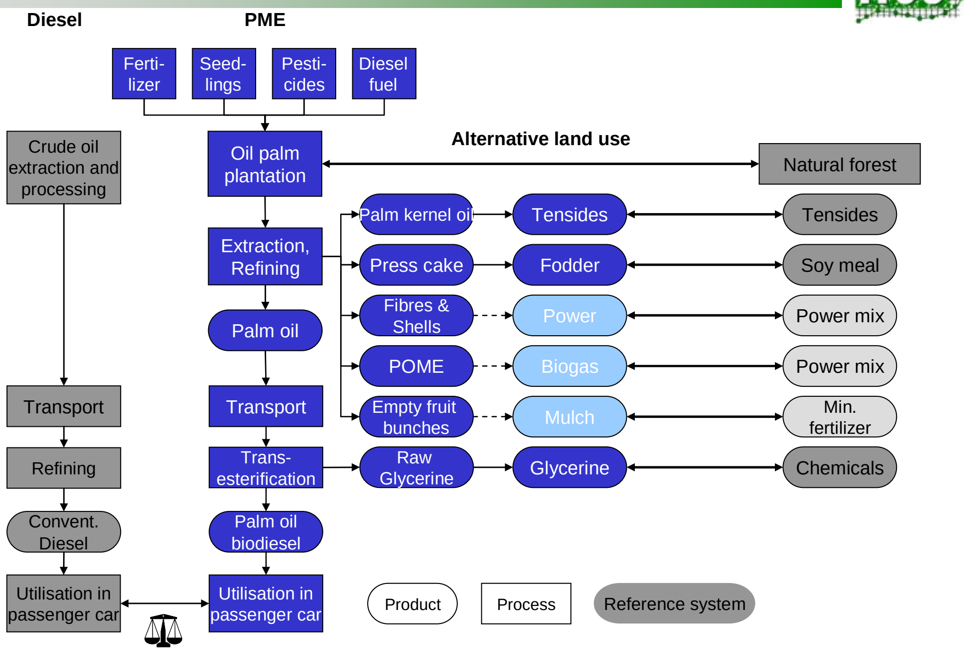
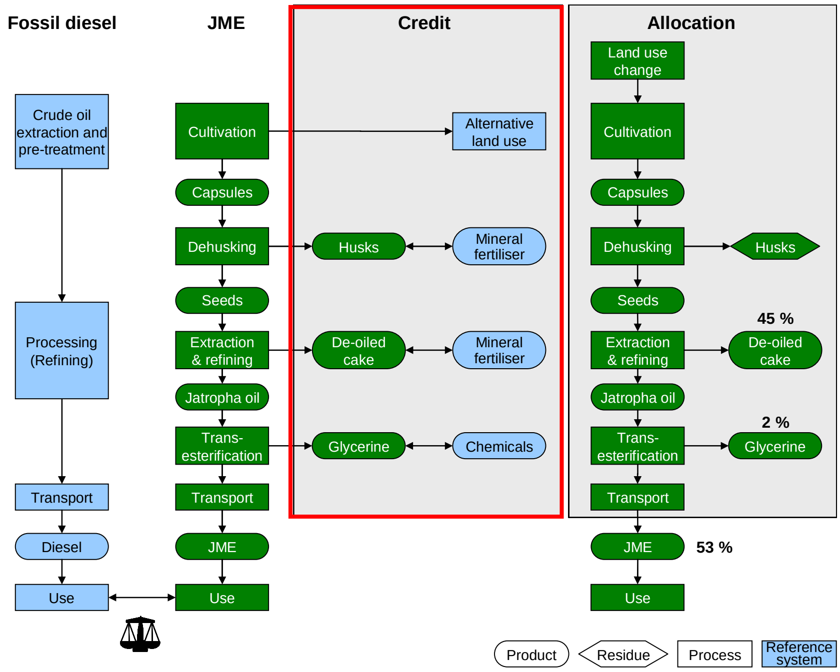


LCA of palm oil biodiesel (PME): Life cycle comparison



Source: IFEU 2008

LCA: Credit method vs. allocation method



Source: IFEU 2008

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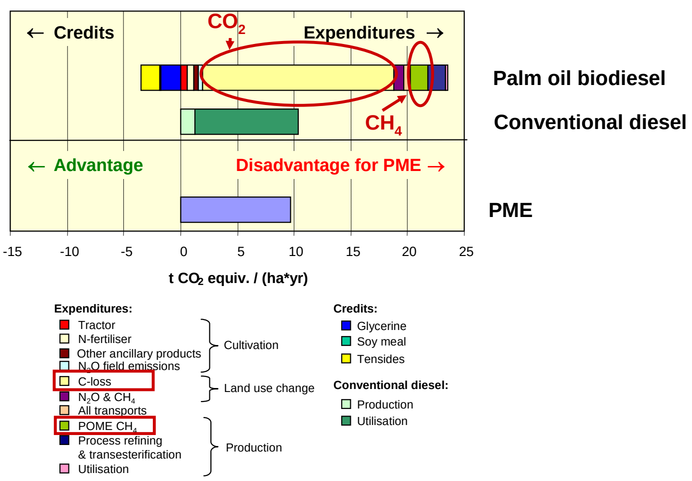
LCA of PME: Results of greenhouse gas balance

Greenhouse effect



Source: IFEU 2008

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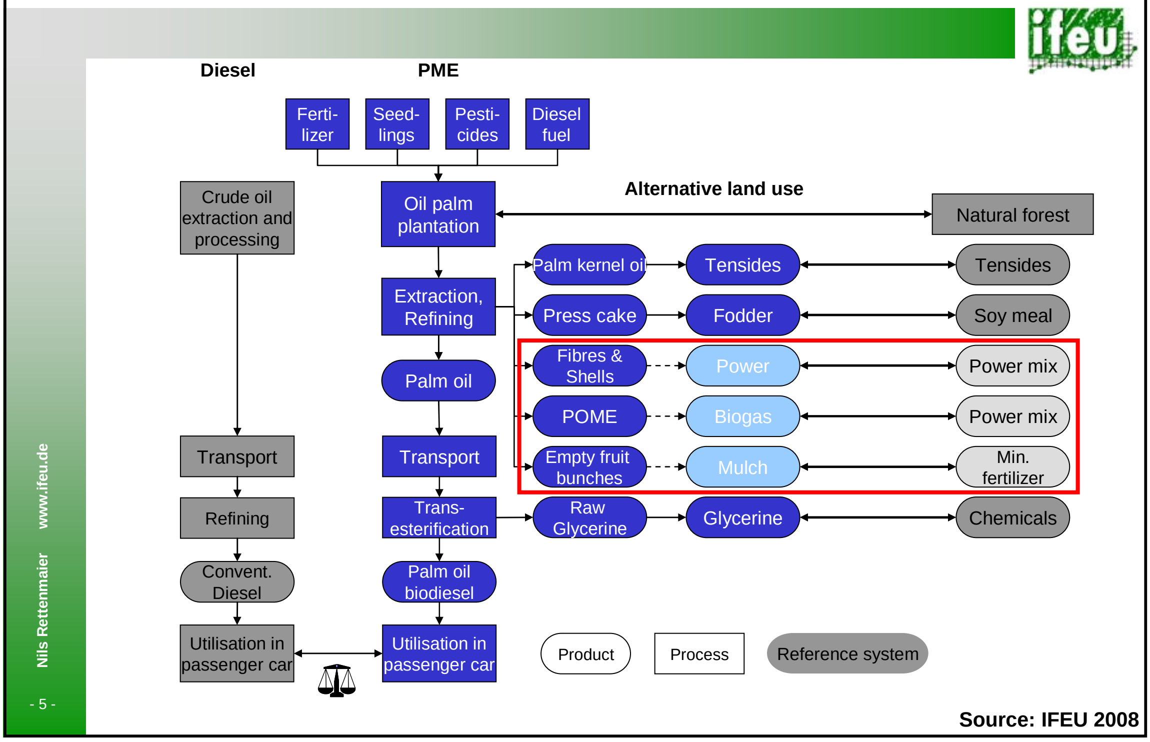
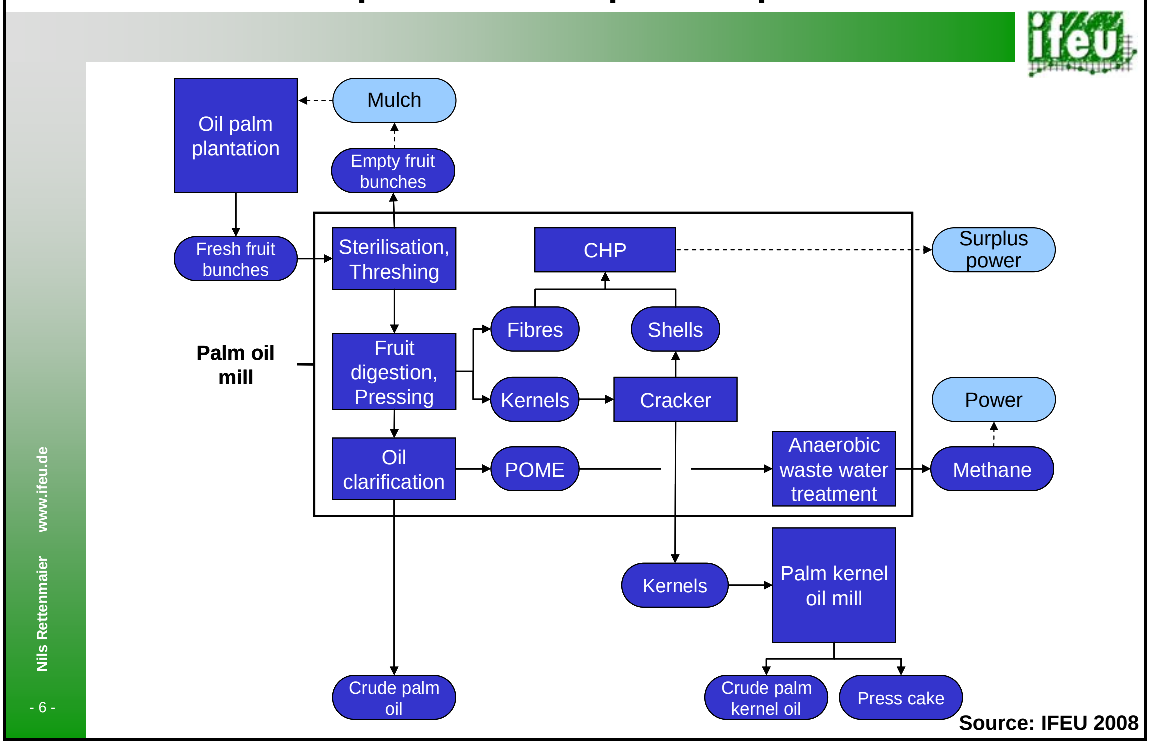
LCA of palm oil biodiesel (PME): Life cycle comparison



LCA of PME: Optimisation of palm oil production



LCA of PME: Optimisation of palm oil production

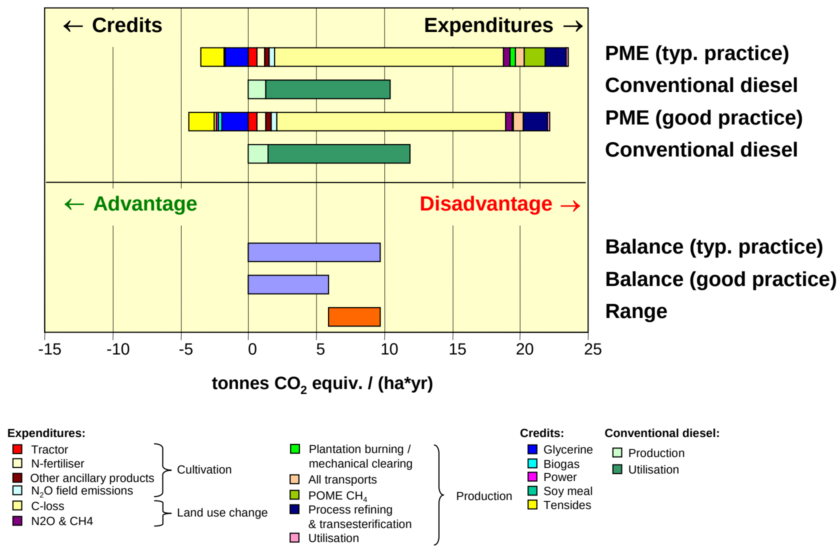
Option	Typical Cultivation*	Optimised Cultivation*
Biogas utilization	0 %	100 %
Sell-out of surplus energy (by-products)	0 %	100 %
Oil yield (cultivation)	3.5 t/ha	4.0 t/ha
Field preparation	Open burning	Zero burning

* Plantation / palm oil mill management

Source: IFEU 2008

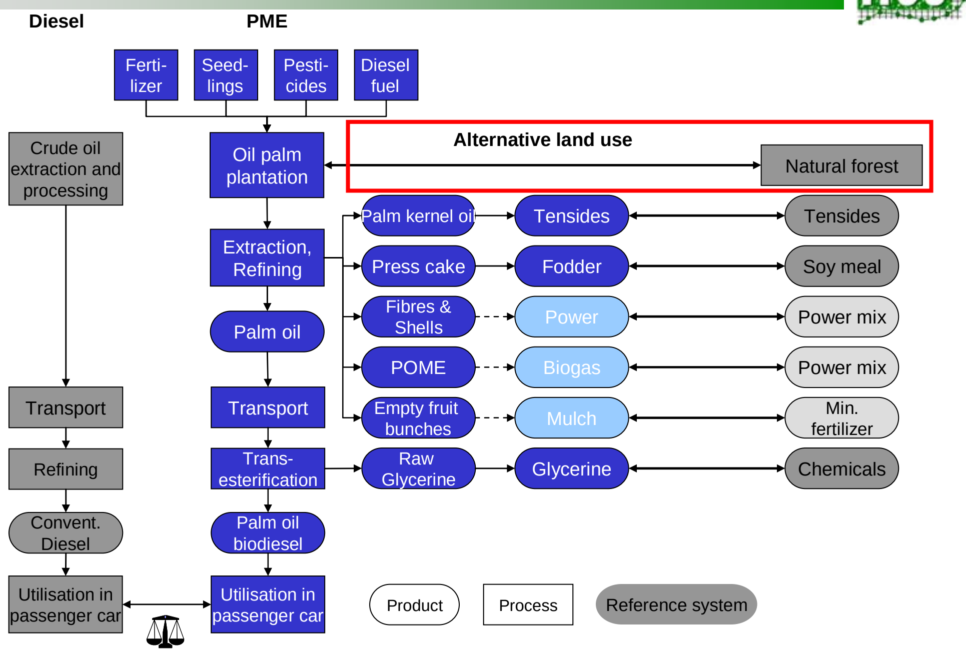
LCA of PME: Optimisation of palm oil production

Greenhouse effect



Source: IFEU 2008

LCA of palm oil biodiesel (PME): Life cycle comparison



Source: IFEU 2008

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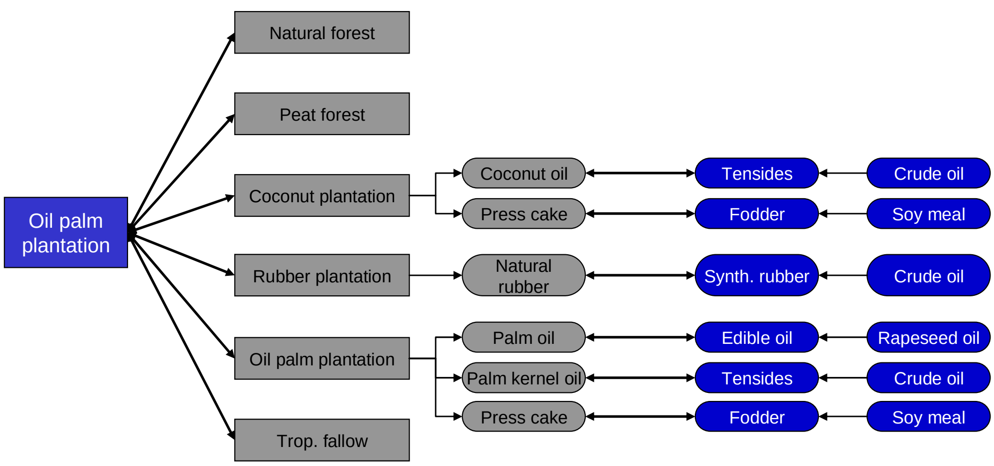
LCA of PME: Land use change (LUC)



Source: IFEU 2008

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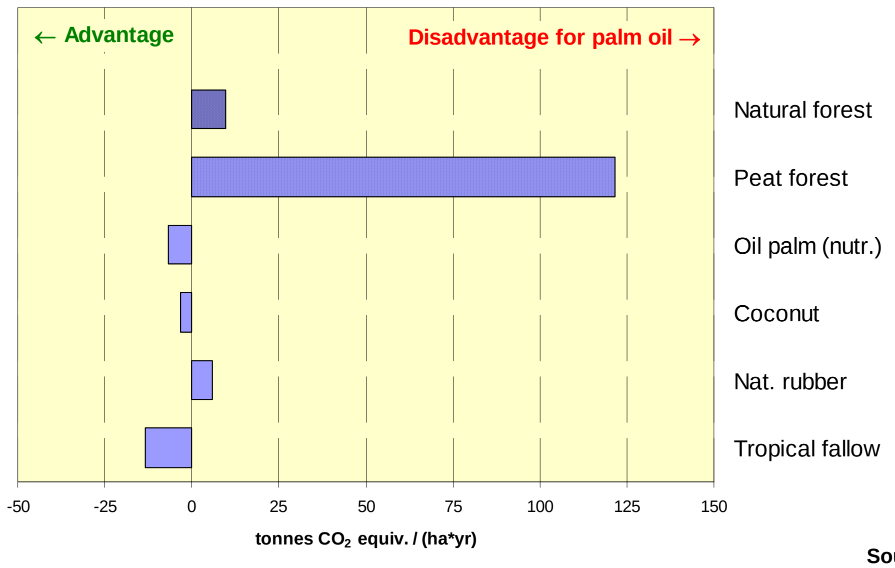
LCA of PME: Alternative land use / Land use change

Greenhouse effect



Source: IFEU 2008

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LCA of palm oil biodiesel (PME): Summary & conclusions

- **LCA results depend on management of plantations & oil mills:**
  - **Yield improvement**
  - **Zero burning**
  - **Energetic use of co-products**
  - **Energetic use of POME biogas**
- **Land use changes have a major influence on:**
  - **Greenhouse gas balance**
    - **Impact depending on magnitude of carbon stock change and depreciation period**
  - **Biodiversity**
    - **Irreversible loss**
- **Land use changes (direct and indirect) should be avoided, except for establishment of oil palms on degraded land**
- **Existing palm oil production (plantations + oil mills) should be significantly optimised**

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Expert Consultation on:

"Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia"

20-22 November 2008, Kuala Lumpur, Malaysia

ANNEX 8

The potential of palm oil for developing countries and its role in the food and fuel debate

Tan Sri Datuk Dr Yusof Basiron* and Dr Yew F.K.**

*CEO, Malaysian Palm Oil Council

** Senior Fellow, Malaysian Palm Oil Council

Presentation

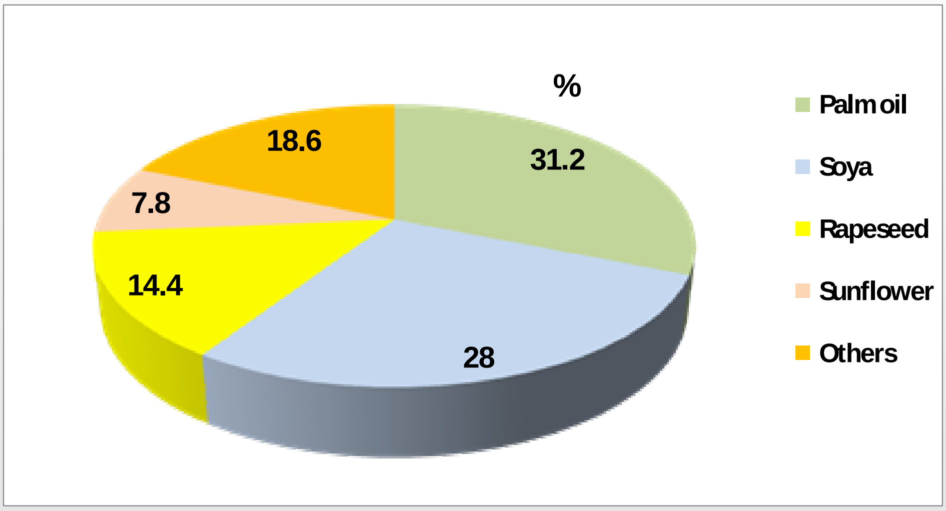
- Importance of palm oil to meet world's demand for food & biofuel
- How palm oil can meet world's requirement through wise use of limited land resource
- How palm oil has resulted in avoided deforestation in importing oils & fats countries
- Why palm biofuel is green
- Why palm biofuel demand is not the cause of high price of vegetable oils
- Showcase oil palm as right crop in 21st century for developing countries
- Conclusions

Need to use land wisely

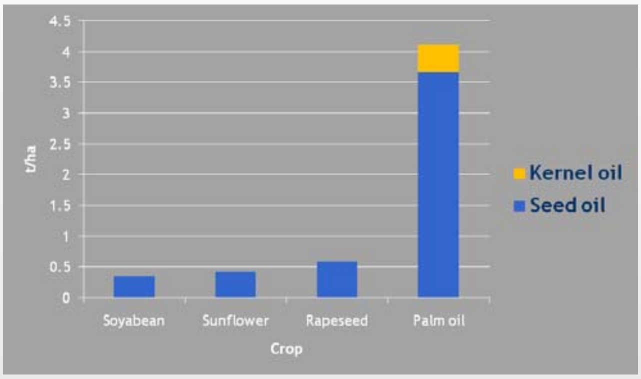
Year	World population (billion)	Arable land per capita (x10 $^{-3}$ km^2)	Arable land per capita (ha)
1922	2.0	7.50	0.75
1975	4.0	3.75	0.38
2005	6.6	2.27	0.23
2030	8.0	1.88	0.19
2042	9.0	1.67	0.17

- World population increasing
- Limited land resource decreasing

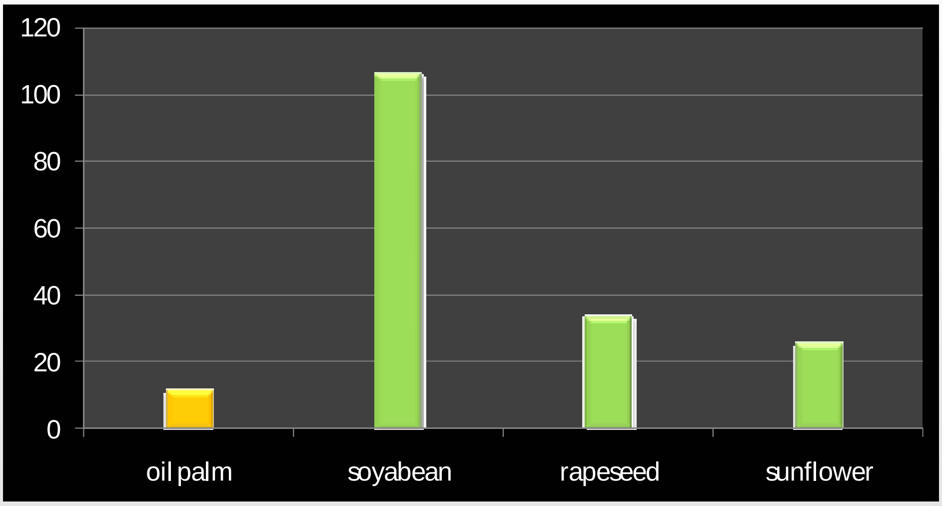
Palm oil's contribution to world supply



High land productivity of oil palm



Harvested area of oil crops in world (million ha)



Oil palm occupies less than 5% of oil crops area and less than 1% of agricultural land area in world

Cultivated area of oil seeds in the world

Land use type	Total area (million ha)	As % of total area
Total agricultural land*	4967	100%
Oil seeds **	233	4.69%
Oil palm**	11	0.22%***
Soyabean**	92	1.85%
Rapeseed**	30	0.60%
Sunflower**	23	0.46%
Coconut**	9	0.18%
Other oil seeds**	68	1.37%
Malaysian oil palm	4.3	0.09%

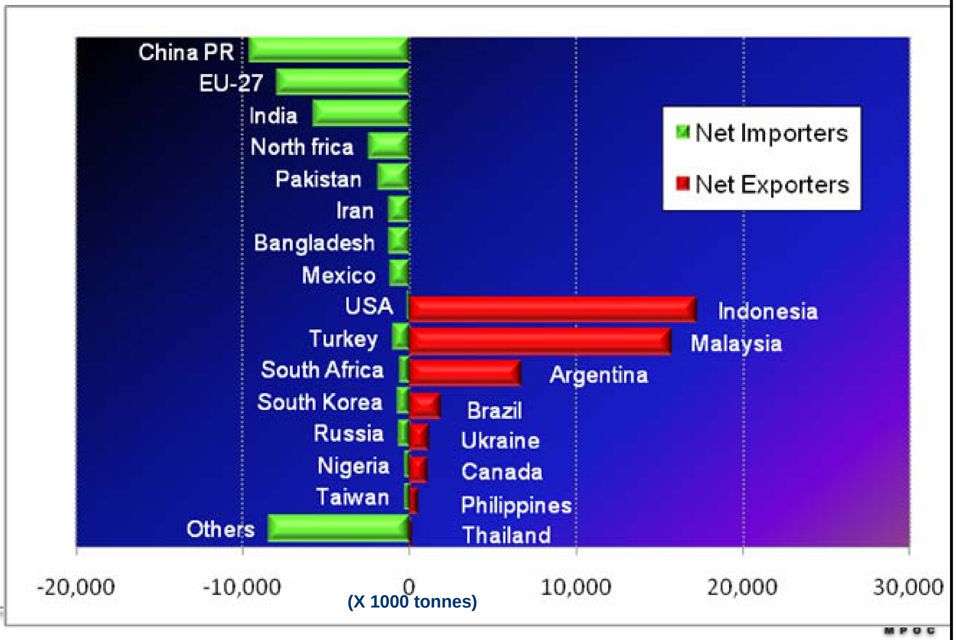
*** oil palm cultivation comprises 4.7% of total land area planted with oil seeds & 0.22% of world agricultural land

Sources: * FAO ** Oil World

Efficient use of land

- Current total land to produce 4 major vegetable oils is 176.8 m ha
- Hypothetically, if oil palm, being the most efficient oil crop, given the role to produce vegetable oil for the world, it only needs 30.3 m ha
- Making available 146.5 m ha or 6 times size of UK for other land use
- If all 176.8 m ha planted with oil palms, 651 m tonnes oil produced; equivalent to 5 times present demand
- Rest of the oil can be used for other purposes eg for biofuel
- This is more than enough to meet world's demand for food & biofuel of 263 m tonnes in the year 2030

Net importing and exporting countries for oils & fats



Main exporters of oils & fats are palm oil producing countries.
Oil palm producers avoid deforestation in importing countries
Oil palm producers accused of deforestation while helping importing countries not to deforest.

World-wide avoided deforestation in importing countries by choosing palm oil as food & biofuel

Parameter	Amount
Avoided deforestation when oil palm substitutes •Rapeseed cultivation •Soyabean cultivation	 53 thousand ha 87 thousand ha
Avoided carbon stock loss in this •Rapeseed area •Soyabean area	 4 m tonnes of C 6.7m tonnes of C

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Indirect land use change effect

- Direct land use change results eg by Fargione et al (2008) stated that palm oil production from clearing forested land gives palm oil a carbon debt lasting 86-840 years
- Indirect land use change effect of oil palm substituting (or avoiding) rapeseed & soyabean from being cultivated not considered
- Palm oil production has a carbon credit (not a carbon debt) if this is considered

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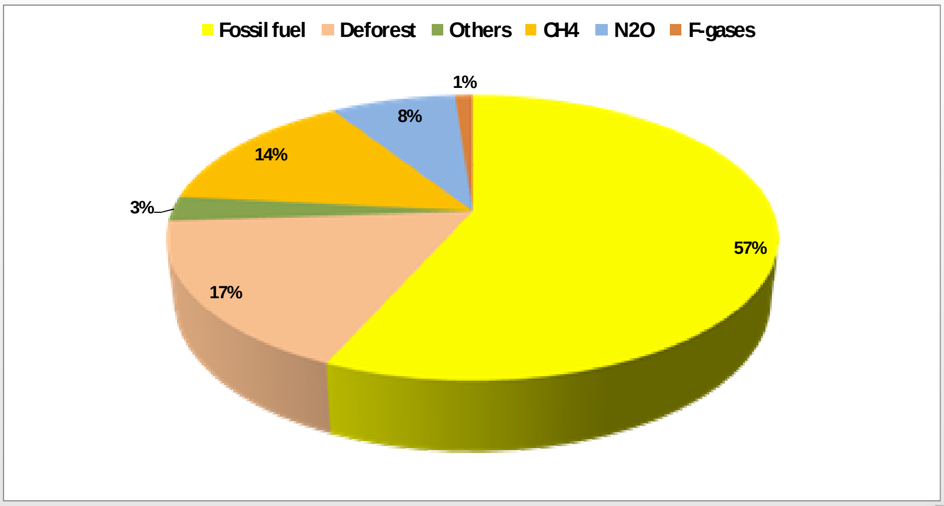
Palm oil substitution carbon credit (POSCC)

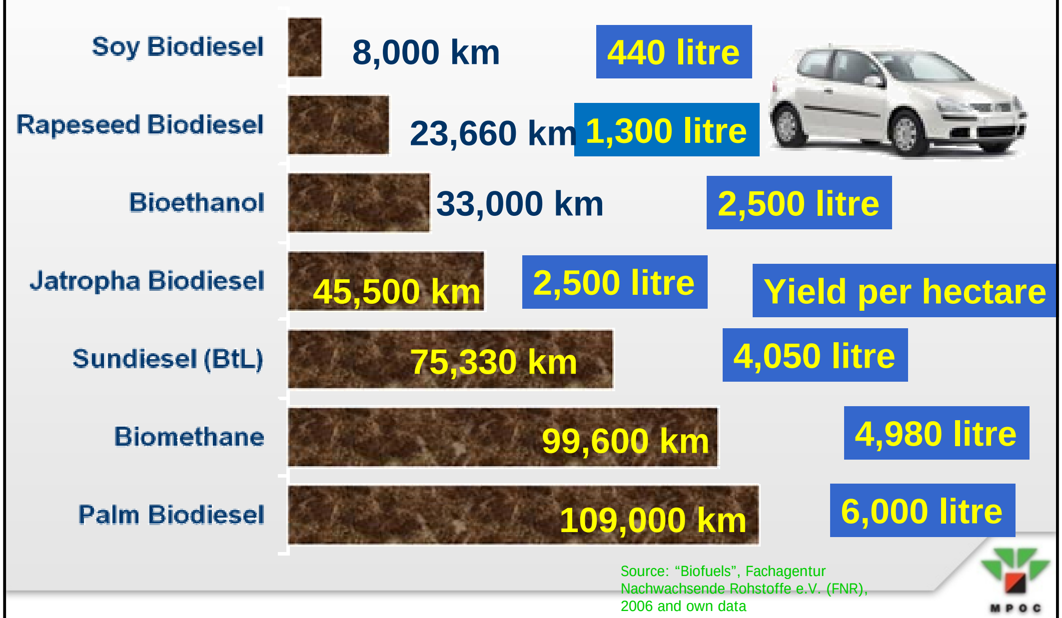
- Defined as number of years needed in production of palm oil to produce the same amount of CO_2 emitted by substitution oil crops during land clearing
- If oil palm substitutes rapeseed, POSCC is 324 years (if oil palm cultivated on degraded tropical forest) and 472 years (oil palm to oil palm replant)
- If oil palm substitutes soyabean, POSCC is 1,395-1,543 years
- Oil palm cultivation results in a carbon credit (not carbon debt)

Sources of GHG emissions (CO_2 equvalent)



Largest amount of GHG from fossin fuel use makes biofuel use a good option to arrest climate change

Mileage per hectare per year
-based on a VW Polo-



LCA GHG emissions of palm biodiesel

Emission sources	Amount (kg CO_2/tonne biodiesel)	
1. Production of fertilizers used	185	(11.5%)
2. Nitrous oxide emitted	130	(8.1%)
3. Use of pesticides	34	(2.1%)
4. Transportation & machinery use	89	(5.6%)
5. Milling & refining of palm oil	19	(1.2%)
6. EFB	87	(5.4%)
7. Effluent ponds	824	(51.5%)
8. Transportation to mills, refineries	36	(2.3%)
9. Biodiesel refining	197	(12.3%)
Total	**1,601**	**(100%)**
10. Production & use of fossil fuel	4,228	
11. Palm biodiesel savings	2,627	
12. **GHG emission savings relative to fossil diesel**	**62%**	

Source: van Zutphen (2007)

GHG emission savings exceed 35% threshold value of EU Directive

Oil palm is a net carbon sequester

Parameter	Practice if methane not trapped in effluent ponds (kg CO_2-e/tonne CPO)	Practice if methane trapped in effluent ponds (kg CO_2-e/tonne CPO)
1)LCA CO_2-e emitted 2)LCA CO_2-e emitted after allocation to co-products 3)CO_2-e sequestered 4)Avoided deforestation	-1,601 -1,143 +870 +8,266	-1,601 -512 +870 +8,266
Net CO_2-e emitted (-) or **Sequestered (+)**	**+7,993**	**+8,624**

1)GHG emission allocated to CPO, palm kernel oil, palm kernel cake and EFB based on weight (2) life cycle of oil palm is 25 years

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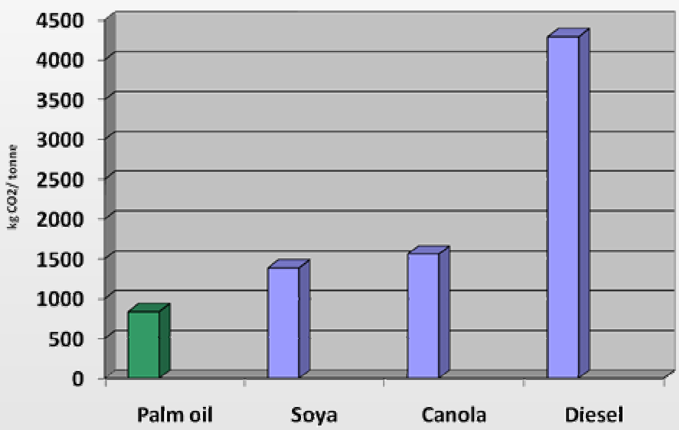
Lower C footprint for biofuel production



Source: van Zutphen(2008)

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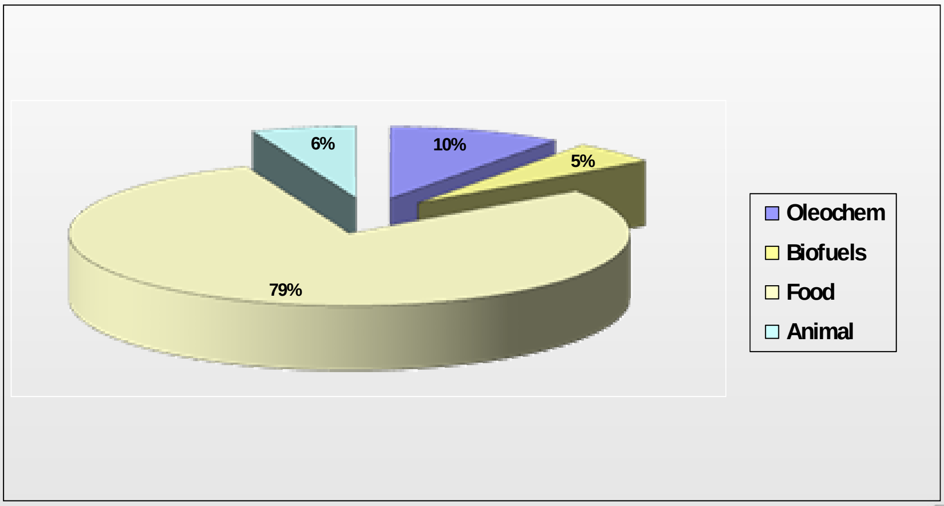
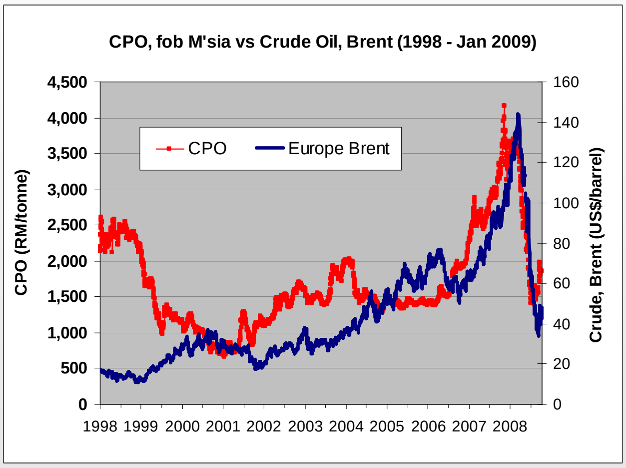
Global market share of industries for oils & fats



Correlation between CPO price and diesel oil price



Oil palm is right crop for developing countries

- Malaysia as example
- Oil palm is grown on legal agricultural land in Malaysia
- Adopts responsible practices just like rapeseed and soyabean
- Adopts good agricultural & management practices eg zero burning, integrated pest management, trapping methane
- RSPO (proof of sustainable production)

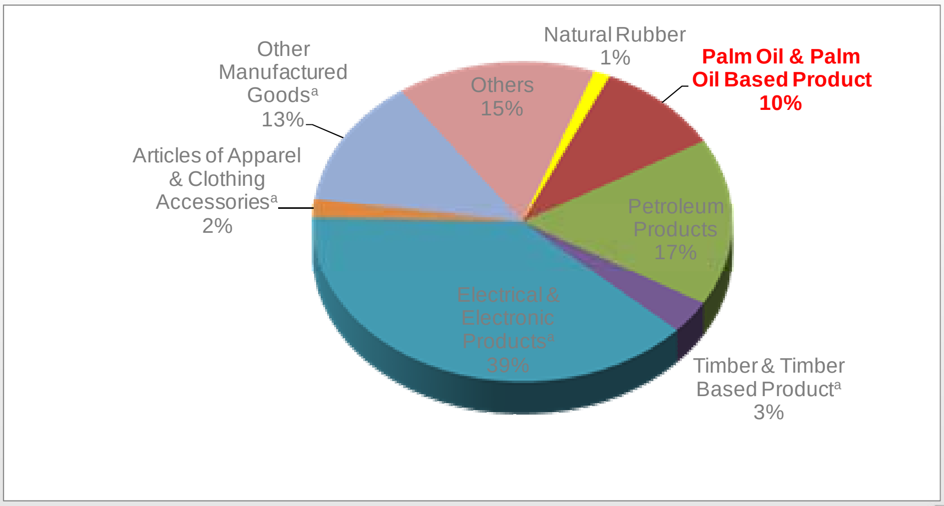
Oil palm is right crop for developing countries

- Oil palm is a suitable crop for tropical developing countries
- Palm oil is a major revenue earner for Malaysia (10% of total export earnings for country)
- Poverty eradication in Malaysia with income of Felda settlers significantly higher than national rural poverty line
- This is possible by respecting 3Ps principles of sustainability

Felda as a good role model to develop agriculture in developing countries

Land use	Area	Area as % of total land
Oil palm	720,076	84.4
Rubber	86,183	10.1
Sugar cane	2,449	0.3
Other agriculture	2,432	0.3
Housing/infrastructure	42,173	4.9
Total	855,313	100

Palm oil's significant contribution to Malaysian economy in 2008



Potential of developing countries to produce more food & biofuel from oil palms

Country	Forest land (m ha)	Agric (m ha)	Urban & built up area (m ha)	Idle land (m ha)	Total (m ha)
Brazil	477.7(56.5%)	263.6(31.2%)	84.6	20.0	845.9
Indonesia	88.5 (48.8%)	47.8 (26.4%)	18.1	26.8	181.2
Malaysia	20.9 (63.5%)	7.9 (24.0%)	3.3	0.8	32.9
PNG	29.4 (64.9%)	1.1 (2.4%)	4.5	10.3	45.3
Philippines	7.2 (24.1%)	12.2(40.9%)	3.0	7.4	29.8
Thailand	14.5 (28.4%)	18.6 (36.4%)	5.1	12.9	51.1
Total	638.2 (53.8%)	351.2 (29.6%)	118.6 (10%)	78.2 (6.6%)	1,186.2 (100%)

Potential production of palm oil from idle land

- 78.2 million hectares of idle or under-utilized land in developing countries
- If planted with oil palms, potential yield of 288 million tonnes of palm oil without need to deforest or open up new land
- Therefore, oil palm expansion in oil palm growing countries need not be curtailed

Conclusions

- Continuous need for oils & fats to feed ever growing world population
- New era of using vegetable oils for biofuel production
- Palm oil contributes significantly to 31% of total vegetable oil production
- Yet occupies less than 5 % of oil crops area and less than 1% of agricultural land in world
- Hypothetically, if oil palm given role to produce oil supplied by 4 major oil crops in world, it requires only 30 million ha
- This will free 147 million ha of land for other land use without need to deforest or open new land

Conclusions

- Alternatively if land area currently devoted to 4 major oil crops is to be planted with oil palm, palm oil production is 5 times current requirement
- Plenty of oil for other uses including biofuel use
- Only 8 countries in world self sufficient in oils and fats, the rest are mostly net importers
- Palm oil already avoids deforestation (53-87 t ha) and avoids loss of carbon stock (4-6.7 million tonnes C) in importing countries
- Palm oil substitution carbon credit (POSCC) of 324 – 472 years from indirect land use effect when oil palm substitutes rapeseed
- For soyabean substitution, POSCC is1,395-1,543 years

Conclusions

- Palm oil biofuel is green biofuel and LCA GHG emission savings definitely exceeds 35% threshold value (EU Directive) but proper studies must be carried out
- In reality,palm oil biodiesel is a net carbon sequester if logical contributions of all credits are accounted for
- Oil palm cultivation is proven crop to eradicate poverty and uplift economy of developing countries
- Estimated 78 million ha of idle or under-utilized land in oil palm growing countries with a potential yield of 288 million tonnes CPO without need to open up new land
- Oil palm expansion in developing countries must not be curtailed unless the alternatives offer better GHG emission reduction effects

MPOC

Expert Consultation on:

“Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia”

20-22 November 2008, Kuala Lumpur, Malaysia

ANNEX 9

Tropical Lowland Peats: To Conserve or Develop Them?

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Key Words: Peat, Tropical Lowland, conservation, oil palm

INTRODUCTION

Peats are formed by the accumulation of organic soil materials. These materials consist of undecomposed, partially decomposed and highly decomposed plant remains. Tropical lowland peats, in addition, often have undecomposed or partly decomposed branches logs or twigs. Peats have been mapped worldwide under many climatic zones from the arctic to the tropics. They are found both in the northern and southern hemispheres wherever suitable climatic and environmental conditions occur. One of the main conditions necessary for the formation of peats are conditions that limit the decomposition and hence the accumulation of organic soil materials.

Tropical lowland peats form a fragile ecosystem because it is domed shaped and is almost 100 percent organic. Its characteristics are highly influenced by the hydrological conditions i.e. pedohydrology. They store large quantities of water and thereby help minimize flooding in the rainy seasons. In the short term they assist in retaining environmental contaminants such as heavy metals. These swamps are able to support some uniquely adapted flora and fauna species. However while peat swamps form an important function as a water catchment, they can be a tinderbox during prolonged droughts and are prone to fires which result in haze and air pollution. Due to their waterlogged and acidic conditions these peatlands only support small native communities who collect wood and fish for their subsistence living.

Due to population pressure, the need to produce more food and to eradicate rural poverty, the Governments of Indonesia and Malaysia have both with varying success, drained and developed these peatlands for agriculture. Many of these failures were partly due to the lack of understanding of the structure and hydrology of these peatlands. These peatlands were treated as any other waterlogged mineral swamp and large drains were dug to remove excess water. This has resulted in the subsidence and sometimes decomposition of the organic materials.

In the early 1960's plantation crops such as rubber and subsequently oil palm have been planted on these problem soils. Again success was limited due to the use of large drains to remove excess water. In 1986, the pioneering work of United Plantations (Gurmit *et al.*, 1986) introduced water control and nutritional management, significantly increasing the successful cultivation of oil palms on peat. This resulted in a rush to clear and plant large areas of peatlands to oil palms in the last 15 years particularly in Indonesia and Malaysia.

The lowering of watertable for agricultural development results in consolidation, subsidence and some decomposition of the surface layers of the peat. Some environmental groups claim that this results in increased decomposition and mineralization of the peat resulting in the release of carbon dioxide (CO_2) and nitrous oxide (N_2O) which contribute to global warming.

On the other hand, countries where large areas of tropical lowland peats occur claim that due to pressure of increased population and the need to eradicate rural poverty requires that peatlands be cleared and planted. This is further aggravated by the need to produce more biofuels to replace fossil fuels (petroleum and coal), the largest single producer of GHG emissions. Thus the Governments of Indonesia and Malaysia face a dilemma – to conserve or to develop tropical lowland peatlands.

Objectives of the Paper

The objectives of this paper is to:

- Review the current knowledge of the characteristics, structure and ecology of tropical lowland peats.
- Review some of the various issues on the conservation or development of tropical lowland peats.
- To recommend land assessment guidelines to assist in the decision making for the conservation or development of tropical lowland peatlands
- To recommend immediate actions that need to be taken.

EXTENT OF LOWLAND PEATS IN INDONESIA AND MALAYSIA

The estimates of the extent of peatlands in Southeast Asia varies with the source. Rieley *et al.* (1995) give the minimum and maximum extent of undisturbed peatlands in Southeast Asia (Table 1). For comparison values for the same countries quoted by Tie (1990) are also given. It is clear that some very large differences exist. This points to a range of values depending on the source used. For Malaysia, these differences are difficult to explain as there is only one soil map each for Peninsular Malaysia, Sabah and Sarawak. Even within the data from Rieley *et al.* (1995) their minimum and maximum values vary considerably. However it is clear that within Southeast Asia, Indonesia has by far the largest extent of organic soils. The extent of organic soils in Indonesia and Malaysia is given below. The distribution of lowland peats in Indonesia and Malaysia is given in Figure 1.

Table 1. Comparison of estimates of undisturbed peatlands (in million ha) (Rieley *et al*., 1995 and *Tie*, 1990).

Country	Rieley *et al.* 1995 (x 1,000 ha)			Tie, 1990 (x 1,000 ha)
	Minimum (Ha)	Maximum (Ha)	Per cent	
Brunei	0.01	0.01	0.03	0.01
Indonesia	17.00	27.00	82.00	26.20
Malaysia	2.25	2.73	8.28	2.56
Papua New Guinea	0.50	2.89	8.76	0.5
Philippines	0.10	0.24	0.72	na
Thailand	0.07	0.07	0.21	0.8
Total	19.93	32.94	100.00	30.07

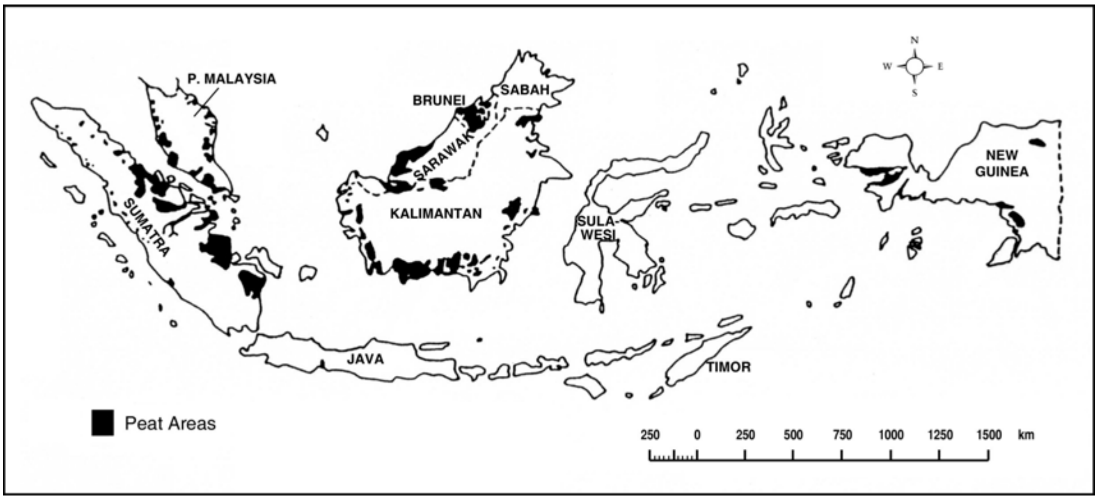


Figure 1. Distribution of lowland peats in Malaysia and Indonesia.

Extent of Lowland Peats in Indonesia

The lowland peatlands of Indonesia are found mainly in Sumatra, Kalimantan and Papua (formerly Irian Jaya). A large proportion of these peatlands consist of ombrogenous and topogenous peats close to the coasts of Sumatra, Kalimantan and Papua. Soekardi and Hidayat (1988) estimate that the total extent of peat in Indonesia to be 18.480 million hectares. Their distribution by Provinces is given in Table 2. According to their estimates 50.4% of Indonesia's peatlands occur in Kalimantan, 24.9% in Papua and 24.3% in Sumatra. Based on a survey of the tidal swamplands in parts of the Sumatra and Kalimantan it was found that 36.2% of the Sumatra and Kalimantan peatlands were shallow (<100 cm deep), 14.0% were of medium depth (100-200 cm) and 49.8% were deep (>200 cm) (Table 3, Radjagukguk, 1991).

Extent of Lowland Peats in Malaysia

The extent of lowland peats in Malaysia is summarized in Table 4, while the land use on these peat areas in Peninsular Malaysia and Sarawak are summarized in Tables 5 and 6. It must be pointed out that some of these data are old and new data needs to be compiled urgently.

Table 2. Extent of peatlands in some provinces in Indonesia (after Soekardi and Hidayat, 1988).

Province	x 1,000 ha	%
West Java	25	<0.1
Acheh	270	1.5
North Sumatra	335	1.8
West Sumatra	31	<0.1
Riau	1,704	9.2
Jambi	900	4.9
South Sumatra	990	5.4
Bengkulu	22	<0.1
Lampung	24	<0.1
West Kalimantan	4,610	24.9
Central Kalimantan	2,162	11.7
South Kalimantan	1,484	8.0
East Kalimantan	1,053	5.7
Central Sulawesi	15	<0.1
South Sulawesi	1	<0.1
Southeast Sulawesi	18	<0.1
Moluccas and others	20	<0.1
Irian Jaya	4,600	24.9
Total	18,480	100.0

Table 3. Distribution of areas of Histosols and peaty soils according to peat thickness in several provinces of Indonesia (Radjagukguk, 1991).

Province	Distribution (%) according to peat thickness (cm)			Total area of Histosol and peaty soils (ha)
	Shallow (0-100 cm)	Medium (100-200 cm)	Deep (>200 cm)	
Riau	8.6	10.7	80.7	486,339
Jambi	33.4	9.3	57.3	168,163
South Sumatra	63.0	11.5	25.5	317,784
West Kalimantan	39.5	34.6	25.9	100,754
Central & South Kalimantan	62.6	19.6	17.8	190,145
Total Sumatra & Kalimantan	36.2	14.0	49.8	1,263,185

Table 4. Extent of organic soils in Malaysia.

Region	State/Division	Total Land Area (Ha)	Extent of Organic Soils	
			Ha	% of State/Division
Peninsular Malaysia (Law and Selvadurai, 1968)	Johore	1,909,886	205,856	10.8
	Kedah	937,712	-	-
	Kelantan	1,497,351	7,880	0.5
	Malacca	164,307	-	-
	Negeri Sembilan	663,730	8,188	1.2
	Pahang	3,584,758	228,644	6.4
	Penang/Province Wellesley	103,929	-	-
	Perak	2,090,827	74,075	3.5
	Perlis	80,974	-	-
	Selangor	840,315	186,602	22.2
	Terengganu	1,289,944	85,537	6.6
	Sub-Total (Peninsular Malaysia):	13,163,733	796,782	6.1
Sabah (Acres *et al.*, 1975)	Sub-Total (Sabah):	7,563,600	200,600	2.6
Sarawak (Melling, 1999)	Kuching	455,955	26,827	0.2
	Samarahan	496,745	205,479	1.7
	Sri Aman	964,699	340,374	2.7
	Sarikei	433,235	172,353	1.4
	Sibu	1,527,590	502,466	4.0
	Bintulu	1,216,621	168,733	1.4
	Miri	2,677,707	314,585	2.5
	Limbang	779,001	34,730	0.3
	Sub-Total (Sarawak):	12,445,000	1,765,547	14.2
MALAYSIA TOTAL:		**25,616,296**	**2,762,929**	**10.8**

Table 5. Extent of peatland developed for agriculture in Malaysia.

Region	State/Division	Total Area of Peat	Area Developed for Agriculture	
			Ha	%
Peninsular Malaysia (1984) (after Abdul Jamil *et al.*, 1989)	Johor	205,856	145,900	70.9
	Kelantan	7,880	2,100	26.6
	Negeri Sembilan	8,188	5,000	61.1
	Pahang	228,644	17,100	7.5
	Perak	74,075	69,700	94.1
	Selangor	186,602	59,900	32.1
	Terengganu	85,537	13,900	16.2
	Sub-Total (P.M.)	796,782	313,600	39.4
Sabah	Sub-Total (Sabah)	200,600	na	na
Sarawak (after Melling *et al.*, 1999)	Kuching	26,827	na	na
	Samarahan	205,479	50,836	24.7
	Sri Aman	340,374	50,836	14.9
	Sarikei	172,353	61,112	35.4
	Sibu	502,466	269,571	53.6
	Bintulu	168,733	47,591	28.2
	Miri	314,585	66,114	21.0
	Limbang	34,730	8,715	25.1
	Sub-Total (Part):	1,765,547	554,775	30.8
MALAYSIA	TOTAL (Part):	2,762,929	868,375	31.4

Table 6. The utilization of peatland for agriculture in Peninsular Malaysia and Sarawak.

Type of crops	Peninsular Malaysia[1] Ha)	Sarawak[2] (Ha)	Total Area (Ha)
Oil palm	146,730	330,669	477,399
Sago	-	64,229	64,229
Rubber	98,143	23,000	121,143
Coconut	29,701	-	29,701
Padi	15,013	2,000	17,013
Pineapples	14,690	1,895	16,585
Mixed horticulture	5,810	908	6,718
Miscellaneous	7,425	369	7,794
Total:	317,512	423,070	740,582

Source: [1] Abdul Jamil *et al.* (1989)
[2] Melling *et al.* (1999)

CHARACTERISTICS OF TROPICAL LOWLAND PEATS

Tropical peats like mineral soils of the tropics are quite different from temperate peats. Tropical peats are formed under quite different climatic and edaphic conditions compared to temperate peats. Temperate peats are mainly derived from the remains of low growing plants (*Sphagnum* spp. *Gramineae* and *Cyperaceae*). Tropical lowland peats, on the other hand, are formed from forest species and hence tend to have large amounts of undecomposed and partially decomposed logs, branches and other plant remains. It can attain an elevation of over 20.7 m found in Loagan Bunut National Park (Melling *et al.I, 2006)* and consist mainly of organic substances with a high acidity (pH 3-4) and ash contents of less than 5%.

Walking in these tropical lowland peat forests can be extremely hazardous as one's feet hardly touch the ground. One has to carefully step on the aerial roots and buttress roots of the current vegetation which tend to form a dense interlocking root mat. Due to this difficulty of walking in these forests most people's experiences of the tropical lowland peats are derived or based on what they observe at the edges of the swamp. Thus most people consider the tropical lowland peats to have a thick luxuriant forest with a high biomass and to be continually waterlogged. Contrary to common beliefs tropical lowland peats are not uniform and are not always under water. These peat forests consist of a lateral variation of vegetation types resulting in a horizontal zonation of forest species and hence above ground biomass as one walks from the edge of the swamp to the centre. These forests are dome-shaped – a fact that is not readily discernible in the field. When one examines a vertical profile morphology of the plant debris making up the forest base, a vertical layering of material with different stages of decomposition and amount of wood or even layers of water can be seen. Thus tropical lowland peats exhibit both a horizontal zonation and vertical layering. Understanding of this zonation and vertical profile layering is critical for the conservation or utilization of these forests. Failure to recognize the structure and zonality of these forests can lead to wrong estimates of the biomass, biodiversity and the role of these forests as a sink or source of greenhouse gas emissions.

Horizontal Zonality of Tropical Lowland Peats

Buwalda (1940), working in Sumatra was probably the first to report that different plant communities exist in the peat swamp forest depending on the thickness of the peat and the distance from the river. Where the peat was more than three metres thick, he reported that the vegetation was poorer than that at the shallow depths. On very thick peat deposits, *Myrtaceae* and *Calophyllum* species with tall slender trunks growing close to one another dominate. In the central or inner parts of the forest, the thickest layers showed a more open vegetation with poorly developed, twisted and stunted trees and scattered pools containing deep brown water with a pH of 3.0 to 3.5. This *Myrtaceae-Calophyllum* forest is rich in *Nepenthaceae* whilst mosses, ferns and *Cyperaceae* cover the soils. On peat deposits shallower than three metres deep, the undergrowth consists of *Araceae*, *Commelinaceae*, *Palmae* (*Zalacca conferata*, *Licula*) and ferns. The soils had a pH of 3.5 to 4.5. Based on these studies in the Indragiri Area, Buwalda reports six different vegetation types with the dominance of one or more species. Similarly Anderson (1961, 1963, 1964) working on Borneo Island (Sarawak and Brunei) described a similar situation.

Ecology of the Tropical Lowland Peat Swamp Forests

In spite of the work of Buwalda (1940) little was known about the ecology of the Peat Swamp Forests in Southeast Asia. Perhaps the most comprehensive and best known study of the ecology of the Tropical Lowland Peat Swamp Forest was carried out by Anderson over a period of ten years in the 1950s (Anderson, 1961, 1963, 1983). Anderson recorded 253 tree species (including 40 small trees which rarely exceed 5-10 m in height in the Tropical Lowland Peat Swamp Forest. Many of these species recorded by Anderson are also found in other forest types outside peat swamp forest. It is also significant to point out that many of the species which are largely confined to the periphery of the Tropical Lowland Peat Swamp Forest also occur in the Lowland Dipterocarp Forest. On the other hand, the species that are present in the forests located in the centre of the swamps are mainly those that are found on the poorer soils, frequently podzols of the heath forest (Anderson, 1963).

The Tropical Lowland Peat Swamp Forests show conspicuous changes in vegetation types from its periphery to the centre of each domed-shaped peat swamp (Buwalda, 1940; Anderson 1961). Anderson who studied these swamps in Sarawak, Malaysia and adjacent Brunei on the island of Borneo had used the term “Phasic Community” (PC) to designate a dominant vegetation zone. Anderson recognized six distinct Phasic Communities or zones on the basis of their floristic composition and structure of the vegetation in each zone (see Table 7 and Fig. 2). They were numbered PC1at the periphery to PC6 in the centre of the Peat Swamp. The main changes that characterize these concentric zonations which are fairly easily seen on aerial photographs have been summarized by Tie (1990) as follows:-

a) An almost complete change in the floristic composition from one zone to another. *Dactylocladus stenostachys* is the only tree species found in all six zones. Amongst the ground flora, only the sedge *Thorachostachyum bancanum* has a similar distribution.

b) A reduction in the number of tree species per unit area and total number of species recorded from the edge to the centre. In sample plots of 0.2 ha, PC1 and 2 had 30-35 tree species (>30 cm girth), PC3 and 4 have about 12-25 species and finally in PC6 less than 5 species occur.

c) A general increase in the number of stems (> 30 cm girth) per unit area. In PC1, it varies between 600-700 per ha, whereas in PC4, 650-850 stems usually occur and in the low dense forest of PC5, the number increased to 1,200-1,350. PC3 is the exception with only 350-600 stems per ha. In the open, stunted forest of PC6 very few stems of more than 30 cm girth are found.

d) A decrease in the average size of a species from the periphery to the centre. *D. stenostachys*, for example, may attain a girth of up to 6 m and a height of 30 m in PC1 but in PC6 it occurs no more than a small tree, usually less than 4 m in height. *Shorea albida* also decreases in size from a girth of up to 8 m and a height of 60 m in PC2 to pole-like in PC4 where they are usually 60-120 cm in girth.

Structure and Development of the Tropical Lowland Peat Swamps

Anderson (1961) also studied the structure of the peat swamps in Sarawak by means of level surveys and borings to the substratum. There is a general rise in elevation in a convex form from the river or coast to the centre of peat swamp. The absolute rise and the convexity at the periphery become more pronounced with distance from the sea. The maximum elevation of 20.7 m above mean sea level was recorded at Loagan Bunut National Park, Sarawak (Melling, 2006) while the most pronounced convexity of the swamp surface was observed at Tanjung Pasir swamp near Marudi. The central raised part of the peat swamp is almost flat with a rise of less than half a metre per kilometer. With the rise in surface elevation, there is sometimes a corresponding fall in the level of the basal mineral materials, usually clays or silty clays, from the river-bank or coast into the swamp centre. This often gives the peat deposit a lenticular cross-section.

Groundwater flow in the peat swamp is apparently confined to the top 1-2 m. The presence of well preserved woody material in the peat deposit below the surface indicates cessation of decomposition and suggests complete stagnation of sub-surface water. Layers of water sometimes as thick as 30 cm can sometimes occur within the peats.

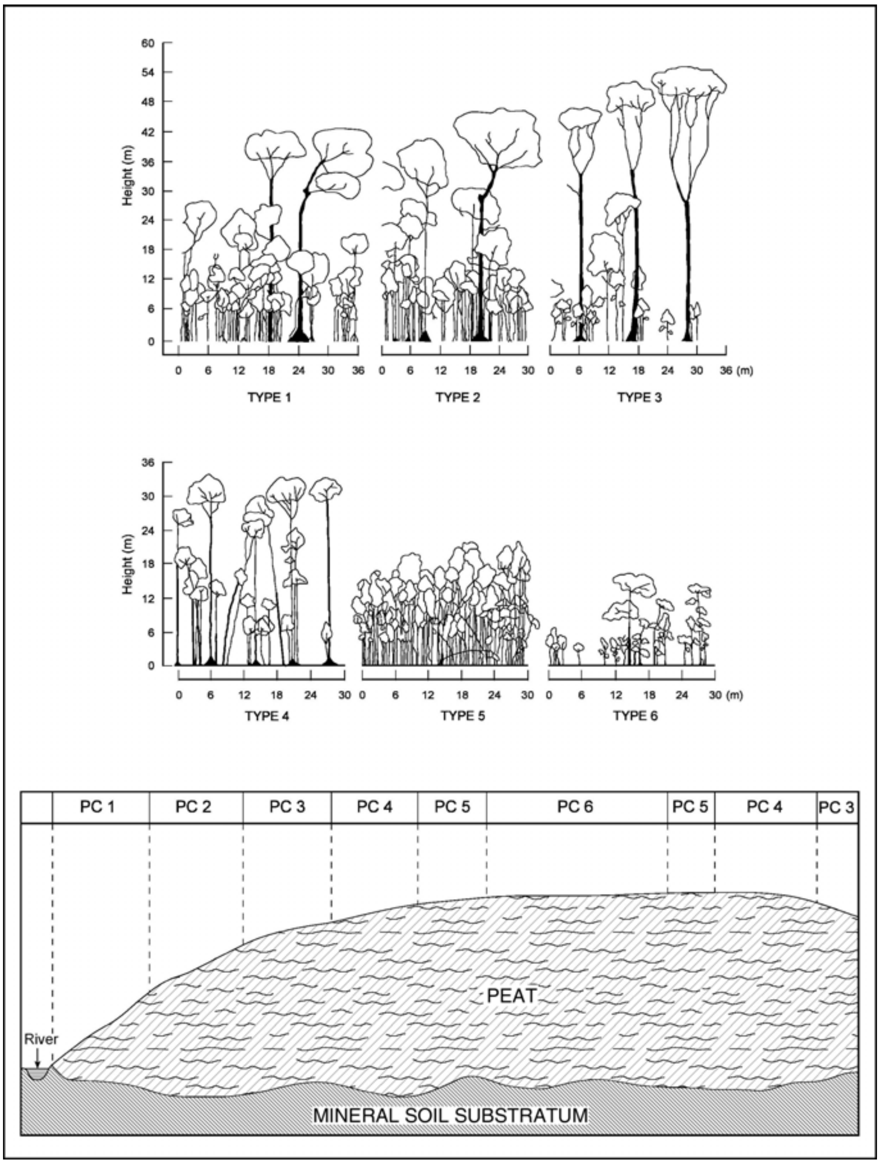


Figure 2. Lateral zonation vegetation in the six phasic communities (after Anderson, 1961).

Source: International PalmOil Sustainability Conference 2008 (IPOSC 2008)

Table 7. Characteristics of the six phasic communities (after Anderson, 1961, 1963, 1983).

PC	Name	Main Tree Species	
		Upper Storey	**Middle-Understorey**
1	Gonystylus-Dactylocladus-Neoscortechinia Association (Mixed Swamp Forest)	*Gonystylus bacanus* (Ramin) *Dactylocladus stenostachys* (Jongkong), *Shorea* spp., *Copaifera palutris*	*Neoscortechinia kingii* *Alangium havilandii*
2	Shorea albida-Gonystylus-Stemonurus Association (Alan Forest)	*Shorea albida*, *Gonystylus bacanus*	*Stemonurus umbellatus*
3	Shorea albida Association (Alan Bunga Forest)	*Shorea albida*	*Tetractomia holttumii*, *Cephalomappa paludicola* *Ganua curtisii*
4	Shorea albida-Litsea-Parastemon Association (Padang Alan Forest)	*Shorea albida*, *Litsea crassifolia*	*Parastemon spicatum*
5	Tristania-Parastemon-Palaquium Association	*Tristania obovata*, *Parastemon spicatum*, *Palaquium cochleariflolium*	Saplings of bigger trees
6	Combretocarpus-Dactylocladus Association (Padang Paya Forest)	*Combretocarpus rotundatus*	*D. stenostachys* *Litsea crassifolia,* *Garcinia cuneifolia*

PC	Emergent height (m)	Girth	Stems* per ha	Species+ per 0.2 ha	Canopy	Other features of trees and ground flora	Occurrence
1	40-50	n.a.#	600-700	30-55	Uneven; multi-storeyed	Structure and physiognomy similar to MDF on mineral soils; many species with pneumatophores, stilt roots and buttresses; *Zalacca conferta* may form dense thickets especially on shallow peats.	Periphery zone of swamps, especially Rajang Delta and near the coast.
2	up to 60	2-4 m, few up to 7 m	n.a.	40-45	Uneven; multi-storeyed	Similar to PC 1 but with scattered very large *S. albida* trees; large trees usually hollow and with stag-headed crowns; *Nepenthes bicalcarata* and *Pandanus andersonii* frequent.	Common; extensive in Rajang Delta.
3	45-60	1-3 m	350-600	10-20, usually <15	Even	Middle storey sparse; lower storey moderately dense; cauliflower-like crowns of *S. albida* distinctive on air-photo; large trees heavily buttressed; *P. andersonii* frequent.	Extensive in Lupar-Saribas and Baram swamps, largely absent in Rajang Delta.
4	30-40	60-120 cm	650-850	10-25	Mainly even; dense	Very slender stems giving pole-like aspect; dense understorey 3-6 m high; *Nepenthes spp.* quite frequent.	Common in central areas of swamps in Rajang Delta and as transition zones in Baram.
5	15-20	mostly <60 cm	1,200-1,350	11-18	Even; dense	Understorey sparse; herbaceous plants largely absent; some pitcher plants.	At transition zones in Baram and Brunei swamps.
6	Few >12	45 cm, few 75-90 cm	Few	<5	Open; shrub-like	Stunted, xeromorphic, with pneumatophores; *Myrmecophytes* and *Nepenthes spp.* numerous; sedge, *Thorachostachyum bancanum* and *P. ridleyi* abundant; sphagnum moss also occurs.	Only in central areas of swamps along middle reaches of Baram River.

* Stems with 30 cm girth or larger; + Tree species with 30 cm girth or larger; # (information) not available.

Hydrology of Tropical Lowland Peat Swamps

The author hypothesizes that the peat basin is actually a hydrologically speaking a 'confined basin' with higher land consisting of levees on two edges, coastal ridges or coastal plain on the seaward site and hills on the landward side. Thus all the water which is already inside the swamp and that which is added on by rains cannot get out until it overflows the levees in periods of very heavy rainfall. In normal rainfall situations the rainwater that is still confined inside the swamp will exert an upward pressure causing the dome to form (see Fig. 3). The heavier the rainfall, and addition of water from the hills, the greater the pressure build-up causing the dome to become more convex inland compared to domes nearer the coast.

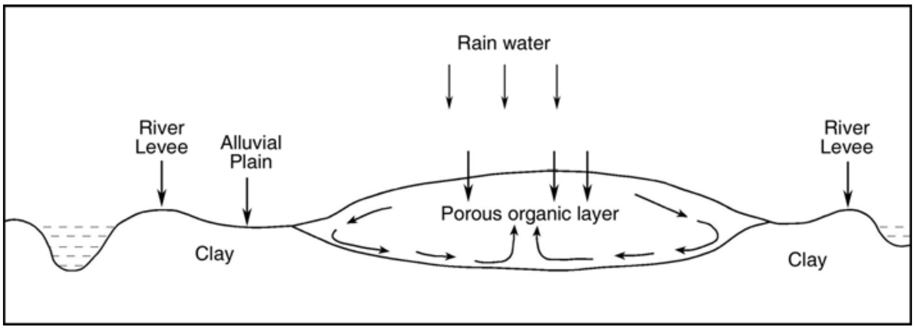


Figure 3. Hydrology of peat swamps.

Peat Types and Profile Morphology

Peat characteristics within a peat swamp vary according to its position. Generally most chemical properties such as exchangeable cations, pH decrease from the edge of the swamp to the centre of the dome. Similarly when one examines the vertical profile morphology of the peat dome a distinct peat profile structure can be seen (see Fig. 4). The organic soil materials making up the profile often change from highly decomposed sapric material in the surface through a partly decomposed hemic material to an undecomposed fibric material at depth. This change corresponds to a decrease of bulk density with depth. Water-filled pores often also thus increase with depth. Logs twigs and branches can occur at any depth within the profile. Hydric (water layers) also can occur within the profile. Thus the types of profile morphology not only varies from one peat swamp to another but also between different locations within an individual peat swamp.

CURRENT ENVIRONMENTAL ISSUES ON PEAT DEVELOPMENT

Due to its very fragile nature any development or disturbance of the peatlands is expected to change the natural ecological balance. Thus many environmental issues ranging from the loss of biodiversity and habitats to loss of above ground biomass can be expected. Loss of carbon in the subsurface by decomposition can also take place. These it is claimed will contribute to greenhouse gas emissions and global warming. How much of these statements are facts and how much of these are overestimates? In this section of the paper these issues will be discussed.

Definition and Extent of Tropical Lowland Peats

A quick review of the extent of tropical lowland peats (Table 1) in the literature shows considerable variation in their extent in different countries. How these values were compiled and the definitions used in the different publications is not fully known. Thus any potential loss of carbon in each country will vary according to the source of information used. The main reasons for this is the lack of proper definition of what is tropical lowland peat. It is recommended that the first thing that needs to be done is to define the terms used so that all future publications should follow these standards. We propose that these definitions be based on the soil temperature regimes and other criteria proposed in *Soil Taxonomy* (Soil Survey Staff, 1975, 1999) and as modified by Paramananthan (1998 and 2008). These are briefly defined below:

Tropical. These areas occur close to the Equator and hence are not expected to experience seasonal variations in temperature. We propose the use of **iso**-temperatures as defined in *Soil Taxonomy* (Soil Survey Staff, 1999) to define this (see Table 8).

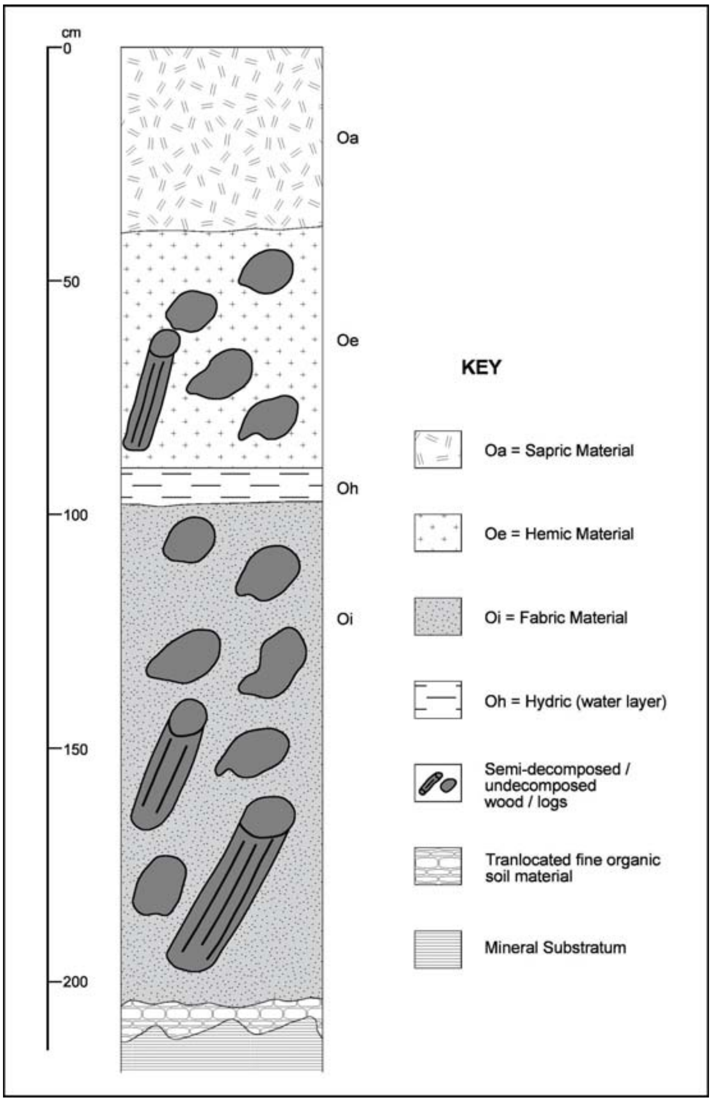


Figure 4. Vertical profile morphology of a peat swamp.

Lowland. The definition of lowlands is related to elevation above mean sea-level. The cut-off elevation will change as one moves away from the Equator. The hyperthermic soil temperature regime can be used to define this (see Table 8). Thus tropical lowlands should have isohyperthermic soil temperature.

Organic Soils (Peat). Before one can define what is an organic soil or peat, a definition of the organic soil materials and a minimum thickness to qualify for an organic soil needs to be made. The definition of organic soil material as proposed by *Soil Taxonomy* (Soil Survey Staff, 1975, 1999) and Paramananthan (1998, 2008) is proposed for adoption to define Tropical Lowland Peats (see Fig. 5 and Table 9). Thus to qualify as an tropical lowland organic soil, a soil should have an isohyperthermic soil temperature regime and have organic soil materials in more than half of the upper 100 cm or more than half of the total thickness of the solum if it is less than 100 cm.

Table 8. Soil temperature regimes.

MSST – MWST (°C)	MAST °C				
	<0	0-8	8-15	15-22	22+
> 5	Pergelic	Cryic Frigid	Mesic	Thermic	Hyperthermic
< 5	-	Isofrigid	Isomesic	Isothermic	Isohyperthermic

***Notes*:**
1. Soil temperature measured at 50 cm below soil surface or at a lithic/paralithic contact, whichever is shallower.
2. MAST = Mean annual soil temperature
   MSST = Mean summer soil temperature
   MWST = Mean winter soil temperature
3. Frigid regime has a mean summer temperature > 8°C

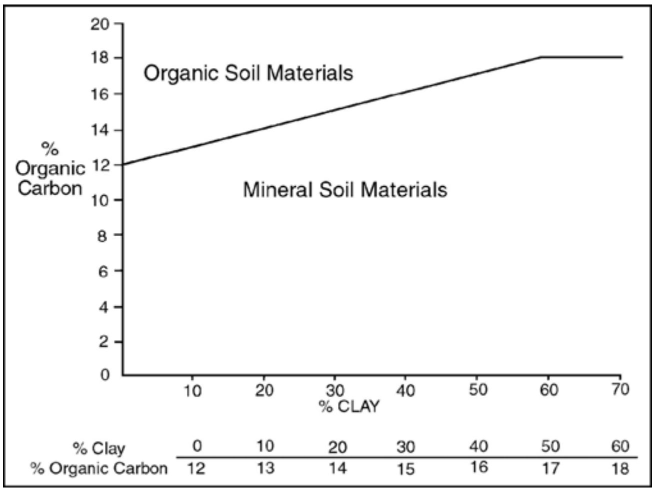


Figure 5. Definition of organic soil materials.

Table 9. Definition of an organic soil.

1.	Organic soil layers make-up more than half the total cumulative thickness of the upper 100 cm.
2.	The depth to bedrock is between 50 to 100 cm and the total thickness of the organic soil layers taken cumulatively is equal to or more than half the depth to bedrock.
3.	The depth to bedrock is less than 50 cm and the total thickness of the organic soil layers taken cumulatively is more than half the depth to bedrock.

Loss of Biodiversity and Habitat

Some environmental groups claim that the clearing of peatlands result in a loss of biodiversity and a loss of habitat for some indigenous flora and fauna (Parish and Looi, 1999). These Groups' claim that these peatlands have a large variety of fauna and flora endemic to these areas. However a review of the literature suggests that the most diverse part of the peat swamp is the mixed peat swamp forest (PC1) and this is similar if not less diverse that the Lowland Dipterocarp Forest on the lowland mineral soils (Anderson, 1963). Buwalda

(1940) and Anderson (1961, 1963 and 1983) confirm that both the biodiversity and biomass significantly decreases from the edge of the peat swamp (PC1) to the centre of the dome (PC6) (see Fig. 2). Some publications use the number of species in the mixed peat swamp forest (PC1) to claim high loss of biodiversity in these peat swamps on land clearing.

Peat swamps are also supposed to be a habitat of endangered fauna and flora. Often mentioned fauna are the *Orang Hutan (Pongo pygmaeus)* and the *Sumatran Tiger (Panthera tigris Sumatranus)* and even elephants *(Elephas maximus Sumatrensis)* (Parish and Looi, 1999). It must be remembered that the peat swamps are not the original habitats of these animals – the Lowland Dipterocarp forests are. A tiger or *orang utan* or an elephant, would not want to live in these unsuitable and unfriendly environments if it has a choice. Even the local native population that live in these swamps only manage to eke out a living collecting wood and catching fish. Good drinking water is difficult to find. Should not these native people be lifted out of this life and out of the poverty zone if they so desire? Are the claims of loss of biodiversity and habitats over-exaggerated? Both Indonesia and Malaysia have designated large areas of forests as wildlife sanctuaries and have set-up sanctuaries for *orang hutans*, tigers and elephants. Are these areas adequate?

Estimates of Above Ground Biomass and Potential Loss of Carbon

Most calculations of the potential loss of above ground biomass and hence the potential loss of carbon sink of peat swamps are based on one value of carbon based on the mixed peat swamp forests. Silvius and Diemont (2007) estimate that the tropical peat swamps in SE Asia store at least 150,000 Million tonnes (MT equivalent in soil carbon). The amount of carbon stored in tropical peatlands has been estimated by Page and Banks (2007) (see Table 10). Hooijer *et al.* (2006) estimate that the SE Asia peatlands (Indonesia, Malaysia, Brunei and Papua New Guinea) store at least 42,000 Mt (assuming carbon content of 60 kg/m^3). Firstly these estimates do not take into consideration the six phasic communities and the reduction in biomass from the edge to the centre. It is apparent that there is a big difference not only in the above ground biomass but also in the tree species from the edge of the peat swamps to the centre (see Fig. 2). Thus there will also be a reduction in the potential above ground carbon storage. The estimates of above ground biomass and potential loss of carbon are over estimates that do not relate to field conditions. One must also remember that an area is only developed to agriculture **after** logging has taken place and the above ground biomass reduced drastically. Further it must be remembered that any development be it urban, soyabean, rape seed or oil palm from forest significantly reduces the above ground biomass. The planting of oil palm replaces some of this biomass much more than soyabean or rape seed. It is also important to remember that logging does not mean a complete loss of carbon as these logs which are removed are converted to furniture, houses etc. and remain as carbon – not a complete loss. Both Indonesia and Malaysia have designated large areas of forest reserves including peat swamps. Some environmental groups also propose that areas of peatlands already planted with oil palm to be replanted with forest. Is this practical or useful? The rate of regeneration of degraded peatlands is extremely slow while oil palm can increase the biomass much more quickly and hence improve the carbon sink while at the same time help supply vegetable oils and biofuels. During the slow regeneration period to forest, the peat surface will be exposed to decomposition and CO_2 emissions.

Estimates of Below Surface Carbon Storage and Carbon Cycle

Most estimates of the organic carbon content in peat swamps e.g. Hooijer *et al.* (2006), only consider the extent of the peat swamp, its depth, bulk density and carbon content 60 kg C/m^3 to estimate the total carbon stored in the peat swamps. They use only one value for the bulk density and carbon content and assume that it does not change with depth. They do not take into consideration the actual vertical layering present in these tropical lowland peat swamps. The changes from sapric to hemic to fibric content with depth, the presence of logs and water layers in these swamps are not considered. In fact in these peat swamps both in their natural state and when they are cleared for agriculture a carbon cycle operates. Carbon is lost both laterally as organic sediment and organic acids and some through decomposition from the surface. The translocation and deposition of the fine organic soil materials at depth is also common (see Fig. 6).

Table 10. Maximum and minimum areas of tropical peatland (km^2) from selected sources. In order to illustrate how differences in area and peat thickness influence calculations of the amount of carbon stored in tropical peatlands two estimates are provided based on: (i) The minimum area value and a peat thickness of 1 m and (ii) the maximum area value and a thickness of 2 m (In each case 60 kg/m^3 is used for the volume density of carbon) (After Page and Banks, 2007).

	Area (km^2)		Mass C (Gtonnes)	
	Min.	Max.	Min.	Max.
Africa	26,607	88,657	1.596	10.639
Asia (Mainland)	622	6,245	0.037	0.749
Central America	14,465	25,935	0.868	3.112
Pacific	190	21,240	0.011	2.549
South America	37,136	96,380	2.228	11.566
Brunei	100	1,000	0.006	0.12
Indonesia	168,250	270,000	10.095	32.4
Malaysia	22,500	27,300	1.35	3.276
Papua New Guinea	5,000	28,942	0.3	3.473
Philippines	60	2,400	0.004	0.288
Thailand	394	680	0.024	0.082
Vietnam	100	1,830	0.006	0.22
Asia (Southeast) Total:	196,404	332,152	11.784	39.858

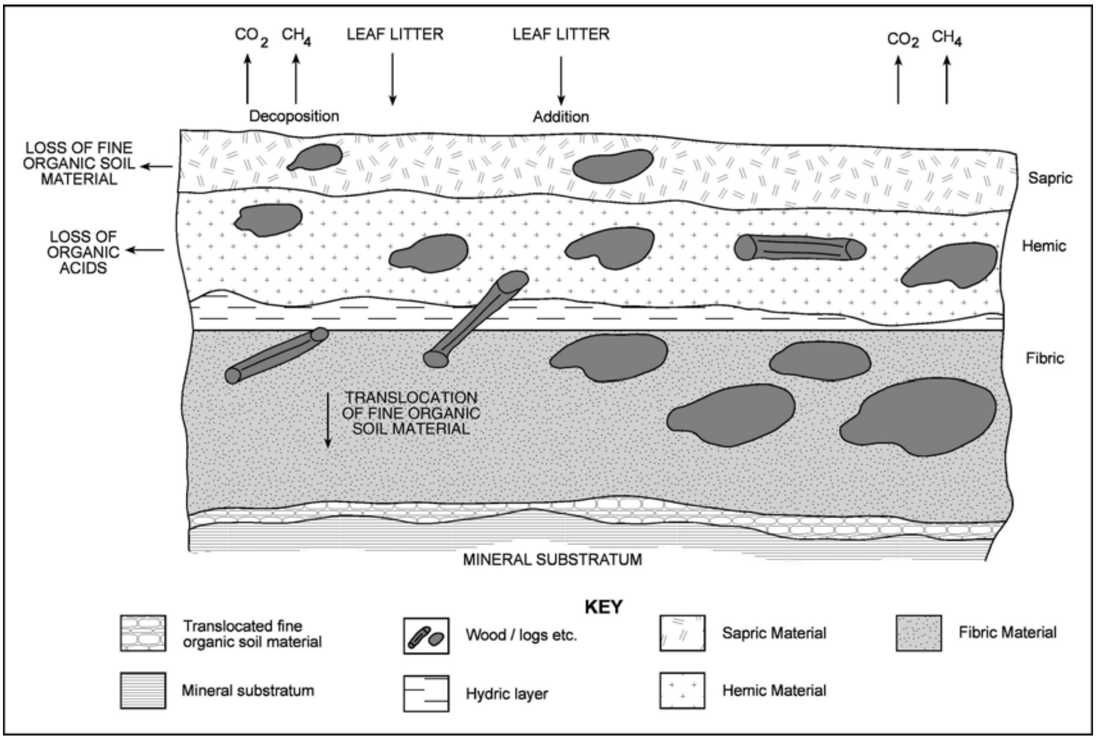


Figure 6. Carbon cycle in peat swamps under natural conditions and with oil palm.

It is our opinion that most estimates of the below ground carbon stored in the peat swamps has been overestimated for the following reasons:

- layering of the material – sapric/hemic/fibric.
- presence of different types and size of wood materials with their different decomposition rates.
- bulk density changes with depth and difficulties of measuring it.
- presence of water layers in these swamp with no carbon.
- lateral movement of carbon-rich peat waters laterally out of the system.
- lateral and downward movement of fine sapric material within the swamp into waterways/canals and to the underlying mineral substratum.

Hydrology and Peat Subsidence

It has been shown earlier (Fig. 3) that the peat domes have a closed hydrological regime most times of the year except in the rainy seasons when overflow from the rivers and excess rain can cause flooding to the surrounding areas. Some environmental groups contend that drainage of these peat swamps upsets this closed system resulting in decomposition, consolidation and subsidence of the peats. This is true as any drainage will upset this closed system. However it must be remembered that this system of drainage with no controls was practiced in the early 1960s till around 1990s. For example Salmah (1992) states the following:

> *"………….. drains in the West Johore Integrated Agricultural Development Project were designed using criteria heavily influenced by the requirement for a flood free environment."*

Such practices obviously result in excessive shrinkage of the peat as the closed system was no longer maintained. Today however when peat swamps are drained for agriculture proper water management is practiced. Water is controlled using control structures to maintain water levels at 40-60 cm below the surface thereby retaining the closed system and hence minimizing the subsidence.

Some of the literature (e.g. Wosten *et al.* (1997); Worsten and Ritzema, 2007) report peat subsidence rates of 100 cm in the first two years and a further 2-5 cm per year subsequently. The data obtained and frequently quoted by Worsten comes from the same West Johor Project quoted above by Salmah. No water control was practiced in this area for almost twenty years resulting in excessive shrinkage and subsidence due to overdrainage. No data are given to show that this has also resulted in decomposition. Most environmental groups also assume that this subsidence means that carbon has been lost. Subsidence **does not** mean and is never equal to decomposition. Kool *et al.* (2006) working in Central Kalimantan have shown that during logging practices a 2.2 to 4.0 m subsidence in the peats only results in 2.3-46.9 cm of decomposition. Even this does not take into consideration that some of the fine initial breakdown products are moved laterally into the drainage channels or settle at the base of the organic layer as shown earlier as part of the carbon cycle in peat swamps. Kool *et al.* (2006) conclude that compaction appeared to be more important factor compared to decomposition in the loss of the dome structure. Subsidence is actually due more to consolidation and compaction.

It is clear therefore that most estimates of subsidence and assumed loss of carbon as carbon dioxide are overestimates. There is therefore an urgent need collect more data on these matters under current water management systems.

Worsten *et al.* (1997) claim that with a subsidence rate of 2 cm per year it will take 75 years for the shallow peat soils (<150 cm depth) to disappear. If their claims are true then many of the early plantings of oil palm and other crops on peat in the 1960s e.g. United Plantations in Perak are no longer on organic soils. This is not the case. Even if as they claim such subsidence and decomposition exposes the underlying acid sulfate soils – these are not a problem as in Malaysia with water management and control these 'problem soils' actually produce high yields of oil palms today. Most peat areas except for those near the coast do not necessarily have acid-sulfate clays as their substratum. Such soils are very localized. When many peat swamps begin to be formed over marine or brackish water deposits (sulfidic material) these quickly change to riverine or non sulfidic material as the depth of peat increases (Andriesse, 1961; Tie, 1990).

From the above discussion it is clear that some environmental groups are using outdated and incomplete data in their estimates of subsidence and decomposition. They refer to data obtained from outdated practices used in the past when drainage without water control has been practiced. Further they equate subsidence to decomposition and hence GHG emissions. There is a need for them to reassess the data in line with current water management practices and recent findings on subsidence and decomposition and GHG emissions.

Green House Gas Emissions

Development of tropical lowland peat swamps, some environmental groups claim, result in subsidence, decomposition and emissions of greenhouse gases which contribute to global warming and climate change. These environmental groups claim that 50-100 tonnes of CO_2 are emitted annually from oil palm planted on peatlands (Silvius, 2007). However Melling *et al.* (2005a, b) have compared the GHG Fluxes (CO_2 and CH_4) in natural peat swamps, sago and oil palm cultivated on peats. The results of Melling *et al.* (2005a, b) seems to contradict what the environmental groups have been claiming. As discussed earlier some of the data used by the environmental groups are outdated or overestimates. Melling *et al.* (2005a, b) however also fail to fully explain why their results may be correct although it upsets current thinking on GHG emissions on peatlands.

In a natural peat swamp most workers assume that these areas are continuously under water. Thus in their natural state they give out mostly CH_4 and little CO_2. It is clear that the new data on peat swamps indicates that watertables in the dry season can be below one-metre and thus decomposition of this exposed layer can take place possibly releasing a lot of CO_2. In an oil palm estate on peat which controls watertables at 40-60 cm throughout the year the peat remains moist up to the surface minimizing the production of CO_2. This probably explains why more GHG are released from a natural peat swamp compared to oil palms planted under water-control regimes. It must however be remembered that in prolonged drought periods even the oil palm estates may not be able to maintain the watertable at 60 cm and hence large amounts of CO_2 maybe emitted but in such situations one can also expect to have higher emissions of CO_2 even from the natural peatlands.

It is clear that more studies such as those carried out by Melling *et al.* (2005a, b) need to be carried out to fully quantify the GHG emissions on natural peatlands and other crops grown on peat. Such studies however should include emissions from the whole ecosystem.

Peat Fires

When prolonged droughts occur peatlands become dry and can become a tinderbox resulting in fires. This then results in haze which cause inconvenience not only to the surrounding areas but also to the neighbouring countries. Haze results loss of visibility, lung infections etc. Peat fires can destroy completely the peat forest and result in large emissions of GHG. The environmental groups claim that the clearing of peatlands for oil palm cultivation has increased the incidences of peat fires in these areas.

The oil palm industry has for the last five to ten years practiced a 'no burn' policy in all their plantations be it on peatlands or uplands. Most plantations today stack their trash in the interrows and do not burn. Of course a lack of enforcement may result in some areas being burnt. Today no estate manager in his right mind would burn his trash as with satellite imagery he is soon caught and dealt with by the law. Why then do peat fires persist, especially in Indonesia?

In Indonesia most plantations are close to, if not adjacent to subsistence smallholders who practice shifting cultivation. They clear and burn their land annually for the planting of food crops. If they do not do this, they do not have food for their family. So for these farmers – slash and burn or no food. In peat areas where slash and burn are also practiced, the fires inevitably spread to neighbourng oil palm estates. These estates are often then wrongly blamed for starting the fires. The fires in the Estate can be easily picked-up on the satellite imagery.

NEED FOR NATIONAL PEATLAND POLICY

Currently both Malaysia and Indonesia do not have a National Peatland Policy. Consequently decisions to develop these lowland peats have been made without proper assessment of this important sensitive resource. For example, the State Government of Sarawak, Malaysia decided that out of the total of 2.7 million hectares of lowland peatland in the State, 1.0 million hectares will be developed to agriculture; mainly oil palm (DID, 2001). Such a development, it is hoped, will help uplift the State's economy and eradicate rural poverty by generating income through better employment in the proposed agricultural enterprises. How these 1.0 million hectares are to be selected and alienated is not fully clear. The current alienation appears to be haphazard. This same situation probably applies to Indonesia. In Indonesia, a Presidential Decree (No. 32/25) July 1990 has restricted the development of peatlands to areas with a peat depth of less than three metres. The scientific or environmental basis for this restriction is not clear. In spite of these problems large areas of lowland peats in Malaysia and Indonesia have been logged and subsequently planted to oil palm over the last 15 years.

Based on the current situation, it is clear that there is an urgent need to reevaluate the basis for development of tropical lowland peats. There is therefore an urgent need to carry out a peatland resource inventory and evaluation of all tropical lowland peatlands – particularly in Indonesia and Malaysia. Such an inventory is required to help formulate a National Peatland Policy. This will also assist Governments to make decisions on whether a particular peat swamp is to be conserved or developed. Such a decision will require data on the current status of the land, its current land use, hydrology, wildlife etc.

The countries with large areas of tropical lowland peat swamps are faced with a dilemma – to conserve or to develop these peatlands. On the one hand, it is claimed that development of these peatlands upsets the hydrological balance and results in shrinkage and decomposition of the organic matter releasing carbon and contributing to global warming. These environmentalists also claim that the clearing of these peatlands results in a loss of biomass and biodiversity and often a loss of habitats of endangered species such as the *orang hutan* and the *Sumatran tiger*. On the other hand the Governments claim that increasing population and pressure for land development and the need to eradicate rural poverty requires that more land be cultivated to agriculture to produce food and oils for the ever increasing population. The need to replace the use of fossil fuels by the more environmentally friendly biofuels is also often another important consideration. It therefore appears that there needs to be a balance or compromise between these two extreme views.

Uniqueness of Individual Peat Swamps

When considering whether a particular peat swamp should be conserved or developed, it is firstly important to recognize that the whole of the individual swamp should be studied as a single contiguous unit. This is because each peat swamp basin has it own hydrological characteristics which are unique to it. Thus the zonality of vegetation, the hydrology and other related properties for one particular swamp basin is unique and may be completely different from another swamp. Some of the failures in past developments are partly due to attempts to develop part of the peat basin and trying to conserve the rest. For example to develop say, 10,000 ha of a peat basin totalling 100,000 ha. The development of this small part of a peat basin can and will have an effect on the remaining part of the peat swamp. It may be difficult if not impossible for the developer of the 10,000 ha to control the watertable without due consideration of the whole 100,000 ha. It is for this reason that the development in the West Johor Agricultural Project and the Hutan Melintang Smallholder Development Projects were more successful. Thus any decision to conserve or develop any particular peat swamp must only be made after an integrated study of the whole of that individual swamp has been completed and the results assessed.

Assessment of Individual Peat Swamp Areas

As mentioned earlier each individual peat swamp has its own environmental and hydrological integrity which differentiates it from the next. Therefore the assessment of each swamp should be treated separately. The criteria and characteristics that need to be studied for each peat swamp area (PSA) can be divided into the following broad groups (see Table 11).

- Definition and Extent of Peat Swamp Area
- Current Status and Existing Land Use in Peat Swamp Area
- Socio-economic Status in Peat Swamp Area
- Wildlife within the Peat Swamp Area
- Vegetation within the Peat Swamp Area
- Hydrology of the Peat Swamps area and surrounding areas
- Topography
- Soils of the Peat Swamp Area and the surrounding areas
- Potential GHG gas emissions of individual Peat Swamp Area

The evaluation of the land resource characteristics for the conservation or development of an individual peat swamp unit is given in Table 12. This evaluation uses the Framework for Land Evaluation (FAO, 1976). Once the data has been collected the decision making process is given in Figure 7. If oil palm is to be planted then the criteria to be used for evaluation for cultivation of oil palm is given in Table 13. The Guidelines to be followed if oil palm is to be cultivated is given in Table 14.

Table 11. Recommended studies for assessment of individual peat swamp areas.

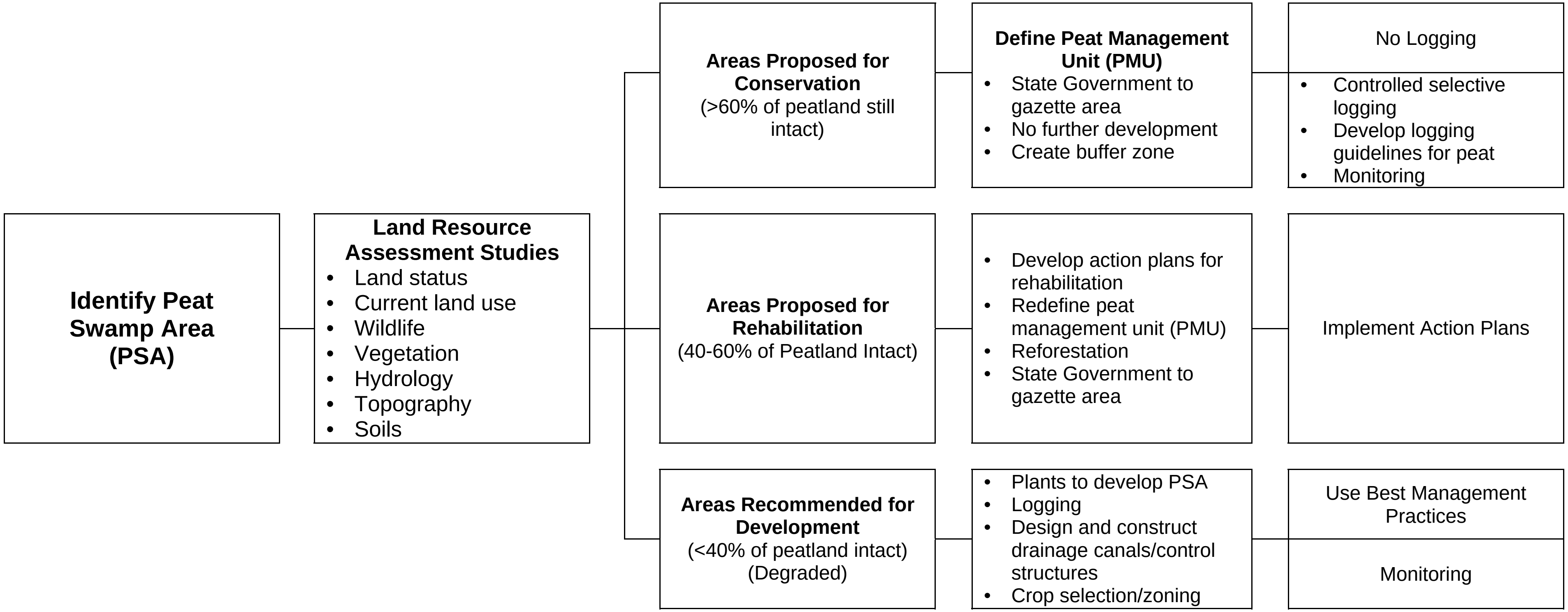
No.	Activity	Description	Final Product
1	Definition of PSA	Demarcate boundary of PSA (Name and Hectarage)	• Map showing defined PSA.
2	Current Status and Land Use	**Status:** • Determine land status e.g. Forest Reserve (logged/unlogged) • Alienated land • Native title land **Land Use:** • Delineation of land use categories • Identify areas destroyed by fire • Planted areas	• Map showing land status of PSA • Map showing current land use in PSA
3	Socio-Economic Survey	• Population, income levels • Dependence on PSA for livelihood • Desire for change	• Population density • Income levels • People's aspirations
4	Wildlife Survey	**Wildlife population:** • Mammals, birds, fishes etc. • Presence of endangered species	• Wildlife population statistics • List of endangered species
5	Vegetation Survey	• Vegetation survey phaesic communities (PC) • Medicinal plants • Endangered plants • Estimate of above ground biomass	• Presence of endangered flora • Biodiversity • PCs present in PSA • Existing biomass
6	Hydrology	• Hydrological surveys • Watertable monitoring over 1-2 years	• Depth and fluctuation of watertable over time • Drainability of PSA
7	Topography and Soils	• Surface and subsurface topography • Characterization of soils • Depth of peat • Soil chemical and physical characterization • Bulk density	• Soil map of PSA • Estimate carbon in subsurface • Physical and chemical characteristics
8	Green House Gas Emissions	• Monitoring of GHG emissions over different PCs	• GHG emission for PSA

LAND SUITABILITY EVALUATION

Once a decision has been made that a particular peat swamp area should not be conserved but that it should be developed, an evaluation of the different crops that can be planted has to be made. Currently the three most common plantation crops that have been planted on lowland peats in the tropics are oil palm, acasia and sago. Thus there is a need to evaluate the suitability of the crop proposed to be cultivated in the area. The common practice is to plant the whole of the PSA with a single crop if it is found suitable. Alternatively crop zones within the peat swamp area can also be considered if the watertable levels to be used for the different crops are compatible. It is best that any crop to be planted should be on an estate basis as peats are considered to be problem soils. Smallholders do not have the financial and technical capacity to manage crops on peats. Small areas of vegetables are alright but large areas are beyond their capacity and more damage may be caused.

Table 12. Evaluation of land resources characteristics for the conservation of a peat swamp area.

Land Resource Characteristic	**Highly Suitable (S1)**	**Moderately Suitable (S2)**	**Marginal Suitable (S3)**	**Currently Unsuitable (N1)**	**Permanently Unsuitable (N2)**	**Remarks**
Current Land Status						
Forest Reserve (%)	>80	60-80	40-60	20-40	<20	Extent of FR within PSA
Alienated Land (%)	<20	20-40	40-60	60-80	>80	Extent of alienated land in PSA
Current Land Use						
Permanent Crops (%)	<20	20-40	40-60	60-80	>80	Existing Plantation Crops
Cash Crops (%)	<40	40-60	60-80	>80		Extent of smallholders
Fire Damage (%)	<20	20-40	40-60	60-80	>80	Assessed over whole PSA
Wildlife						
Presence of Endangered (%)	>80	60-80	40-60	20-40	<20	% of PSA
Wildlife Population	>80	60-80	40-60	20-40	<20	% of PSA
Vegetation						
Area occupied by PC (5+6)	<20	20-40	40-60	60-80	>80	PC5+6 have low biomass
Presence of Endangered Plant Species (%)	>80	60-80	40-60	20-40	<20	% of PSA having endangered species
Hydrology						
Length of Dry Season (months)	$\geq$3	2-3	1-2	No dry months	-	Susceptibility for fires
Overall Suitability for Conservation	<20	20-40	40-60	60-80	>80	Worst rating over whole of PSA
Decision	Conserve		Rehabilitate	Develop		



Source: International PalmOil Sustainability Conference 2008 (IPOSC 2008)

Figure 7. Flow chart showing decision making and action plans for the conservation/development of Tropical Lowland Peats.

Table 13. Evaluation of peatland characteristics for oil palm cultivation (Estate-level management).

Peatland Characteristic	Highly Suitable (S1)	Moderately Suitable (S2)	Marginal Suitable (S3)	Currently Unsuitable (N1)	Permanently Unsuitable (N2)	Remarks
Climate						
Total Annual Rainfall (mm)	2,000-2,500	2,500-3,000	3,000-3,500	3,500-4,000	>4,000	Too high flooding/hampers field operations
		1,500-2000	1,300-1,500	1,000-1,300	<1,000	Low rainfall susceptibility to fire hazard
Dry season (months)	<1	1-2	2-3	3-4	≥4	Long dry period – fires
Mean Annual Temperature (°C)	+25	22-25	20-22	18-20	<18	
Topography						
Slope (%)	<0.1	0.1-0.3	0.3-0.5	-	-	
Phasic Community	PC1	PC2 PC3	PC4	PC5 and PC6	-	Very low BD in PCs 5 and 6
Wetness						
Drainability	Already drained	Easily drained	Moderately difficult to drain	Difficult to drain	Very difficult to drain	
Flooding	Not flooded	Occasional flooding	Short term shallow	Short term deep	Long term deep	Hamper field operations
Physical Soil Conditions						
Surface Woodiness (%)	<10	10-30	30-40	40-50	>50	% of surface with wood stumps (PC3-4)
Surface Wood Litter (%)	<25	25-50	>50			% of surface with wood litter (PC2-4)
Organic Soil Material Class	s/t, s, s/h	s/f, h, h/f, f, t/w	s/w, h/w, f/w,	w	-	t = terric, s = sapric, h = hemic, f = fibric, w = woody
Soil Fertility Conditions						
Soil Fertility Characteristics	Moderate	Low				Surface 50 cm
Salinity (dS/m) 50 cm	0-1	1-2	2-3	3-4	>4	

Table 14. Guidelines for the development of Tropical Lowland Peats (oil palm).

1.	Construct main canals with control structures (Government)
2.	Log area (by contract) (Monitoring)
3.	Construct secondary drains with controls (wait at least one year)
4.	Land alienation, land clearing and stacking (no burning)
5.	Compaction of planting lines and planting
6.	Construction of tertiary drains and roads/rails
7.	Monitoring • Ensure water-level maintained at 40-60 cm below surface • Regular desilting of drains • Fire hazards in dry season

It is recommended that the FAO's Framework for Land Evaluation (FAO, 1976) be used to evaluate the suitability or otherwise of a crop to be planted on lowland peats. The key to the use of this Framework is to develop a table which evaluates the land characteristics which influence the performance of the crop considered when planted on tropical lowland under different levels of management. An attempt has been made here to do this for oil palm cultivation under estate level management (see Table 13). In the case of peatlands, strict additional guidelines for the development of these areas for agricultural development must be prepared and enforced. This is to ensure that any subsidence and decomposition is minimized. Tentative Guidelines for the sustainable planting of oil palm on peats is given in Table 14. Once these Guidelines are enforced strictly the decomposition and subsidence of the peat can be minimized. It is our opinion that with such Guidelines and their enforcement, areas already cultivated with oil palm can be replanted. A similar set of Guidelines can be developed for the different crops such as sago and acasia.

IMMEDIATE ACTIONS REQUIRED

It is clear that tropical lowland peats are a fragile ecosystems. In spite of this the need to eradicate rural poverty has resulted in large areas of peatlands being developed. The lack of understanding of this problem soil has resulted in many dismal failures. Today however with our better understanding of these soils, some success has been achieved. However as some environmental groups claim, the drainage of these swamps results in subsidence and decomposition of the peatlands with the resultant release of CO_2. Unfortunately some environmental groups have used incomplete or outdated data in their claims. There is a great dearth of reliable data particularly for tropical lowland peats. The correct approach therefore is to quickly improve the data base we have on these soils so that a more reliable picture can be obtained. Thus some immediate actions need to be taken to solve this problem. Among the action that needs to be taken are:

- Immediate moratorium on alienating new peat areas for development.
- Areas already alienated but not yet developed be 'put on hold' until the area is evaluated or a new land be offered as an alternative.
- Quickly initiate a programme to collect data on the peat resources of the country and to formulate a National Peatland Policy.
- Perhaps, in this context the most important step is to identify the individual peat swamp areas and to characterize them and their current land use and land status.
- More data on GHG emissions from natural peat areas and areas with different crops be collected using the whole canopy method.

Without such data all the detrimental effects of developing peatlands and its effects on global warming will continue to be highlighted.

REFERENCES

Abdul Jamil, M.A., Chow, W.T., Chan, Y.K. and Siew, K.Y., 1989. Land use of peat in Peninsula Malaysia. *Bengkel Kebangsaan Penyelidikan dan Pembangunan Tanah Gambut*, 21-22, 1989. MARDI Selangor.

Acres, B.D., Bower, R.P., Burroughs, P.A., Folland, C.J., Kalsi, M.S., Thomas, P. and Wright, P.S., 1975. *The Soils of Sabah. Vol. 1-5*. Land Resources Study 20. Land Resources Division, Min. Overseas Development, England.

Anderson, J.A.R., 1961. *The ecology and forest types of the peat swamps forests of Sarawak and Brunei in relation to their siviculture*. Ph.D. Thesis, Univ. of Edinburgh, U.K.

Anderson, J.A.R., 1963. The flora of the peat swamp forests of Sarawak and Brunei, including a catalogue of all recorded species of flowering plants, ferns and fern allies. *Gardens' Bulletin*, *Vol. XX*, *Part II*, 131-228.

Anderson, J.A.R., 1964. The structure and development of the peat swamps of Sarawak and Brunei. *J. Trop. Geography*, *18*, 7-16.

Anderson, J.A.R., 1983. The tropical peat swamps of Western Malesia. *In:* A.J.P. Gore (Ed.), *Ecosystems of the World, Vol. 4B, Mires: Swamp, Bog, Fen and Moor*. Elsevier Scientific Pub. Co. Amsterdam 6, 181-199.

Buwalda, P., 1940. Bosverkenning in de Indragirische Bovenlanden. Rep. For. Res. Sta, Bogor, Indonesia (unpub.) (Quoted by Polak, 1975).

Drainage and Irrigation Department (DID), 2001. *Water Management Guidelines for Agricultural Development in Lowland Peat Swamps in Sarawak*. Drainage and Irrigation Department, Sarawak, Min. Rural and land Development, Kuching, Sarawak, Malaysia.

Food and Agriculture Organisation (FAO), 1976. A Framework for Land Evaluation. *Soil Bulletin 32*, FAO, Rome.

Gurmit, S., Tan, Y.P., Padman, C.V. Rajah and Lee, L.W., 1986. Experiences on the cultivation and management of oil palms on deep peat in United Plantations Berhad. *In: Proc. 2nd. Int. Soil Management Workshop*. Thailand/Malaysia, 7-8 April, 1986.

Hooijer, A., Silvius, M., Wosten, H. and Page, S., 2006. PEAT-CO_2 Assessment of CO_2 emissions from drained peatlands in SE Asia. Delft Hydraulics report Q3943 (2006).

Kool, D.M., Buurman, P. and Hoekman, D.H., 2006. Oxidation and compaction of a collapsed peat dome in Central Kalimantan. *Geoderma*, *137*, 217-225.

Law, W.M. and Selvadurai, K., 1968. The 1968 Reconnaissance Soil Map of Peninsular Malaysia. *Proc. 3rd Malaysian Soils Conference, Kuching, Sarawak*. Dept. of Agriculture, Sarawak.

Melling, L., 1999. Sustainable Agriculture Development on Peatland. Paper presented at the Workshop on 'Working Towards Integratged Peatland Management for Sustainable Development', 17-18 August 1999, Kuching, Malaysia.

Melling, L., Hartono, R. and Goh, K.J., 2005a. Soil CO_2 flux from three ecosystems in tropical peatland of Sarawak, Malaysia. *Tellus 57B, I-II*.

Melling, L., Hartono, R. and Goh, K.J., 2005b. Methane fluxes from three ecosystems in tropical peatland of Sarawak, Malaysia. *Soil Biology & Biochemistry, 37(2005)*, 1445-1453.

Melling, L., Lau, J.U., Goh, K.J., Hartano, R. and Osaki, M., 2006. Soils of Loagan Bunut National Park, Sarawak, Malaysia. Final Report, Peat Swamp Forests Project MAL/99/G31, UNDP, GEF, Jabatan Pertanian, Malaysia.

Page, S. and Banks, C.J., 2007. Tropical Peatlands: Distribution, Extent and Carbon Storage – Uncertainties and Knowledge Gaps. *In: Tropical Peatlands, PEATLANDS International 2/2007*.

Paramananthan, S., 1998. *Malaysian Soil Taxonomy – Second Approximation*. Mal. Soc. of Soil Science and Param Agric. Soil Surveys. October 1998, Serdang Malaysia.

Paramananthan, S., 2008. *Malaysian Soil Taxonomy – Second Edition* (In press).

Parish, F. and Looi, C.C., 1999. Southeast Asia Peatland Action Plan and Management Initiative. *Proc. Int. Conf. and Workshop on Tropical peat Swamps "Safe-Guarding a Global Natural Resources"*, 27-29 July, Univ. Science Malaysia, Penang, Malaysia.

Radjagukguk, B., 1991. Utilisation and management of peatlands in Indonesia for agriculture and forestry. *In:* Aminuddin, B.Y. *et al.* (Eds.), *Proc. International Symposium on Tropical Peatland, Kuching, Sarawak*. MARDI, Serdang, Malaysia, 21-27.

Rieley, J.O., Page, S. and Sieffermann, G., 1995. Tropical Peat Swamp Forests of Southeast Asia: Ecology and Environmental Importance. *Malaysian J. Trop. Geography*, *26(2)*, 131-141.

Salmah, 1992. Water Management in Deep Peat Soils in Malaysia. Ph.D. Thesis submitted to Cranfield Institute of Technology-Silsoe College, U.K., March 1992.

Sewandono, M., 1938. Het. veengebied. van Bengkalis. *Tectona*, *31*.

Silvius, M. and Diemont, H., 2007. Climate Change, Poverty, Biofuels and Pulp Deforestation and Degradation of Peatlands. *In: Tropical Peatlands, PEATLANDS International 2/2007*, 32-24.

Silvius, M., 2007. No Palm Oil from Plantations on Peat. *In: Tropical Peatlands, PEATLANDS International 2/2007*, 35.

Soekardi, M. and Hidayat, A., 1988. Extent and distribution of peat soils of Indonesia. Third Meeting Cooperative Research on Problem Soils, CRIFC, Bogor.

Soil Survey Staff, 1975. *Soil Taxonomy*. A Basic System of Soil Classification for Making and Interpreting Soil Surveys. U.S. Dept. of Agric. Soil Conserv. Ser. Agric. Handbook No. 436. U.S. Govt. Printing Office, Washing D.C.

Soil Survey Staff, 1999. *Soil Taxonomy*. A Basic System of Soil Classification for Making and Interpreting Soil Surveys – Second Edition. Soil Conservation Service U.S. Dept. of Agriculture, Washington, D.C.

Tie, Y.L., 1990. *Studies of peat swamps in Sarawak with particular reference to soil-forest relationships and development of domed shaped structures*. Ph.D thesis, Univ. of Reading, England.

Wosten, H. and Ritzema, H., 2007. Subsidence and Water Management of Tropical Peatlands. *In: Tropical Peatlands, PEATLANDS International 2/2007*.

Wosten, J.H.M., Ismail, A.B. and van Wijk, A.L.M., 1997. Peat subsidence and its practical implications: a case study in Malaysia. *Geoderma*, *78*, 25-36.

Expert Consultation on:

“Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia”

20-22 November 2008, Kuala Lumpur, Malaysia

ANNEX 10

The LCA Approach to Illustrate Palm Oil's Sustainability Advantage

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Using the LCA technique and computing for the different industry practices, the green house gas emission from nursery to mill with six other product flows, was estimated to range from ~650 – 1,300 kg CO_2/ton CPO. Allocation of the CO_2 by weight to two other co-products, namely palm kernel feed and palm kernel oil reduce the green house gas load of CPO by about 30%. There is potential to reduce the CO_2 load of CPO by as much as 60% when empty fruit bunch (EFB) are used to produce products that are not use within its system boundary.

Hot spots were easily and objectively identified using the LCA approach. The most prominent hot spot is the emission of biogas from open treatment ponds, an area where technology is already available to reduce the impact.

The assessment of impacts over the life cycle also meant considerations on the ability of the plantation living biomass to sequester CO_2 as well as its emission associated with landuse change. In the study, the emission and sequestration were estimated in relation to the 20 year life span of the oil palm. Further reduction in the CO_2 load per unit of CPO was ascertained based on the proposed concept.

The LCA approach that was used to quantify green house gas emission in the study is applicable to evaluate other impact categories such as resource consumption, acidification and eutrophication.

Introduction

Ever since bioenergy from agriculture produce and waste took centre stage as the way to achieving energy security, many viewpoints have surfaced as to the sustainability of this form of renewable energy including its contribution to climate change mitigation. Climate change is widely associated with green house gas (GHG) emissions generated from anthropogenic activities, the major sources being the combustion of fossil fuel for power generation, transportation and industrial processes.

Bioenergy sources include woody biomass and plant-based energy carriers produced from sugar, starch and oil feedstocks. The current technologically feasible forms of the bio-based energy carriers are bioethanol and biodiesel. Pivotal to the GHG mitigation aspect of biofuel is the issue of carbon-neutral, where carbon emitted when burned is offset by the carbon that plants absorb from the atmosphere for growth. The GHG mitigation associated with the carbon-neutral phenomenon is further enhanced by proposition that the living biomass is also a carbon sink.

There are reservations on the reduction of GHG linked to biofuel (Sean Milmo, 2007) in particular on the first generation biofuels with the main target being agriculture activities required to produce the bioenergy feedstock. The life cycle aggregation of GHG emission was also reported to be too small to warrant the emphasis accorded by policy makers. Among the reasons highlighted are inefficient agriculture practice and loss of carbon sinks due to landuse change.

While such criticisms should not be brushed aside, it is also a fact that biofuels from different feedstocks generate variable GHG emission, contributed by several factors that include agriculture and management practices, land use change, conversion efficiency and end use of the fuel. Life cycle estimates are sensitive to assumption about land use changes, form of fertiliser application, and by-product use.

The paper will use actual industry data to work out estimates of the aggregated GHG emission from field to mill for crude palm oil that is one of the current feedstock for biodiesel. It must be noted however that Malaysian palm oil is barely used to produce biofuel at this point of time. The exercise is carried out to illustrate the life cycle approach of data treatment that provides for inclusion of time and spatial considerations. The study targets only at the carbon footprint.

Field to Mill System Boundary

The material flow captured in the life cycle inventory analysis for GHG emission from field to mill of crude palm oil (CPO) is illustrated in Figure 1. The functional unit is one ton of CPO produced at the mill.

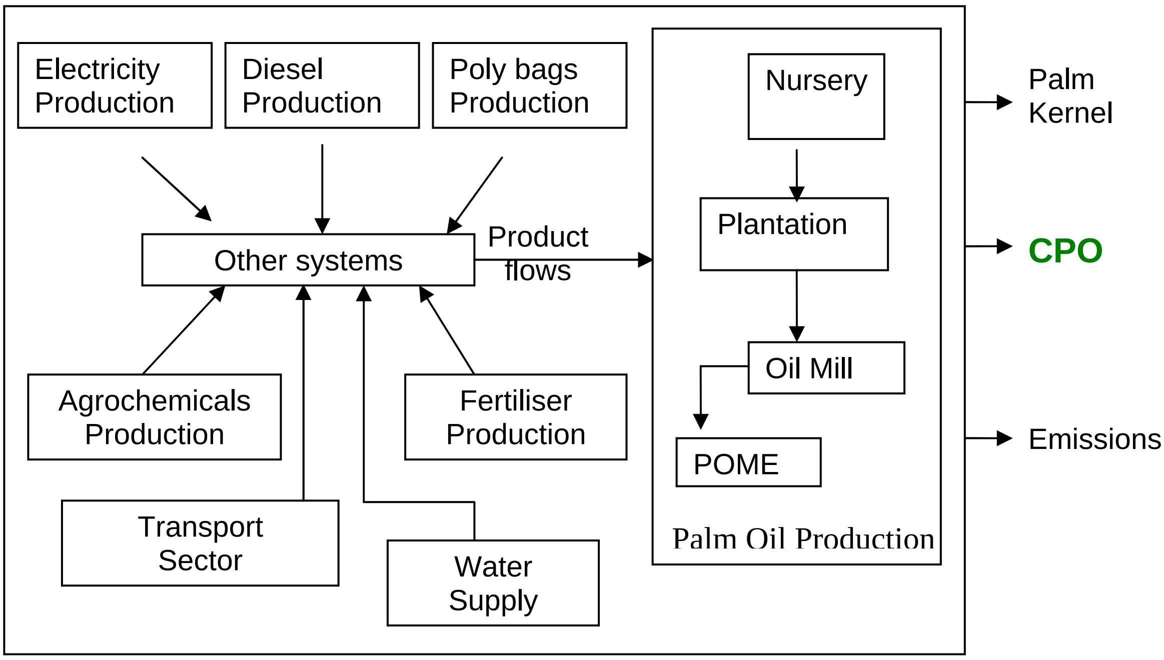

Figure 1 System boundary for the life cycle inventory analysis of GHG emission from CPO

The material flow of major unit processes directly related to CPO production is:

- Oil palm agriculture
    - Nursery stage
    - Plantation stage
- Transportation of FFBs to the mills
- Milling stage
    - Palm oil mill effluent (POME) treatment

The unit processes that are related to the palm oil industry from the life cycle perspective include:

- Fertiliser production and application
- Electricity generation
- Public water supply
- Polybags production
- Diesel production and use
- Sea transportation for import of fertilisers

The biological processes that are considered within the system boundary cover:

- Carbon sequestration
- Carbon emission from landuse change of logged-over forest to oil palm plantation

The Life Cycle Inventory of GHG in CPO Production

The input output inventory related to GHG emission for the production of 1 ton CPO is tabulated in Table 1. There are a number of computations and assumptions made in developing the LCI of GHG for CPO. Among the more significant parameters are:

a) Palm oil as a biomass feedstock is readily available over the life span of the oil palms.
b) Input and GHG emission at the nursery stage are apportioned over the typical life span of oil palms set at 25 years, unless otherwise mentioned.
c) CO_2 emitted from combustion of biomass or biomass-derived fuel, e.g. CO_2 in flue gas released from boilers, are not included in the life cycle accounting as they are balanced off by carbon dioxide absorbed during photosynthesis to produce the biomass feedstock.
d) The input and output inventory for agrochemicals other than fertiliser are not included due to their wide diversity and low dose used.
e) The GHG emission refer to $CO_{2\text{-equivalent}}$ that comprise direct CO_2 emission and equivalents related to methane (CH_4) that is 21 times the global warming potential (GWP) of CO_2 and is released from the anaerobic treatment systems for palm oil mill effluent (POME);and the N_2O released from volatisation of nitrogenous fertilisers at 310 times the GWP of CO_2.

Allocation by Number of Co-Products

Palm kernel oil (PKO) and palm kernel cake (PKC) from palm kernel are major co-products of CPO. Mills that recycle the empty fruit bunch (EFB) for purposes outside the system boundary of CPO production, namely use of EFB for particle board manufacturing; paper making; or the conversion to cellulosic ethanol (second generation biofuel) will have three co-products to every ton of CPO produced. Currently EFB is used as mulch to reduce the application of synthetic fertilisers.

Allocation of GHG emission to CPO can range from 50 to 80%, dependent on the mode of allocation, i.e. by weight, energy content or monetary value, as shown in Table 2. Allocations by weight and energy are currently the most reliable as the price of CPO has not been stable for the past months, and price of EFB has yet to be sold as a commodity.

Source: International PalmOil Sustainability Conference 2008 (IPOSC 2008)

Table 1: Input – Output Inventory related to GHG Emission for CPO Production (SIRIM, 2008)

Input Item	Quantity	Unit
Seed	1.66	no.
Seedling	1.66	no.
FFB	5.18	ton
Polybag	1.66	no.
N-fertiliser (as N-)	0.01	ton
- Ammonium sulphate	0.02	ton
- Ammonium nitrate	0.005	ton
- Ammonium chloride	0.003	ton
- Urea	0.002	ton
- NPK Mixed	0.036	ton
- Muriate of potash	0.005	ton
-Phosphate	0.031	ton
Kieserite	0.07	ton
Borate	0.004	ton
Electricity	135	kWh
-Nursery	134	kWh
-Plantation	-	kWh
-Mill (turbine)	0.301	kWh
Diesel	26.81	litre
- Plantation	12.03	litre
- Transport (field to mill)	8.50	litre
- Mill	6.285	litre
Water	7912	litre
-Nursery	759	litre
-Plantation	-	litre
-Mill (for steam)	7153	litre

Milling Stage for CPO

Output Item	Quantity	Unit
CPO	1	ton
Palm Kernel	0.06	ton
EFB	1.21	ton

Discharge	Quantity	Unit
POME	3.54	m^3

Case of biogas-release from POME treatment

GHG Emission	Quantity	Unit
Direct CO_2	335.27	kg
N_2O (fertiliser application)	0.57	kg
CH_4 (from POME)	30.30	kg
Total CO_{2}- equivalent	1,143	kg

Case of biogas-capture from POME treatment

GHG Emission	Quantity	Unit
Direct CO_2	335.27	kg
N_2O (fertiliser application)	0.57	kg
CH_4 (from POME)	-	kg
Total CO_{2}- equivalent	512	kg

Table 2 Four Allocations of GHG Emission to CPO

No.	Products	Allocation %
1.	Allocation by weight for CPO with PKO and PKE as co-products	77%
2.	Allocation by weight for CPO with PKO, PKE and EFB as co-products	40%
3.*	Allocation by energy content for CPO with PKO and PKE as co-products	85%
4.*	Allocation by energy content for CPO with PKO, PKE and EFB as co-products	56%

* *Ebergy values are calculated based on values reported by Wood. and Corley (1991)*

Dependent on the mode of allocation and industry practice, the GHG emission associated with the production of CPO from field to mill can range from ~220 – 980 kg CO_2/ton CPO. With increasing emphasis on the waste to wealth concept, technologies are being developed that will enable utilisation of every part of the oil palm and its fruits. Increase in the number of co-products will implicate smaller GHG emission allocation to CPO and all of its co-products.

Effect of Carbon Sequestration in the Computation of GHG Emission

Living biomass are absorbers of CO_2 due to the photosynthesis process. However there is much debate as to whether standing crops are actually net accumulators of CO_2 when they are harvested for use as feedstock for biofuels.

The ability of oil palm plantation to sequester carbon from the atmosphere was assumed to take place right from the onset of transplant from the nursery to the plantation. The annual rate of sequestration of CO_2 by oil palm plantations estimated by Henson (Henson, 2004) over the 20-year period between 1980 and 2000 for replanting cycle of 20, 25 and 30 years was 3.327 million ton/year. This sequestration rate was adopted as an approximate value for the next 5 year period of 2000 to 2005 at 878 kg carbon/ha/year or 3.22 ton CO_2/ha/year.

Based on the average current yield of 19 ton FFB/ha/year (Min. Plantation Industries and Commodities,2006), the amount of CO_2 sequestered for every ton of CPO produced is calculated as 0.87 ton CO_2/ton CPO. When compared with CPO produced from mills that harness the biogas from the effluent treatment system and generate ~0.2 - 0.5 ton CO_2/ton CPO the plantation is a net accumulator of CO_2. In mills that release the biogas generated, the sequestered carbon will reduce the CO_2 load by at least 20% dependent again on the industry practice.

Effect of Landuse Change

The carbon sequestration phenomenon maybe negated by the CO_2 emission associated with landuse change and warrants investigation. A study on the soil carbon flux from tropical peatland (Melling L., 2007) reported that the carbon flux from forest in peatland soil at 2.1 kg C m^{-2} yr^{-1} is higher than land occupied by oil palm at 1.5 kg C m^{-2} yr^{-1}. Since CO2 will also be released from forest land, in this respect, the study did not consider emission released from oil palm plantation on peatland.

Henson (Henson, 2004) has established that between 1980 and 2000, the annual carbon emission related to conversion of logged-over forest land to oil palm plantation is 5.22 million ton/year. It must be noted here that logged-over forest land is not pristine forest or primary forest.

In attempting to present a balance carbon accounting, the carbon emission estimated from equations recommended in the IPCC Land Use Land-Use Change and Forestry guidelines (IPCC 2007) was applied. The change in carbon stock is assumed equivalent to carbon loss in the form of carbon dioxide emission when logged-over forest land was changed to oil palm planting. The IPCC equation was adapted for the conversion of logged-over forest to oil palm planting as below:

$L_{conversion} = C_{After} - C_{Before}$ (Equation 3.3.8 of IPCC)

$L_{Conversion}$ = carbon stock change per area for conversion of logged-over forest to oil palm planting, ton ha^{-1}

C_{After} = carbon stocks in oil palm biomass one year after conversion to oil palm planting, ton C ha^{-1}

C_{Before} = carbon stocks in logged-over forest immediately before conversion to oil palm planting, ton C ha^{-1}

The carbon emission value from landuse conversion obtained from the equation is likely over-estimated as the conversion factors used for logged-over forest are those of primary forest. Table 3 shows the carbon stock change over a one-year period is around 94% when logged-over forest is converted to oil palm planting. Between 2002 to 2005, the carbon stock reduction range from ~7 million ton yr^{-1} to 28 million t yr^{-1} with the possible release of ~30 – 100 million ton CO_2 yr^{-1} .

Table 3: Conversion factors used in estimating CO_2 associated with $L_{conversion}$.

Parameter	Value	Remarks	Reference
Above-ground living biomass content (dry matter) for forest land (t/ha)	205		IPCC Pg. 3.160
Carbon content of above-ground biomass before conversion (t/ha)	103	Carbon content is taken as 50% of the dry biomass	IPCC
Above ground living biomass content for young oil palms 1-3 years (t/ha), taken as C_{After}	14.5	Value refers to carbon stock for a one-year old oil palm and also the value attributed to C_{fter}, seedling that are planted in the estate.*	Henson I.E.,1999
Carbon content of living biomass of young oil palms 1-3 years (t/ha)	5.8	Carbon content of biomass of young palms is taken as 40%	Henson I.E., 1999
$L_{Conversion}$ (t/ha) per year	96.7	Time frame of one year is taken in the estimation of $L_{Conversion}$	

**Note: Although IPCC assumed carbon stock right after land conversion as zero, the study here assumed there is biomass content in the form of seedlings that are transplanted from the nursery directly to the new converted area.*

In the life cycle context, the CO_2 emitted within the year for a given area that has been converted from logged-over forest land to oil palm planting is apportioned to the life span of oil palms, conservatively taken as only 20 years in line with the IPCC guidelines, although most oil palms are replanted only after 25 - 30 years, The CO_2 emission that will be included in the inventory for landuse change is computed as ~1.5 to 5 million ton CO_2 yr^{-1} in accordance with the actual landuse change acreage and apportioning over the palm life span.

The CO_2 sequestered was also estimated as ~12 million ton CO_2/year by Henson between 1980 to 2000 (Henson, 2004). Considering a dynamic situation of CO_2 sequestered by the standing biomass and the temporal-apportioning of CO_2 released from landuse change, the oil palm plantation is in principle still a net carbon sink. The amount of CO_2 sequestered for every ton of CPO produced is reduced to 0.66 ton CO_2/ton CPO.

The LCA Technique

The LCA technique enabled comparison of different agriculture and industry practices. Hotspots that contribute to the carbon footprint from field to mill per ton of CPO were easily singled out. While the generation of CO_2 is evident, the industry has many technological and management options that are practicable and implementable to reduce the GHG emission. The LCA principles and methodology provided an objective approach to compare the quantum of reduction achievable with the different mitigation steps and activities.

Reference

Henson I.E. (2004). Modelling Carbon Sequestration and Emissions Related to Oil Palm Cultivation and Associated Land Use Change in Malaysia, MPOB Technology, Malaysian Palm Oil Board, Bangi.

IPCC (2007) Good Guidance Practice for Land Use, Land-Use Change and Forestry. IPCC, Japan

Melling L. and Goh K. J. (2007). Soil C Flux from Tropical Peatland of Sarawak, Malaysia, Carbon Sequestration in the Context of LCA Workshop, Shah Alam.

Ministry of Plantation Industries and Commodities (2006). Statistics of Commodities 2006, 20th Edition.

Sean Milmo (2007) The Green Fuell Myth, Chemistry World, Vol. 4, No. 10. *Royal Soc. Chem.*, UK

SIRIM (2008), Interim National LCI Database, National LCA Project, SIRIM, Shah Alam.

Wood B.J. and Corley R.H.V. (1991) The Energy Balance of Oil Palm Cultivation, PORIM International Palm Oil Conference – Agriculture, Bangi.

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Expert Consultation on:

“Direct and indirect impact of biofuel policies on tropical deforestation in Malaysia”

20-22 November 2008, Kuala Lumpur, Malaysia

ANNEX 11

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BIOENERGY SUSTAINABILITY
- WWF'S PERSPECTIVE -

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Existing tools

- Protected areas, environmental & social legislation, land use planning...
- Voluntary Commodity Initiatives such as: FSC, RSPO, RTRS & Basel Criteria, BSI... are established or under development
- GHG calculation not required, as the initiatives were not developed for bioenergy
- Good start but not sufficient to ensure a sustainable development of bioenergy: we need a system that is suitable for bioenergy.

A Global Solution?

- Ask for global legislation? CBD? Difficult, long process
- Ask for national legislation? Possible, but risk of conflicts in case of international trade
- Ask for global standards combined with regional/national legislation. Route chosen by WWF:
  - Forestry Stewardship Council –FSC
  - Roundtable on Sustainable Palm Oil –RSPO
  - Roundtable on Responsible Soy –RTRS
  - Better Sugarcane Initiative –BSI
  - Roundtable on Sustainable Biofuels -RSB

Bioenergy Sustainability Assurance

- Sustainability of bioenergy = sustainability of agriculture & forestry management + GHG performances + social performance
- In WWF's view there is no justification for bioenergy which is not delivering SIGNIFICANT GHG reductions and its produced in a responsible manner.

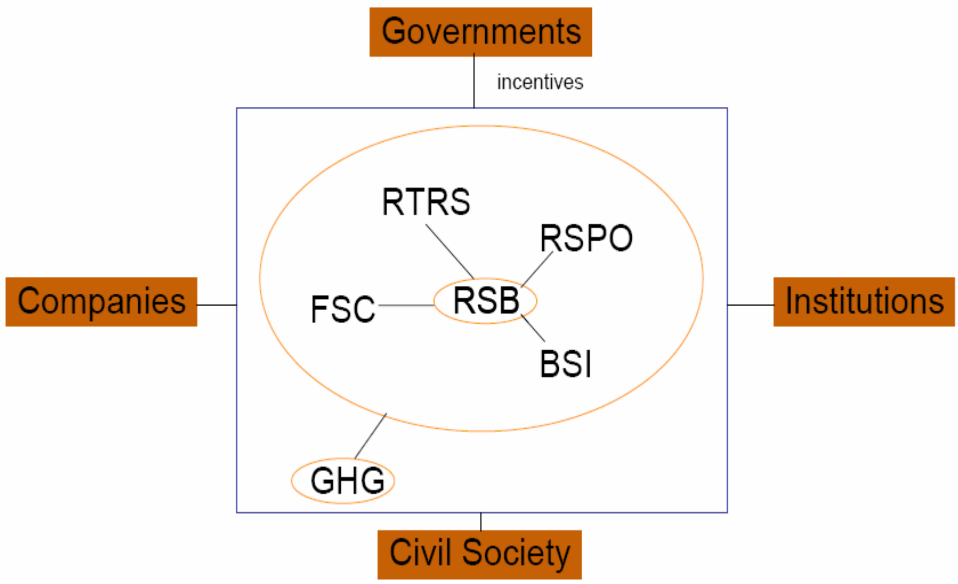
Minimize environmental and social impacts maximise benefits!

- No conversion of high conservation value areas (HCVAs): forests, permanent grasslands, floodplains etc.
- Responsible use of water and soil resources
- Protection of biological diversity

International Meta-Standard Strategy

- There is a need for an internationally agreed production standard covering all kind of crops
- The standard should not be used for protectionist purposes and should NOT disadvantage small producers.
- Should ensure legality and environmental and social sustainability
- Should comply with ISEAL standards

International Meta-Standard Strategy



How would it work?

Bioenergy standard	RSB (generic)	RSPO (palm oil)	BSI (sugarcane)
Criteria 1	YES	YES	NO
Criteria 2	YES	YES	YES
Criteria 3	NO	YES	NO
Etc.			

Link between (private) standards, certification and policy

- Legislation determines environmental and social criteria
- Independent benchmark of existing standards & accreditation
- Certification by accredited bodies and standards is accepted
- CREDIBILITY of standards and schemes is hugely important
- Developing credible standards and certification schemes takes years and resources

The EU biofuel directive

- The biofuel sustainability scheme is still under development, however:
  - Its likely to adopt the meta-standard approach, based on existing credible schemes
  - Will define „no-go" areas (wetlands, grasslands, forests), based on biodiversity and carbon criteria
  - Will probably promote production on idle/degraded lands or waste products
  - Promote better management farming practices
  - Will hopefully link incentives to GHG performances and will define minimum GHG savings (45% by 2013, 60% by 2015)
  - Will define social safeguards (reporting)
- Only certified products will count against the renewable targets

Certification is not a „silver bullet"

- Certification will not address:
  - Displacement: displacement acts across crops and borders. The demand for displaced crops will not disappear but it most of the cases will create new production capacities.
  - Indirect land use changes will significantly influence the GHG balance of the bioenergy feedstocks!
  - Land use conflicts: competition with food.

Additional measures are needed

- Support for efficient, participatory land-use planning, improvement in law enforcement and governance to avoid unwanted (indirect) land-use changes (conversion)!
- Support for GHG and environmentally „efficient bioenergy" for example 2nd generation but not for „0 generation" (inefficient) cars! Link incentives to GHG and environmental performance!
- Support production of bioenergy based on waste products, improve efficiency in existing systems (Indonesia could significantly increase its production of palm oil by implementing better management practices) and promote production on idle / degraded land

Conclusions

- Bioenergy can have a significant contribution to climate change mitigation, rural development etc. but it can also go terribly wrong.
- The additional land demand for biofuels is small compared to the total use of land for agriculture but it will be 30-70% of the additional land requirement between now and 2050. That means it is a significant driver of future LUC. (UK Gov, Gallagher Review)
- We need a global approach when it comes to better management practices, standards combined with regional and national policies!

Conclusions

- Credible standards and certification schemes can significantly reduce environmental and social impacts and maximize benefits. However additional measures are needed!
- Use credible schemes, otherwise the sustainability claims will be questioned.
- We need to avoid proliferation of standards and schemes which lead to confusion!

Expert Consultation on:

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ANNEX 12

WWF for a living planet®

Input for the "Direct and indirect impact of biofuel policies on deforestation" expert consultation, Kuala Lumpur, Malaysia.

The increasing demand for climate friendly energy, rural development opportunities and energy security issues has propelled bioenergy in the centre of many sectoral debates including: climate change, agriculture, forestry, energy, nature conservation, food security etc. One of the most heavily debated aspects is the overall sustainability of bioenergy feedstocks. WWF considers that the large scale use of bioenergy can deliver significant GHG reductions, but production has to be environmentally and socially sustainable. To achieve sustainability WWF recommends the use of existing, credible, independent certification schemes and some additional measures to address the climate and indirect impacts of bioenergy production.

Bioenergy - one element of broader climate strategy
Recent science findings reveal that in order to avoid dangerous climate change, global warming should stay below a 2° C increase compared to pre-industrial temperatures. In order to do this, at least 50 to 85 % of global CO_2 emissions will have to be cut by the middle of this century. As those reductions must happen against the observed trend of an increase of global GHG emissions of more than 30% since 1990 – or about 3% annually in the last few years, there is no "silver bullet" to achieve those reductions all available and sustainable options should be employed.

Bioenergy trends
Besides climate change, increasing oil prices, rural development policies, and the uncertainty of energy supply are driving accelerated and large scale investments into bioenergy globally. Currently, bioenergy accounts for more than 10% of energy consumed worldwide with more than 80% consumed in developing countries.

WWF believes the modern bioenergy use could play an important role to fulfil the interrelated goals identified above. At the moment more than 50 countries have bioenergy, biofuel targets. However, not all bioenergy development is necessarily sustainable. A vast number of literature and growing experience has pointed out that depending on which crops are produced, its location and technologies and inputs used, bioenergy developments can cause significant negative environmental and social impacts such as deforestation, species and habitat loss, soil erosion, excessive water use, land use conflicts, food shortages, stable food crop price surges, and more importantly, livelihood loss and displacement of people.

Deforestation
As stated in the WWF Living Planet Report in 2006, deforestation is one of the major threats for terrestrial and freshwater species; with a decline of about 55% of tropical species population between 1970 and 2003. In addition, forests play in the fight against global warming. GHG emissions from land-use changes are estimated to be responsible for 18% of global greenhouse gas emissions, with deforestation accounting for most of these emissions. It

is increasingly recognised that this source of emissions needs to be addressed in order to keep the global average temperature rise below the 2 degree tipping point.

Additionally many people source: food, medicine, building materials and fuelwood directly from forests and depend on forest ecosystem services for water supply, flood prevention, and climate change mitigation. Some 1.6 billion people worldwide depend on forests for their livelihoods, with 60 million indigenous people depending on forests for their subsistence.

Without stopping deforestation the Millennium Development Goals, particularly Goal 7 “Environmental Sustainability” cannot be achieved. The UN Millennium Goals Report 2007 states that *deforestation continues, especially in biologically diverse regions*. The UN 2006 Progress Chart drew the alarming picture that eight of ten regions show no progress, quite the contrary a deterioration or reversal against the target of reversing forest loss. It showed as well that deforestation is one of the areas where the least progress could be observed over the last years.

The fact, that 67 countries as well as the European Commission signed the postcard to support WWF's call for achieving zero net deforestation by 2020 at the CBD in May in Bonn is a clear sign, that the concerns about deforestation of WWF are shared by many others.

The problems that underlie deforestation cannot easily be singled out or addressed without “seeing the whole picture”. A distinction needs to be made between poverty driven deforestation and deforestation caused by other factors. National and international trade (and other) policies create a demand on commodities which often cause deforestation and where this demand meets ineffective governance frameworks in tropical countries, increased rates of deforestation can be the result.

Indirect impacts of the biofuel policies

Addressing the indirect impacts of the biofuel policies is one of the most difficult aspects of promoting a sustainable bioenergy sector. Indirect impacts can act across borders and crops in most of the cases by replacing other land-uses. Most of the sustainability tools used or promoted by different stakeholders have limited effect on indirect impacts.

In this context it is worth considering the recent results published by the UK government on the indirect impacts of biofuel (Gallagher Review). The report estimates, that, at present, feedstocks for biofuels occupies only 1% of cropland but that the rise of the world’s population, changing diets and demand for biofuels are estimated to increase demand for cropland by between 17% and 44% by 2020.

The Gallagher Review concludes that we do not have policies in place which would enable us to effectively address indirect impacts. Promoting production on degraded/idle land, improving productivity in existing plantations and introducing a sustainability scheme for all agricultural products are part of the potential strategy. Additionally better links with the ongoing REDD debate and the EU FLEGT process are needed.

Palm oil as biofuel

Palm oil is one of the many bioenergy feedstocks with current or potential use in energy production. However whilst at present palm oil supplies only 1% of the European Union supply of biodiesel there are widespread concerns about the environmental and social implications of a rapid expansion of demand in the future.

Historically soaring demand in consumer countries has lead to the establishment of new production capacities. The customary method of preparing additional areas for cultivation is not to use fallow land, but particularly in Indonesia to lay out palm oil plantations on specially cleared natural forest areas.

The main argument for palm oil use in energy production lays in the results of the energy balances and greenhouse-gas balances on the stationary (heat and electricity) and mobile use (liquid fuels). The calculations show that palm oil use can save significant quantities of fossil energy and greenhouse-gases in comparison to other vegetable oils, but only when plantations are established without bringing habitats and soils that currently store large amounts of carbon, such as wetlands, forests and peat soils, into cultivation.

Increased pressure on the palm oil markets due to the rapid growth in demand gives rise to concerns and speculation that further natural forest land is threatened with conversion into oil palm plantations, not only in Indonesia, but also in Sabah, Sarawak (Malaysia), in Papua New Guinea, in Colombia and Ecuador as well as in the longer term in Africa.

WWF's position is that palm oil for any use – food, non-food, or energy - should be produced in accordance with the RSPO criteria. WWF believes that biofuels could have a role to play in providing sustainable energy for the future since they can contribute to a reduction of green house gases provided the commodity in question, in this case palm oil, is produced in accordance with broadly agreed criteria for sustainable production and the life cycle of the commodity has a positive GHG balance (including GHG emissions associated with land clearing to establish the plantation).

The expansion in the demand for, production and processing of biofuels must be managed with great care, taking into account wider environmental concerns, including biodiversity, water, soil, landscapes, and social aspects.

In WWF's view, the RSPO (Roundtable on Sustainable Palm Oil) has the potential to play a critical role in addressing the problems. The RSPO has endorsed a set of principles for sustainable palm oil production. These include a prohibition on the conversion of primary forests and habitats with high conservation value. This includes peatlands.

WWF's requirements for palm oil as a biofuel

In addition to complying with the RSPO P&Cs, WWF believes that biofuels for transport can make sense if a number of additional conditions are met :

- The use of the biofuels demonstrates substantial GHG savings over its full lifecycle compared to the use of fossil equivalents;
- There are no unacceptable indirect or displacement impacts from the use of land and/or commodities to produce biofuels.

There is a shared responsibility between companies producing biofuels (including the RSPO) and governments in both producing and consuming regions to ensure that these conditions are met.

Companies producing and using palm oil for biofuels can meet these conditions by:

- Committing to only using RSPO certified palm oil by 2015,
- Conducting their own lifecycle GHG balance calculation (*we do not have a recommended methodology*) and demonstrating a minimum of 65% savings over fossil fuels,
- Helping to ensure that the RSPO develops and sets credible lifecycle GHG standards for certified palm oil production (*again we do not have a set methodology or minimum*);
- A number of supply chain changes can reduce the risk of indirect impacts (*but we do not know how much they reduce the risk or if they can eliminate indirect impacts*):

    - Sourcing palm oil from increased yields from existing plantations or improved recovery from mills (*this would require companies to have established records of yields and then demonstrate that palm oil sourced for biofuels comes from extra production*);
    - Growing 'new' palm oil on idle, degraded and/or unused land –(*As there are as yet no agreed definitions or methodologies for assessing this, we are currently asking companies to invest both financially and technically in developing these definitions and methodologies).*

WWF is working with BP, SHELL and NESTE Oil on a methodology based on the HCV framework to identify idle land.

Governments in consuming regions where palm oil is used for biofuel*s* n*eed to:*

- *Require companies supplying biofuels from palm oil to use only RSPO certified palm oil – 100% by 2015 at the latest;*
- *Establish or adopt an internationally accepted methodology* for lifecycle GHG balances and set a minimum GHG balance for palm oil biofuels of 65%;
- Require companies to implement practices that are likely to reduce the indirect impacts of palm oil use for biofuels;
- Set precautionary and intermediary targets (followed by impact assessments of the direct and indirect impacts) for overall biofuels use;
- Monitor and evaluate the direct and indirect impacts of biofuels use globally;
- Support governments in producing regions to develop and implement credible land use planning and governance systems that ensure the sustainable use of land and resources.
- Promote and support strategies providing benefits for the local communities from alternative, sustainable practices not involving conversion, such as: REDD, payment for environmental services, etc.

Governments in producing regions where palm oil for biofuels is sourced need to:

- Require all palm oil producers to be RSPO compliant by 2015 at the latest;
- Support the RSPO in developing GHG standards;
- Develop and implement credible land use planning and governance systems that ensure the sustainable use of land and resources.

The RSPO should seek to address these issues and the wider sustainability impacts of palm oil by:

- Ensuring that all RSPO are 100% certified by 2015 at the latest;
- Develop or adopt and set credible lifecycle GHG standards – by end 2009;
- Introduce measures to minimise the indirect impacts of palm oil production including:
    - Setting targets for yield improvement;
    - Requiring prior proof of compliance with P&Cs before expansion;
    - Promoting the use of idle, marginal or degraded land as standard;
    - Lobbying producer region governments to establish credible land use planning.

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Annex: Principles for the sustainable production, trade and consumption of bioenergy

Bioenergy should deliver large positive energy and GHG balances over fossil fuels.
Greenhouse gas (GHG) and energy balances vary widely amongst energy crops. Some crops perform far better than others. It is not enough to look into crop selection, soil and climate as determining factors for bioenergy production. Any land conversion of carbon rich vegetation such as primary forests or soils such as peat lands can also cancel out the potential carbon benefits of bioenergy feed stocks. As such, impacts of land use change, agricultural practices, use of by-products and low carbon sources of energy, conversion techniques and final energy use, will also affect the life cycle of GHG balance and therefore need to be considered.

Energy crops should be selected on the basis of the most efficient carbon (soil and air) and energy balance, from production through to processing and use.
Conventional crops such as sugar cane for bioethanol for example, can provide these benefits if produced and processed sustainably. Future investment and research needs to be oriented towards more efficient technologies and towards ligno-cellulosic crops that offer better options to reduce GHG emissions as well as reduced impact on the environment.

Displacement effects that influence GHG balance, mitigate social and environmental damage should be addressed
Competition for staple products or displacement of food crops as a result of bioenergy development is of particular concern. National and international mechanisms should be put in place to monitor impacts of biofuel production on food availability, access to food and stability of food supply. Early warning system and intervention strategies must be in place particularly for the small and vulnerable small holders.

Bioenergy strategies must contribute to the livelihood and wellbeing of indigenous populations
Biofuel development should not harm and should contribute to the wellbeing of smallholders and communities in rural areas, particularly indigenous peoples. Because indigenous peoples are often discriminated against and politically marginalized, special efforts should be made to respect, protect, and comply with their collective and individual rights, including customary as well as resource rights. Indigenous peoples have the rights to the lands, territories, and resources that they have traditionally owned or otherwise occupied or used, and that those rights must be recognized and effectively protected, as laid out in the ILO Convention 169 and the UN Declaration on the Rights of Indigenous Peoples. Therefore special efforts should be made to establish stakeholder mechanisms in order to ensure that indigenous peoples likely to be affected by biofuel development can give their prior informed consent to that development and can share in the benefits.

Permanent grasslands, natural and semi-natural forests, natural floodplains, wet and peat lands, important habitats for threatened species and other high conservation value (HCV) areas should not be converted to bioenergy production
Experience has shown that when a certain crop replaces an already existing agricultural production capacity, (in most cases), the demand for the original crop will not disappear from the market. As the demand persists, new production capacity will be set up, in many cases by converting high conservation value (HCV) areas into new agricultural land. Their conversion can lead to a host of negative consequences.

Bioenergy feedstocks should be produced using better management practices
Better management practices ensure responsible use of soil and water resources, enhancement and/or protection of biological diversity and fair social benefits. Lessons from cross sectoral experience on better management practices must be made available and shared across countries and landscapes.

There should be an equitable playing field for small producers
The development of biofuels has the potential to impact positively on poverty through employment and income effects for small producers, wider growth multipliers, energy price effects, etc. However, there are risks that some of these potential may be lost as economies of large unsustainable operations kick in, especially with bioethanol, and as pressures on land increase. In a lot of areas in the developing world, land ownership, tenure and/or stewardship of land is non existent or unclear, particularly for small producers. Strong legal frameworks are required to provide small farmers with continued secure access to land, particularly in cases of unclear tenancy or ownership. Inclusive business models where biofuel production companies enter in a sustainable and equitable relationship with local, independent providers of feedstocks have strong potential to contribute to income and employment increase of small holders in developing countries. Pro poor policies should be put in place such as quotas for procurement of feedstocks from family farms; and providing small producers with access to credit and technologies to process cleaner biofuel.

Governments should implement complementary measures: including land use planning, food security measures, improvement of law enforcement and governance.
Certification and standards are not a panacea for driving sustainable bioenergy. Some impacts of bioenergy production, such as the indirect land-use changes due to bioenergy production, are currently difficult to tackle within a certification scheme. For this reason, additional instruments such as: efficient and participatory land-use planning, improved governance, law enforcement, waste products and preferred use of “idle land” and the monitoring of macro effects of bioenergy production are needed.

Public subsidies and other financial instruments should be directed towards additional measures to help ensure sustainable and pro poor bioenergy production
Given the rapid growth of bioenergy industry, public finance should be allocated to ensure functioning integrated landscape planning policies to balance biodiversity conservation, social needs and commercial land-use. Resources should also be allocated to transparent monitoring and evaluation mechanisms of bioenergy production performance in producer regions.

Biodiversity concerns should be incorporated in the broader energy policies
Biofuel strategies should also be developed within a broader energy framework that works to reduce energy production and consumption; promote sustainable transport and improve energy efficiency. Impacts on forest and agricultural biodiversity should be taken into account not only in the biofuel strategy development, but also in the broader energy policies development.

European Commission

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Abstract
This document contains the Proceedings of the Expert Consultation: “Direct and indirect impact of biofuels policies on tropical deforestation in Malaysia", held in Kuala Lumpur, Malaysia on 20-21 November 2008. This meeting was jointly organised by two Research Actions: the Biofuels Action of the Institute for Energy and the TREES Action of the Institute for Environment and Sustainability, Joint Research Centre, in cooperation with the Malaysian Palm Oil Council (MPOC). The objective of this Expert Consultation was to exchange expertise, collect/analyse/discuss data and information on the following topics: 1) Direct and indirect effect of biofuels policies (National, European and global) on tropical deforestation in Malaysia; 2) Status of biofuels sustainability certification, with specific reference to palm oil and the Round Table on Sustainable Palm Oil (RSPO); 3) Wildlife conservation and environmental care; 4) GHG emissions related to palm oil cultivation and use, effect of land use change, Life Cycle Analysis of Biofuels. This meeting aimed to exchange and discuss data availability, accuracy and uncertainties, to improve understanding in the field of biofuels, in order to provide the best technical support to Malaysian or European decision-makers in the field of biofuels and bioenergy.

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