# Historical $CO_2$ Emissions from Land Use and Land Use Change from the Oil Palm Industry in Indonesia, Malaysia and Papua New Guinea

Fahmuddin Agus[1], Petrus Gunarso[2], Bambang Heru Sahardjo[3], K.T. Joseph[4], Abdul Rashid[5], Khali Hamzah[5], Nancy Harris[6], Meine van Noordwijk[7]

[1]Indonesian Soil Research Institute, Bogor, Indonesia
[2]Tropenbos International, Indonesia Programme, Bogor, Indonesia
[3]Bogor Agricultural University, Bogor, Indonesia
[4] University of Malaya, Kuala Lumpur, Malaysia
[5]Forest Research Institute Malaysia, Kepong, Malaysia
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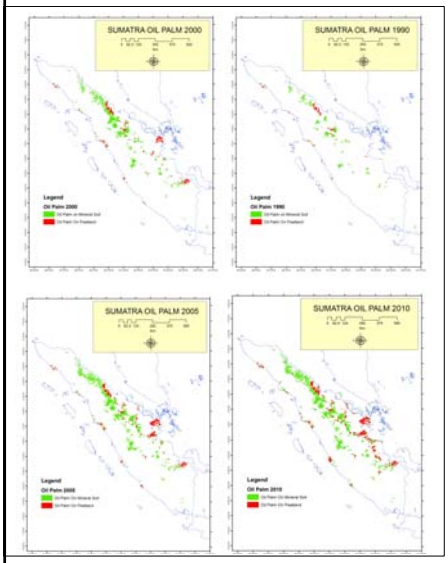
This study was commissioned and reviewed by the Second Greenhouse Gas Working Group of the Roundtable on Sustainable Palm Oil (RSPO). Co-Chairs: Timothy J. Killeen and Jeremy Goon

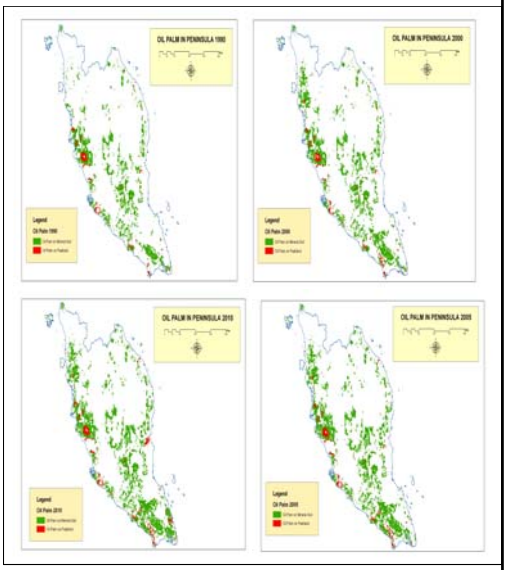
RSPO
Roundtable on Sustainable Palm Oil

An International Multi Stakeholder Organization and Certification Scheme for Sustainable Palm Oil

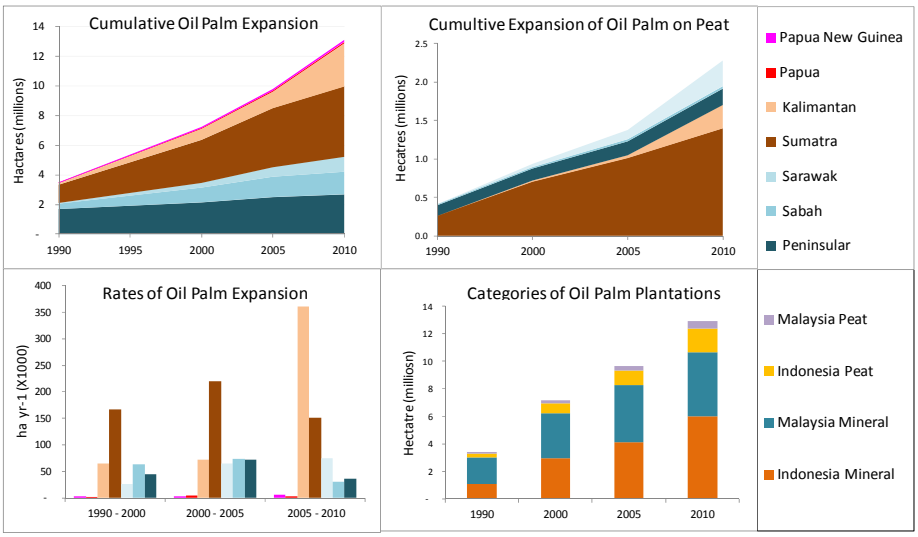
Sumatra




Peninsular Malaya

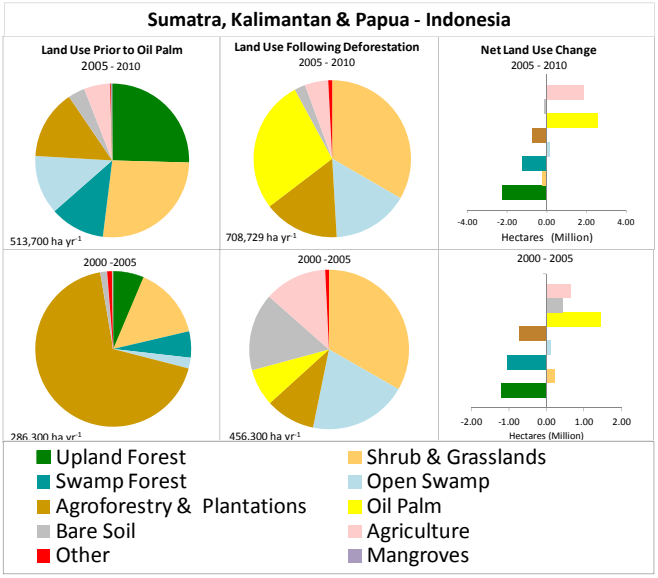


Green: OP plantations on mineral soils
Red: OP plantations on peat soils




The spatial extent and rate of growth of oil palm in Malaysia, Indonesia (Kalimantan, Sumatra and Papua) and Papua New Guinea.

## Summary of land use change




- Left column: land use prior to new oil palm plantations; value in the LR corner is annual increase in oil palm plantations.
- Middle column: land use following forest conversion, (both upland and swamp forests); value in LL corner is annual rate of deforestation
- Right column: net land use change over each five year period;

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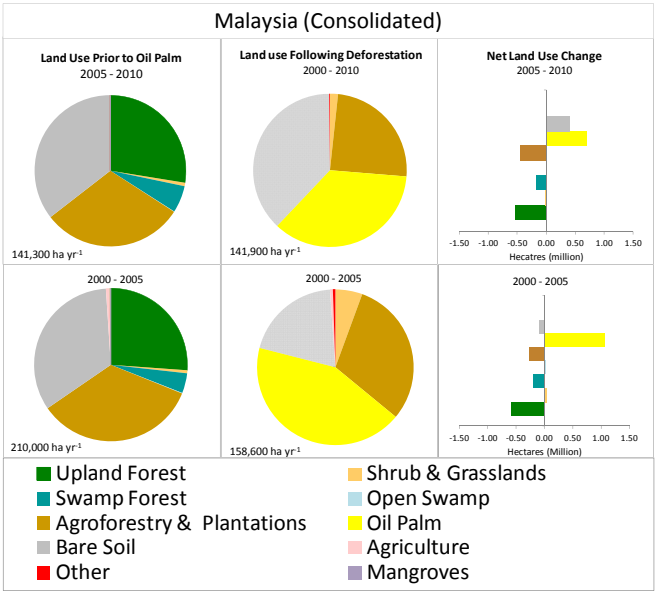


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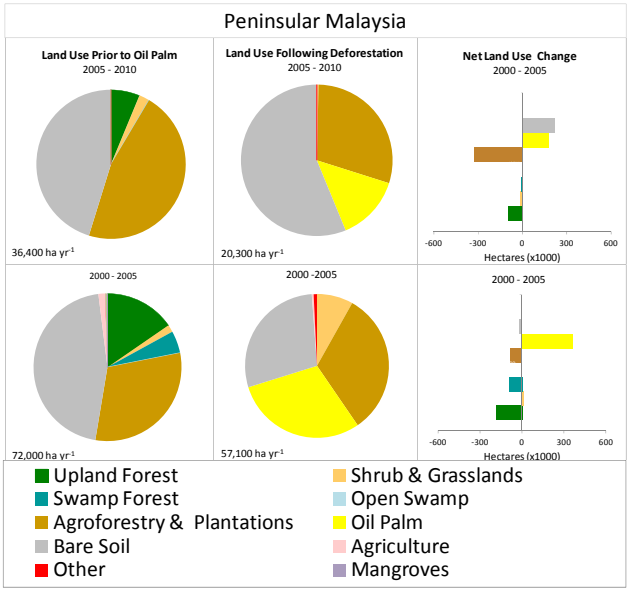


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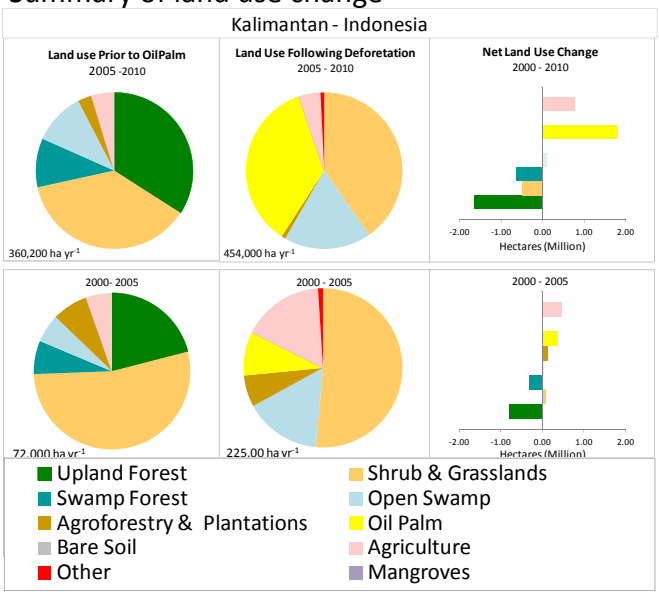


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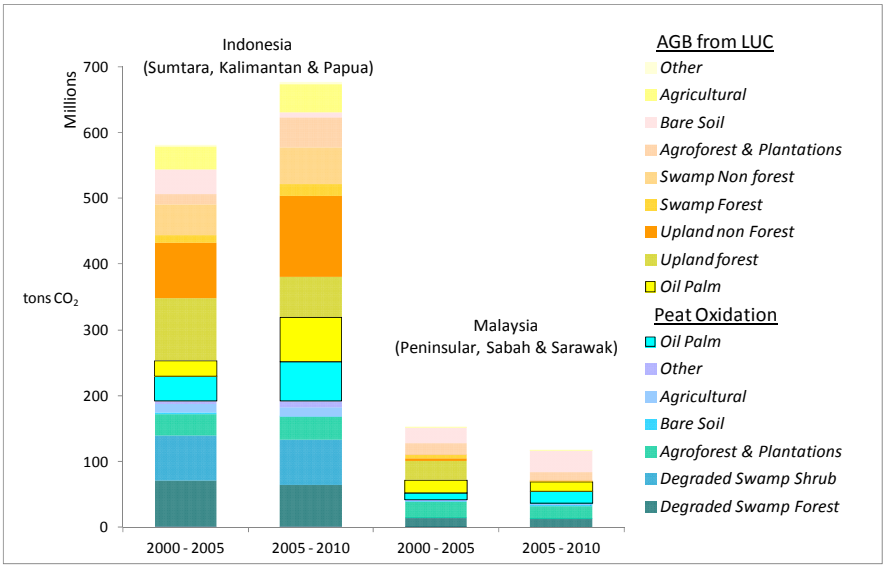
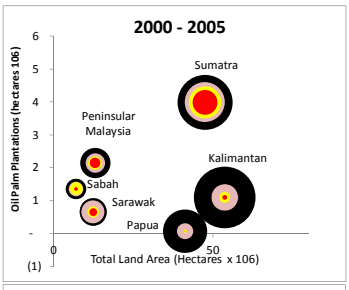
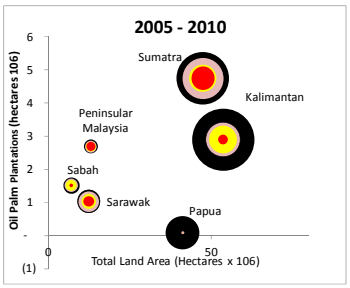
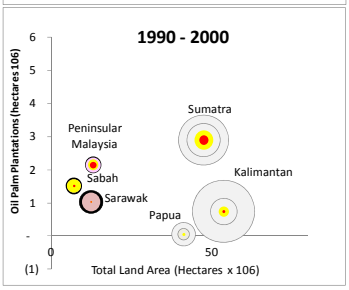
## Total $CO_2$ emissions from land use change and emissions from peat in Indonesia and Malaysia for the two temporal epochs between 2000 and 2010.

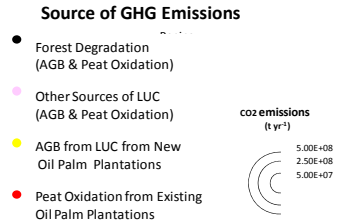


Estimated GHG emissions stratified by land use and source.

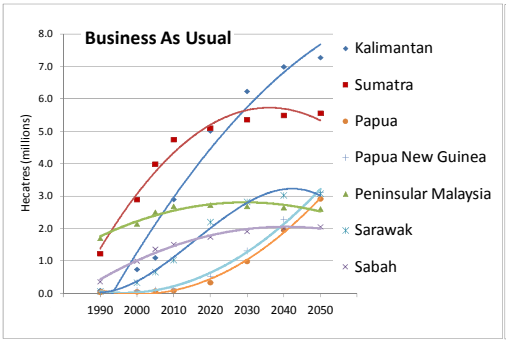


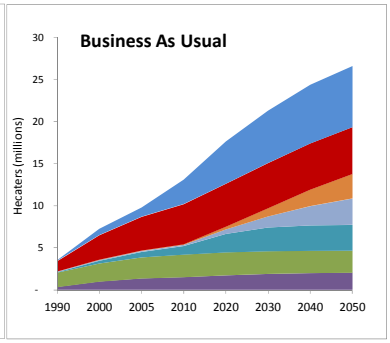



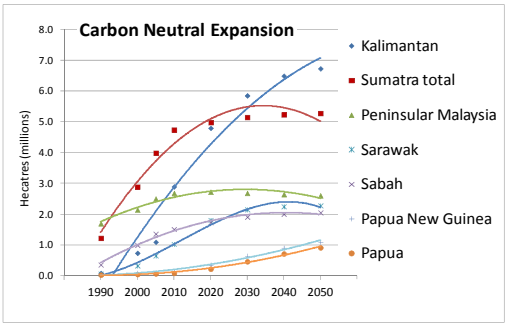



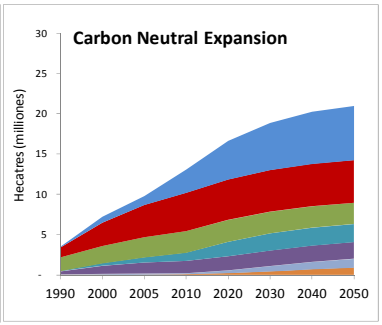



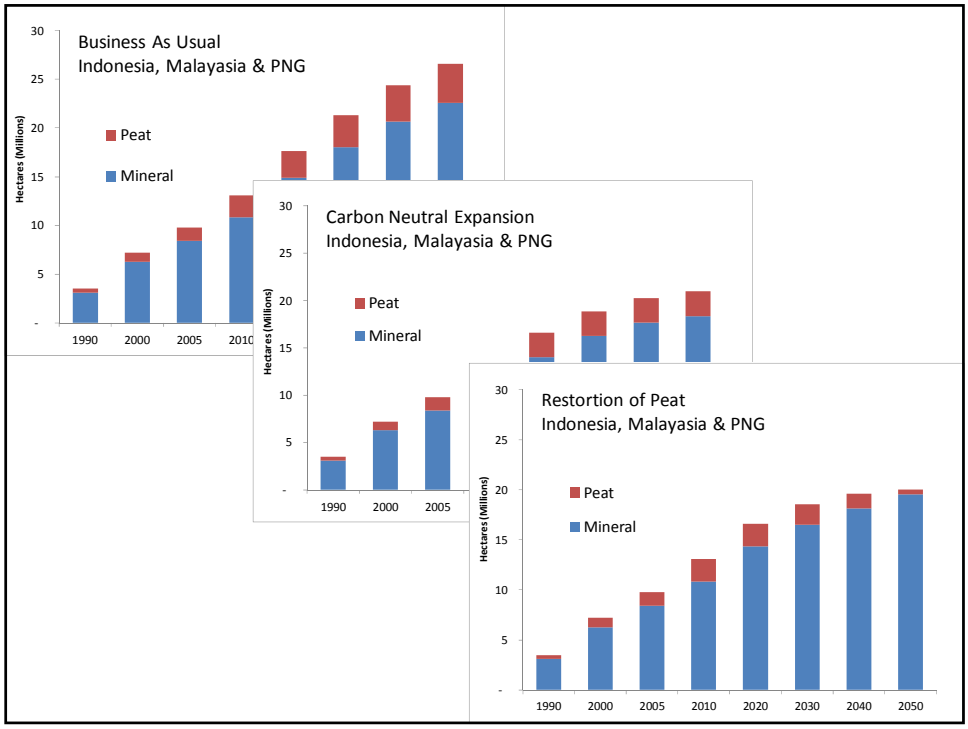

- The vertical axis shows the area of oil palm
- the horizontal axis the total surface area of each of the three sub national units.
- Forest degradation refers to transitions from high biomass to low biomass natural land cover types
- Other Sources of LUC pools GHG emissions from AGB from LUC and emissions from peat oxidation for agriculture, agroforests and plantation forestry.
- Data for oil palm is presented separately for AGB from LUC and peat oxidation.






## Comparison with other studies.

Koh & Wilcox (2008)

Our analysis of land-cover data compiled by the United Nations Food and Agriculture Organization suggests that during the period 1990–2005**, 55%–59**% of oil palm expansion in Malaysia, and at **least 56%** of that in Indonesia occurred at the expense of forests.

| | **1990 -2010** | | |
|---|---|---|---|
| | **Indonesia** | **Malaysia** | Both |
| **Upland Forest (UDF+DF)** | 19% | 38% | 26% |
| **Swamp Forest (USF+DSF)** | 14% | 4% | 11% |
| | 33% | 42% | 37% |
| **Shrub & Grasslands (SCH+GRS)** | 20% | 0% | 13% |
| **Open Swamp (SSH+SG)** | 6% | 0% | 4% |

Center for Remote Sensing and Processing - NUS
Miettinen et al. (2011) Global Change Biology (2011) 17, 2261–2270.

| | 2000 - 2010 | | | |
|---|---|---|---|---|
| | Total Deforestation | | Conversion of Peat | |
| | CRISP | RSPO | CRISP[1] | RSPO |
| **Peninsular Malaysia** | 440,000 | 381,000 | 52,000 | 100,000 |
| **Sumatra** | 3,451,000 | 1,767,536 | 1,292,000 | 1,117,488 |
| **Borneo** | 5,000,000 | 4,503,999 | 1,038,000 | 1,293,872 |

## Sarawak

| | Total Forest Cover | | | Peat Forest Cover | | |
|---|---|---|---|---|---|---|
| | 2000 | 2005 | 2010 | 2000 | 2005 | 2010 |
| FRIM | 8,483,071 | 7,872,703 | | 1,343,063 | 1,251,060 | |
| RSPO | 9,704,000 | 9,500,000 | 9,293,413 | 607,311 | 517,856 | 366,048 |
| SARVISION | | 8,984,450 | 8,118,614 | | 1,055,897 | 702,967 |
| | | | | | | |
| Change FRIM | | 610,368 | | | 92,003 | |
| Change RSPO | | 204,000 | 206,587 | | 89,455 | 151,809 |
| Change SARVISION | | | 865,836 | | | 352,930 |

Rashiid et al. (2011) land use change in Malaysia, report to RSPO GHG WG2

SARVISION (2011). Impact of oil palm plantations on peatland conversion in Sarawak 2005-2010

Carlson et al. (2012) Carbon emissions from forest conversion by Kalimantan oil palm plantations. *Nature Climate Change*

| **Extent of Oil Palm plantations** | | |
|---|---|---|
| | Carlson et al | RSPO |
| 1990 | 90,300 | 85,742 |
| 2000 | 836,000 | 737,317 |
| 2010 | 3,164,000 | 2,896,952 |
| % on peatland | 13% | 11% |

Carlson et al. (2012) Carbon emissions from forest conversion by Kalimantan oil palm plantations. *Nature Climate Change*

| **Carlson et al.** | | **RSPO** | |
|---|---|---|---|
| Primarily intact | 47% | Primary Forests | 0.2% |
| Logged forests | 22% | Disturbed Forests | 43.5% |
| Agroforests | 21% | Shrub lands | 46.6% |
| Non-forested | 10% | Grasslands | 1.1% |
| | | Agroforest | 3.1% |
| | | Other | 5.6% |

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