UNIVERSITY OF LEICESTER

BogFest: Edale, Peak District National Park
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GLOBAL PEATLANDS

Are you cooking the planet?

From tropical peatlands to your weekly shop

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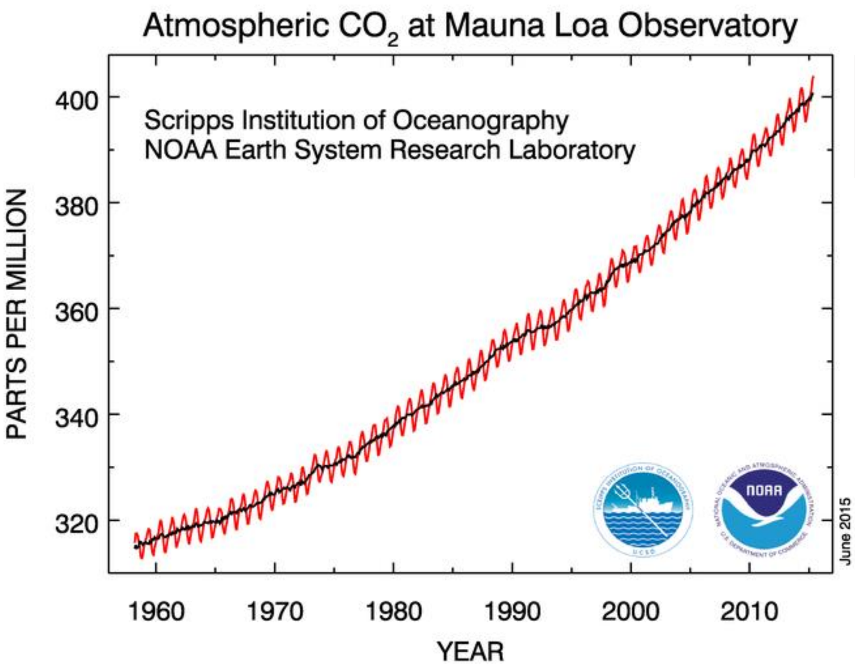
How are these pictures connected?

Atmospheric CO_2 concentration



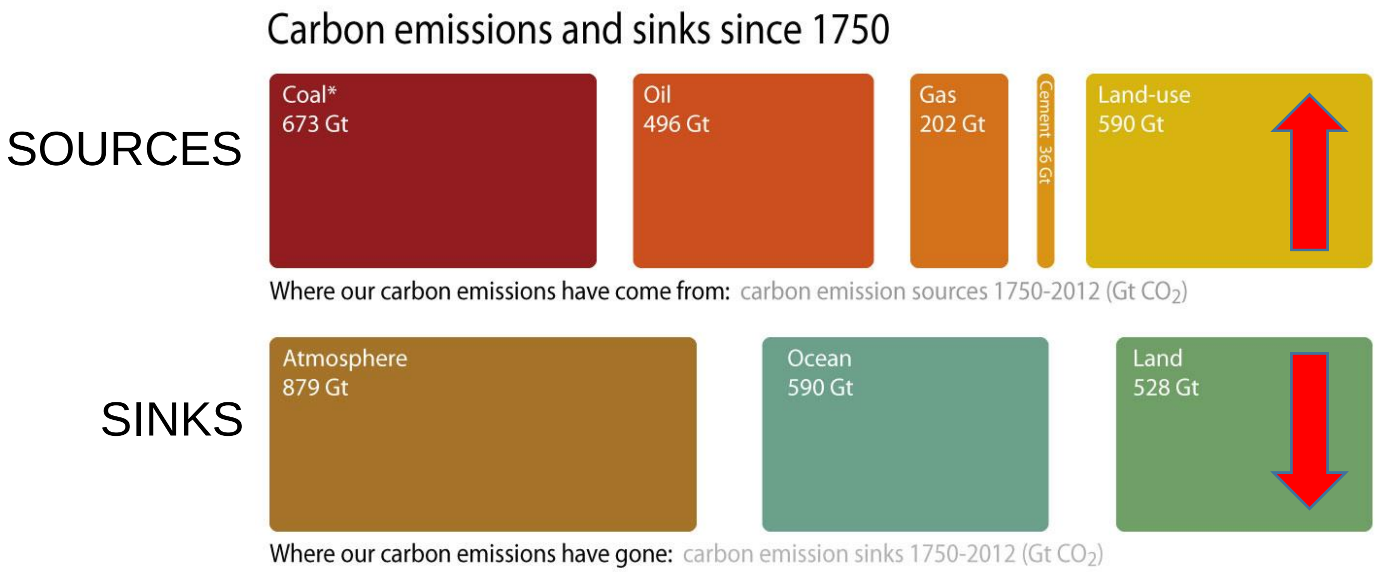
403 ppm
2016

Global CO_2 concentration increased from ~277ppm in 1750 to 403 ppm in 2016 (up 44%)

Mauna Loa (Hawaii) registered the **first** daily measurements above 400 ppm in May 2013

(Graph: NOAA)

Carbon emissions & sinks



Together ocean and vegetation sinks have absorbed 56% of human carbon emissions since 1750.
Without these sinks working overtime atmospheric CO_2 concentrations would already be well over 500 ppm.

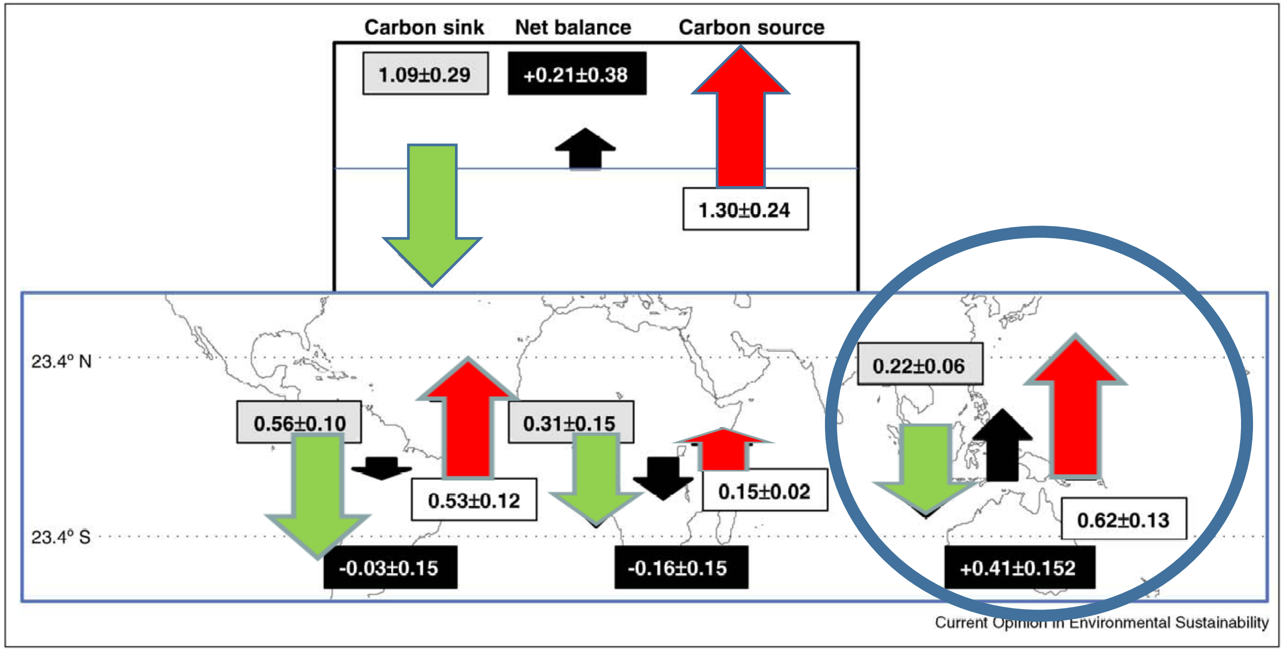
Yet at the same time we are REDUCING the 'land' carbon sink (e.g. forest & peatland loss)
And CONVERTING carbon sinks to carbon sources (e.g. peatland drainage)

(shrinkthatfootprint.com/carbon-emissions-andsinks#bhbYIw30FQRf7HCw.99)

The tropical carbon story

Estimates of carbon sources and sinks in tropical forest regions, 2000–2005

Arrow lengths are indicative of magnitude of fluxes, but not exact.
Green arrows indicate biomass carbon sink
Red arrows deforestation/land use change net carbon source
Black arrows the net balance

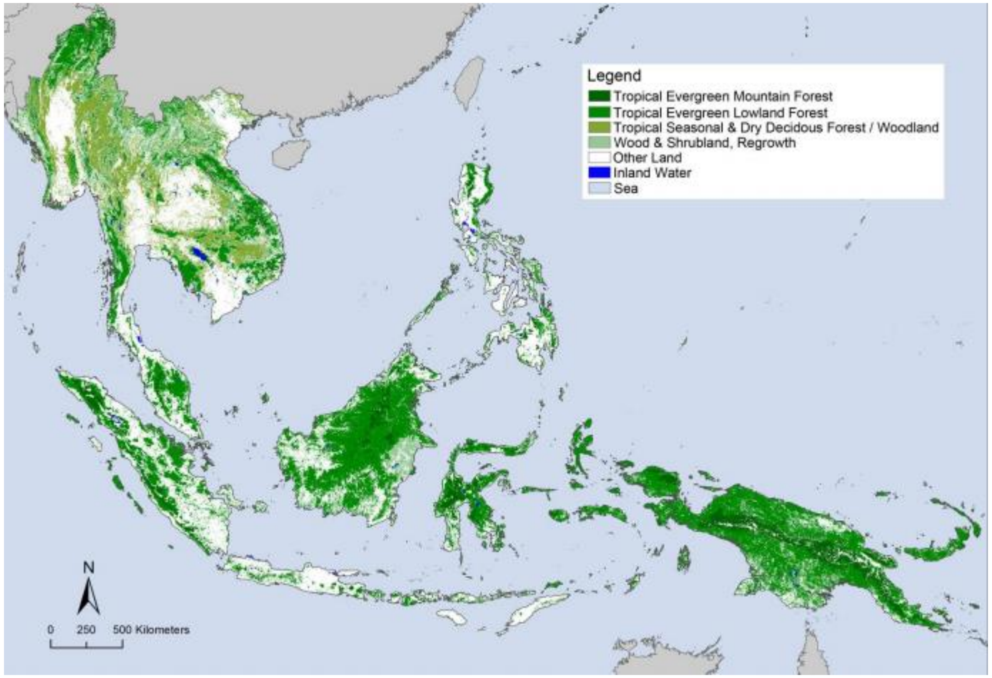


SE Asia – a net source of carbon

(From Malhi, 2010)

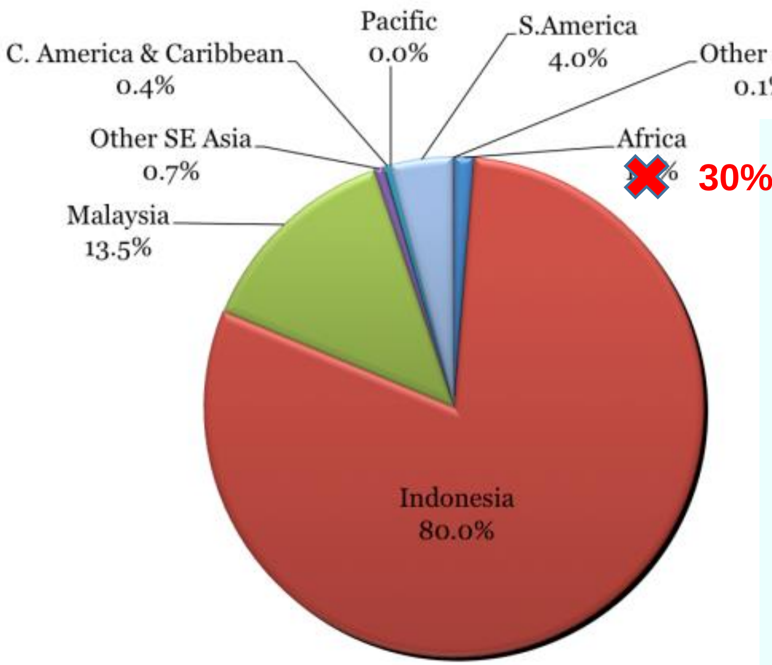
Southeast Asia

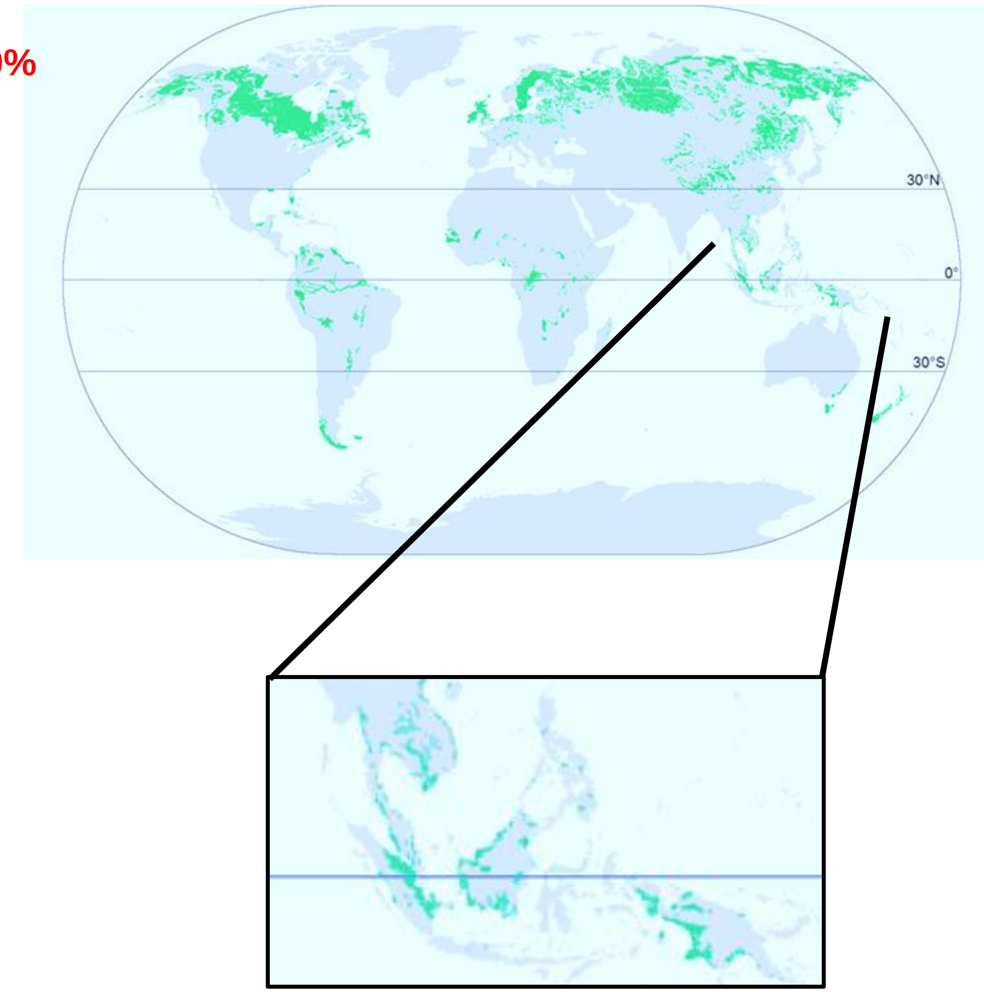
- Why is SE Asia such a strong source of carbon from land use change?



(Map source Stibig et al., 2014)

Tropical peatland C stock

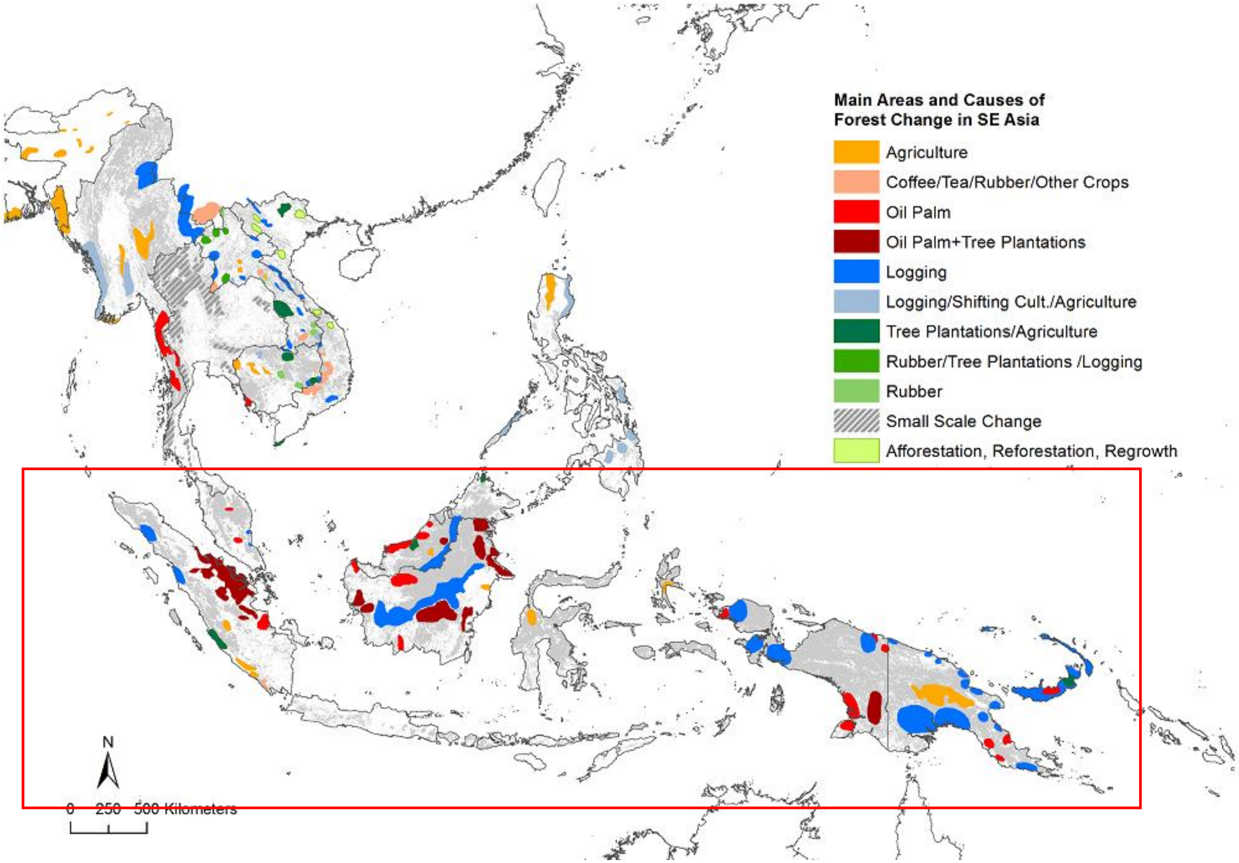




Tropical peat C pool
Best estimate ~120 Gt carbon
69 Gt in SE Asia

(Page et al., 2011 Global Change Biology; Dargie et al. (2017) Nature
(Map: http://www.aseanpeat.net/index.cfm?&menuid=62)

SE Asia – location for rapid forest loss



Rapid plantation development - oil palm and pulpwood – particularly on peatland
2000-2010 : 2.25% / year loss of peat swamp forest
(compare to overall rate of regional forest loss of 0.6% / year)

(from Stibig et al. 2014 & Miettinen et al. 2011)

Tropical peatlands

- Why does it matter that tropical peat swamp forests have been the focus of such rapid land use change?
- And what has this got to do with those items in your shopping trolley?

- Let’s now focus on the peat swamps and the carbon impact of the principal driver of change – conversion to plantations
- It is also important to consider why SE Asian peatlands have been the focus for such rapid land use change

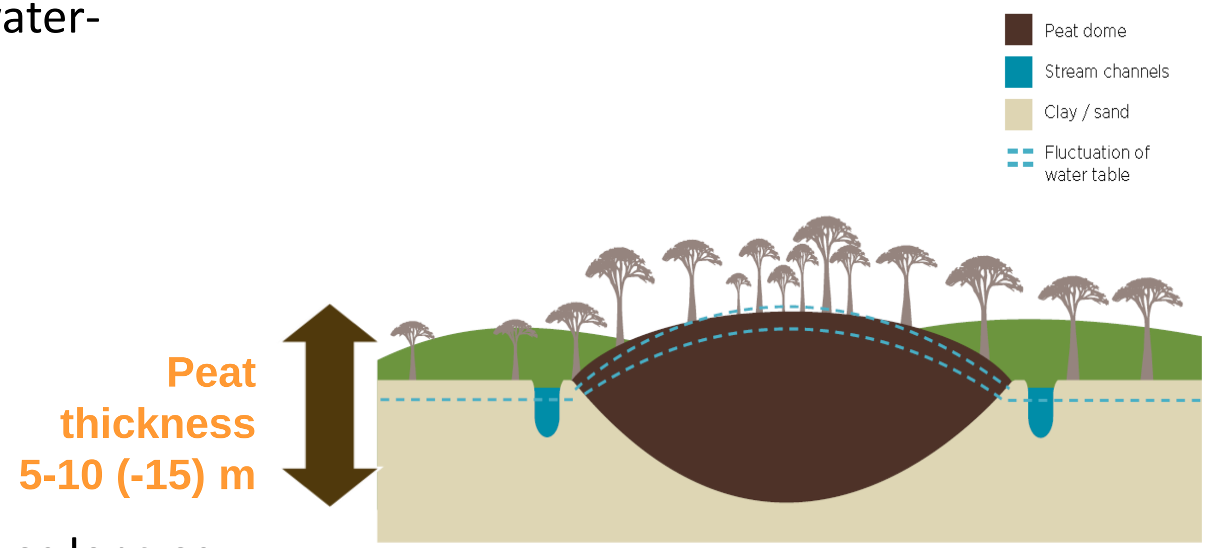
Peatlands are part land and part water: tropical peatlands are no different

Peatland in Riau's Kampar peninsula
(JG Photo/Safir Makki)

Mendaram peatland in Brunei

Water is essential for peat formation and maintenance

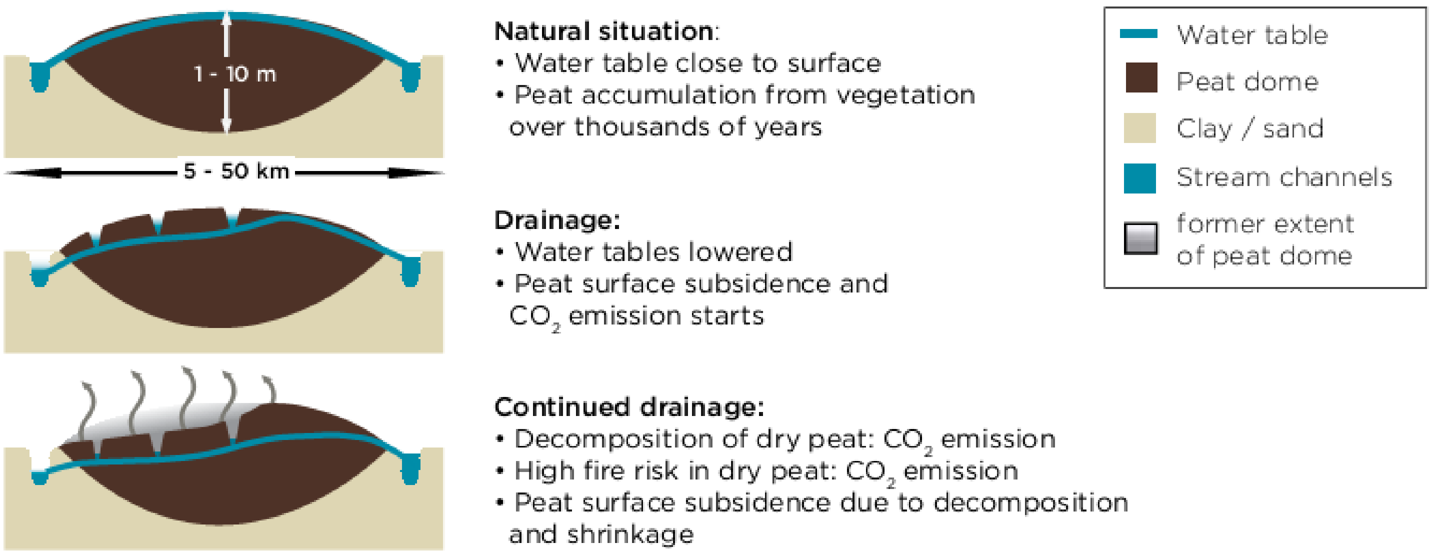
- Peatlands develop where dead vegetation (carbon) accumulates over 1000s of years in water-saturated conditions.



- Accumulation continues as long as water tables are at or close to the peat surface throughout the year.
- Tropical peatlands are no different from other peatlands – water is essential.

Peatland drainage

- **Drainage** lowers peat water table promoting
  - peat oxidation i.e. peat decomposition : proceeds rapidly in a tropical environment → CO_2 emission to the atmosphere
  - increased fire risk → CO_2 + CO + CH_4 emissions to the atmosphere



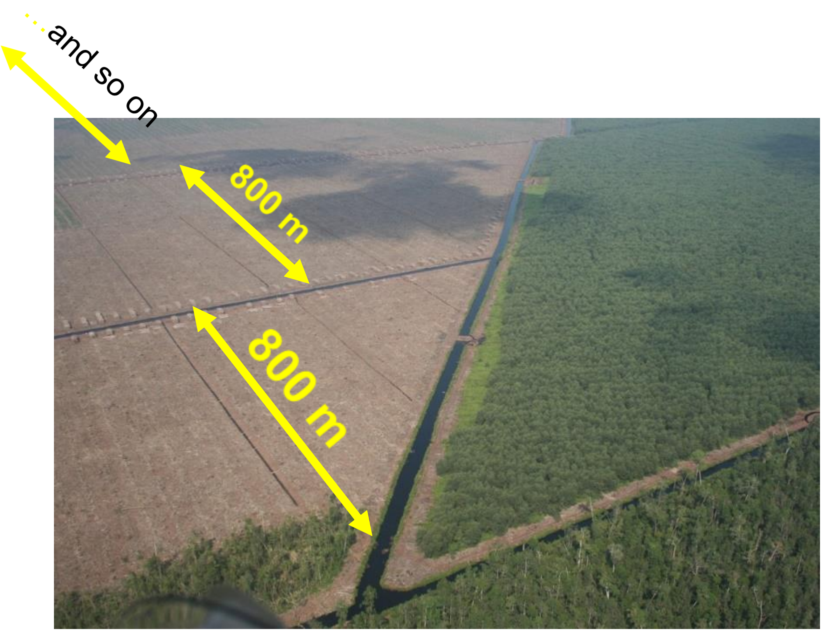
(Page, Morrison et al. 2011)

Vulnerable peat carbon pools

Why is the tropical peat carbon pool in SE Asia so vulnerable?

- ➢ Rapid land use change
- ➢ Agricultural conversion (smallholder → industrial-scale plantations)
- ➢ Use of fire as a cheap & rapid land clearance tool
- ➢ Climate change

→ Conversion of peatlands from C sinks to C sources



Increasing demand for agricultural land – but all cultivation on peat requires drainage

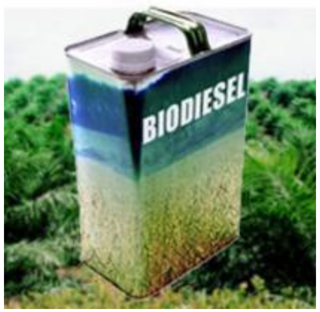
Drainage depths

- Oil palm – 60-80 cm
- Acacia (pulpwood) – 70-80 cm
- Vegetables – 30-60 cm

- In practice, often > 100 cm – even to 150 cm

Increasing scale of plantation management

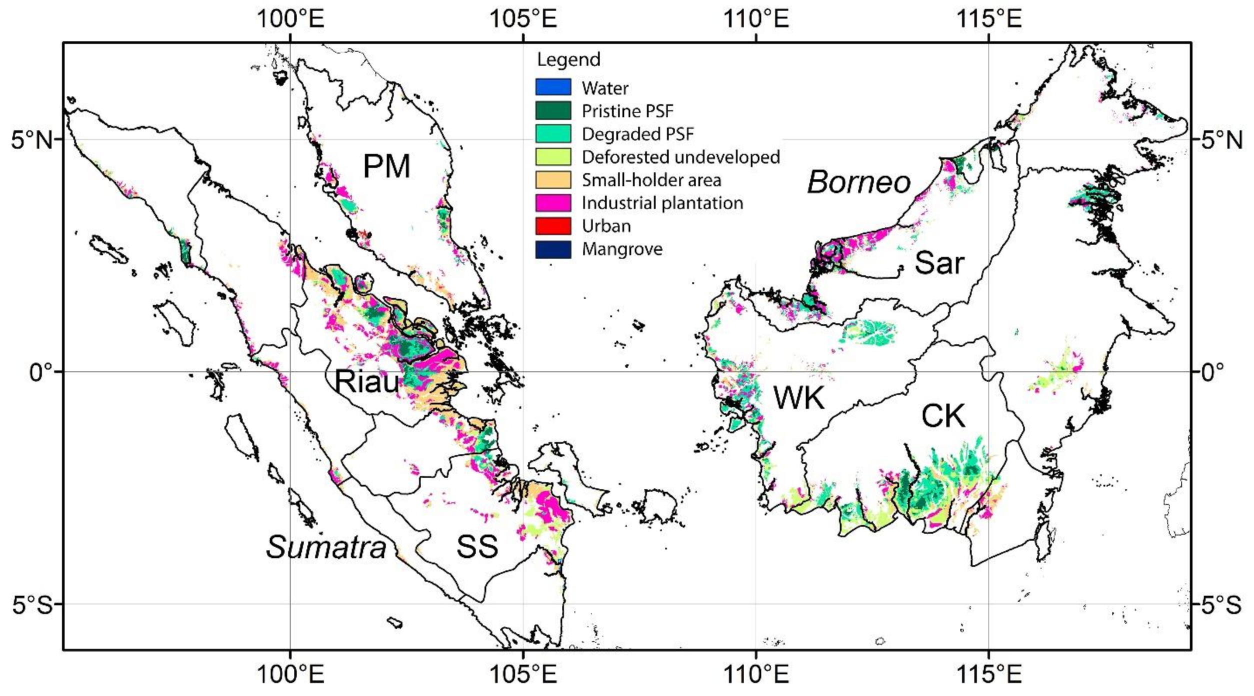
- Oil palm plantation establishment and palm oil production has grown rapidly in SE Asia over last two decades: Indonesia and Malaysia currently meet **85% of global palm oil demand**



- Industrial plantations covered ~3.1 Mha (20%) of the peatlands of Peninsular Malaysia, Sumatra and Borneo in 2010
- Projections of future conversion rates indicate 6 to 9 Mha of peatland may be converted to plantations by 2020 (40-60% of SE Asian peatlands)

(Miettinen, Hooijer, Page et al. 2012)

Land uses on peat in SE Asia: 2015

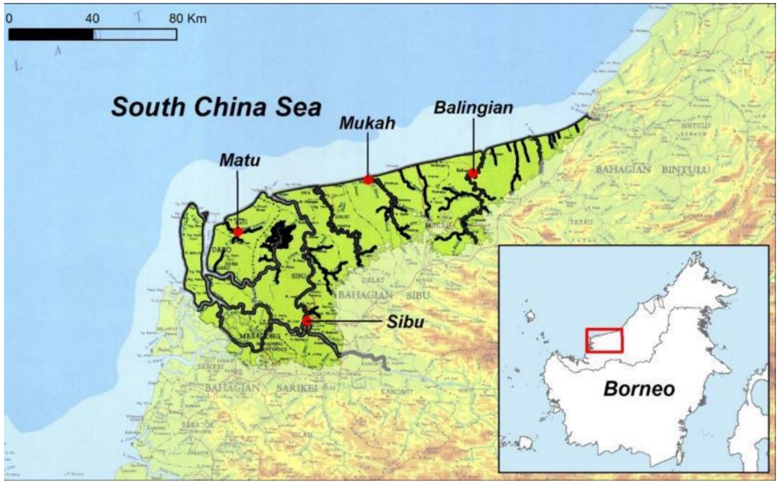


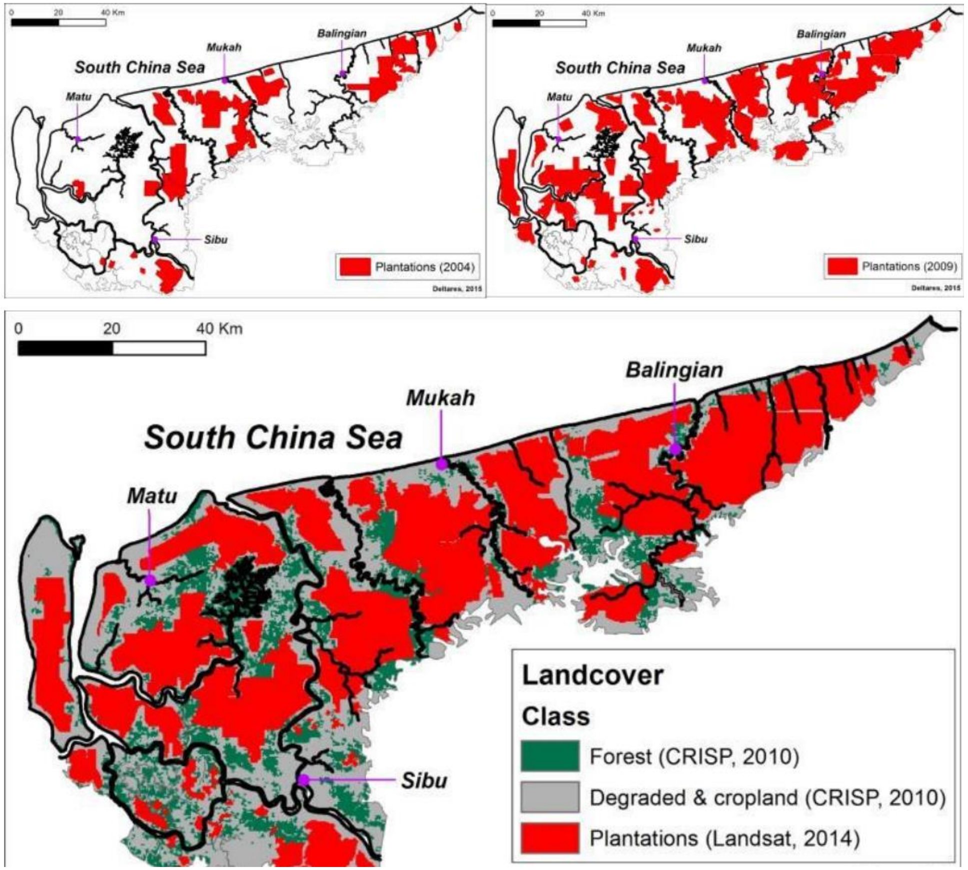
Pristine PSF	Degraded PSF	Tall shrub & 2° forest	Ferns & low shrub	Small-holder areas	Industrial plantations	Other
6.4%	**22.8%**	**11.1%**	**5.4%**	**22.4%**	**27.4%**	**4.5%**

~50%

(From Miettinen et al. (2016) Global Ecol. & Conservation
& Miettinen, Page et al. (2017) Env Res Letts)

Rajang Delta, Sarawak

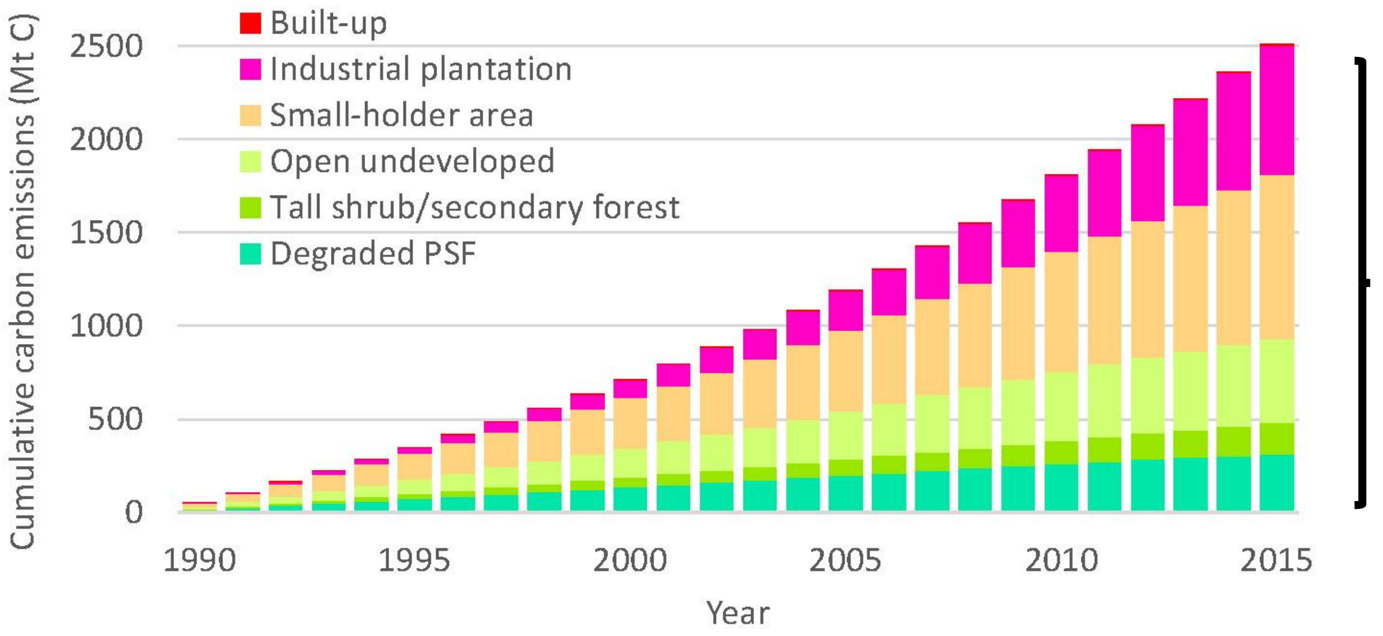




Very rapid expansion of
oil palm plantations
on coastal peatlands –
2004, 2009, 2014

(From Hooijer et al, 2015)

Scale of carbon emissions from oxidation of drained peatlands in insular SE Asia (excluding fluvial & fire losses)



Total 2500 Mt C loss = 4% of region's C pool (69 Gt) over only 25 yrs

From: Miettinen et al. (2016) Global Ecol. & Conservation;
Miettinen, Page et al. (submitted);
Page et al. (2011) Global Change Biology

Global picture: organic soil GHG emissions

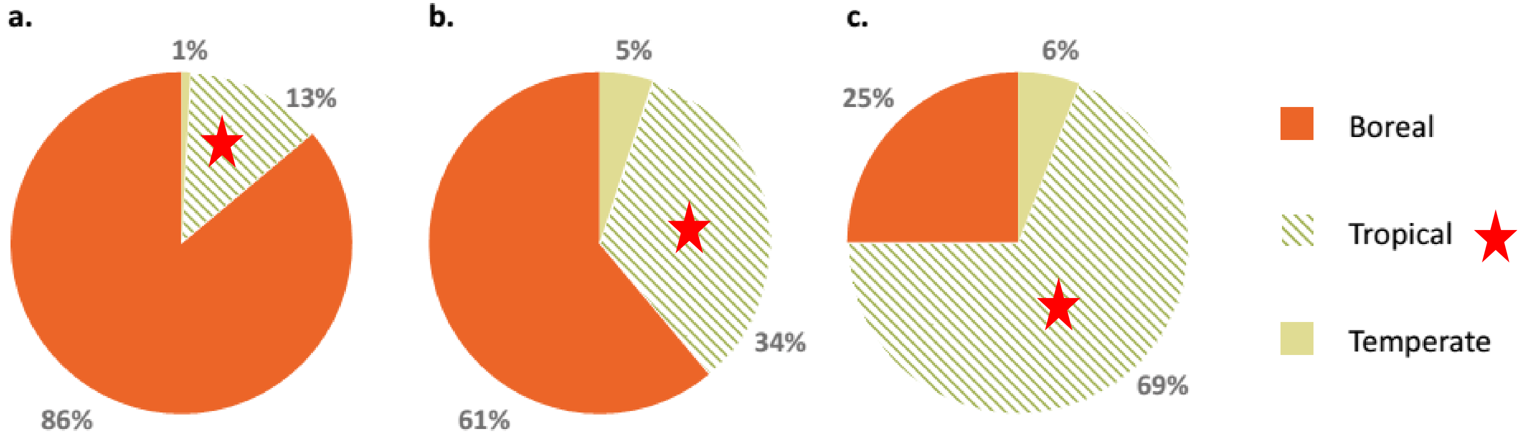


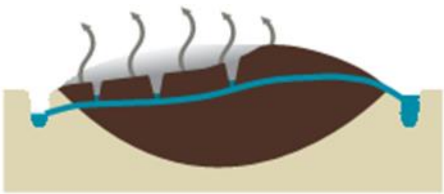
Figure 2.1 Global information on organic soils per climatic zone.
a: distribution of organic soils; b: distribution of drained organic soils; and c: GHG emissions[3] from drained organic soils.

[3] The estimates are based on the IPCC Guidelines 2006 (Tier 1 approach: CO_2 and N_2O) and on the geo-referenced data of the Harmonized World Soil Database.

N.B. – Excludes fire emissions

From: Biancalani, R. & Avagyan, A. (eds) (2014) Towards climate-responsible peatlands management. FAO, Rome.

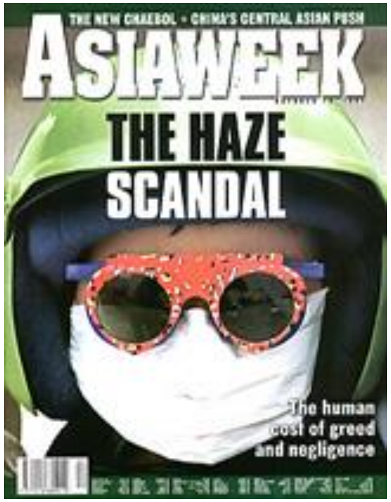
Peatland fires



Continued drainage:
- Decomposition of dry peat: CO_2 emission
- High fire risk in dry peat: CO_2 emission
- Peat surface subsidence due to decomposition and shrinkage

Peat fires

Sept 2002*: "Smoky haze chokes Southeast Asia …. Again this year hundreds of fires burn deep into the underlying peat layer … spreading smoke across the region".*



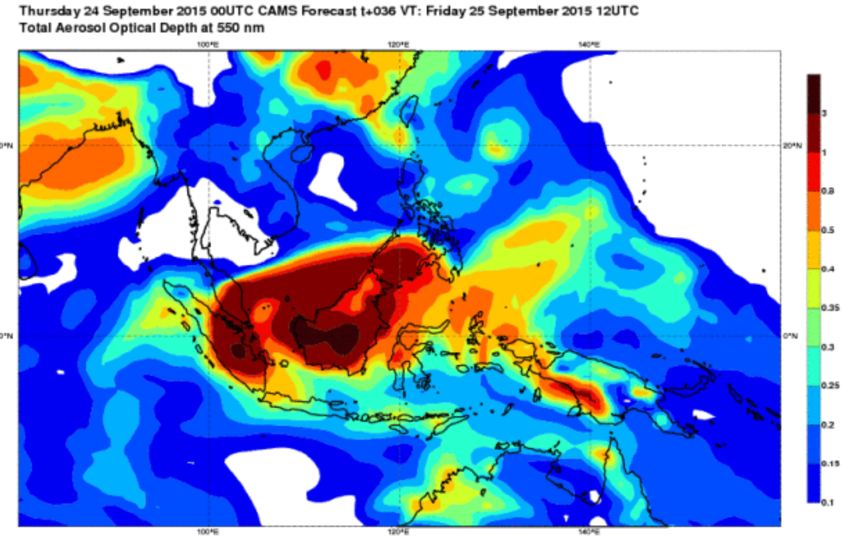
Singapore – 2013 & 2015

2015: *"Six Indonesian provinces declare a state of emergency as haze from the wildfires on Sumatra and Kalimantan worsens..."*

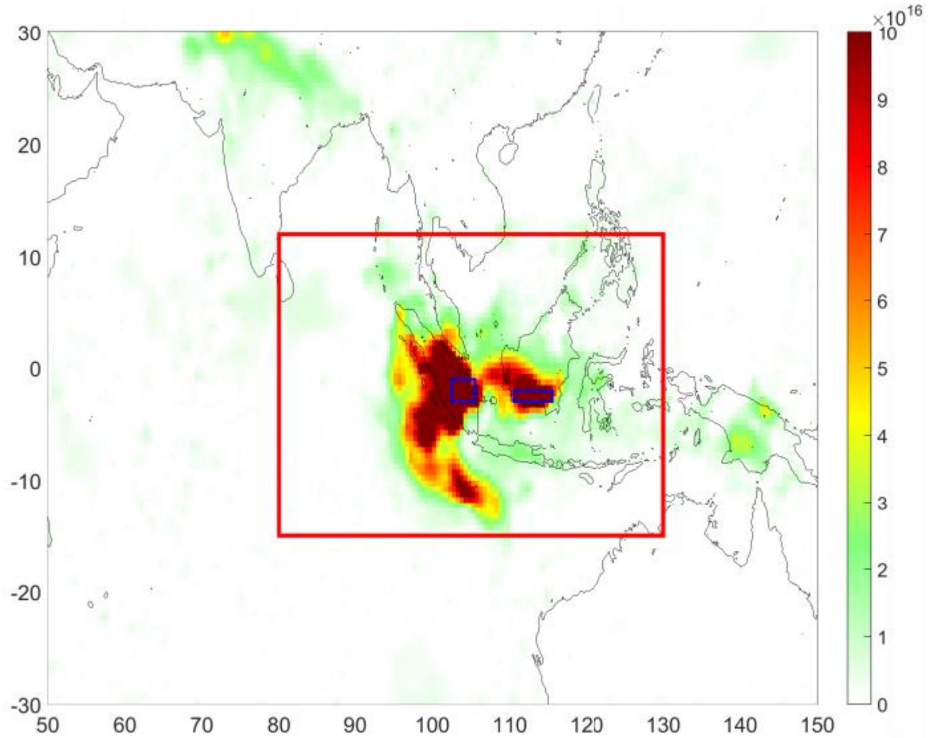
(http://www.prokerala.com/news/photos/an-indonesian-student-shows-a-placard-during-a-339799.html)

Peat fire emissions – new knowledge from satellite technologies

Aerosols from biomass burning captured by Copernicus project – Sept 2015



Ammonia emissions from biomass burning - IASI satellite - 25 Oct 2015

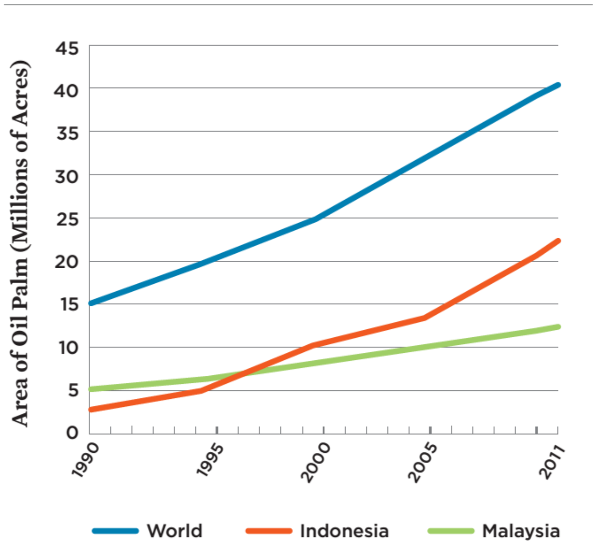


(From: www.atmosphere.copernicus.eu; Whitburn et al. (2016) Geophys. Res. Letts.)

Why continue?

- Despite knowledge of the high GHG emissions associated with plantation development on peat soils & consequences of peat fires, plantations continue to be established on land occupied by peat swamp forest.
- Why?
- (a) Land shortage – e.g. Sarawak
- (b) Economics - companies subsidise establishment of plantations by selling timber from the concession area: Often the only high quality remaining forested land is on peat soils
- (c) Demand for cheap vegetable oil

The demand for palm oil



World oil palm cultivation area, 1990-2011

(source: www.ucsusa.org/palmoilfacts)

- Demand likely to continue:
  - High yield (5-8 times more oil produced per hectare than other oil crops)
  - Relatively cheap (low labour costs)
  - High demand for vegetable oils (cooking oil, food & laundry products, cosmetics etc)
  - Demand for biodiesel fuel (renewable energy)
  - SE Asian peatlands now – could we see future plantations on peatlands in S. America or Central Africa?

Solutions?

- Encourage expansion of new plantations on degraded land – save remaining forests and peatlands
- Promote biofuel policies that avoid unintended consequences – e.g. where carbon costs of vegetable oil production outweigh the gains from using the oil as a renewable energy source
- Encourage companies using palm oil derivatives to ensure that raw materials do not contribute to deforestation and peatland drainage
- Educate consumers to exert their influence – only buy products from companies that recognise the importance of sourcing palm oil in a responsible manner
- NEW (Dec 2014): EU law on food information to consumers (FIC) means that food manufacturers can no longer hide ingredients under generic titles. Now all ingredients have to be described – including palm oil (although not whether it is from ‘sustainable’ sources)

(www.ucsusa.org/palmoilfacts)

Responsible management

National and international initiatives to improve practices

- Roundtable on Sustainable Palm Oil
- Company policies: zero burn, zero deforestation, no planting on peatland
- Peatland research programmes (e.g. MPOB)
- Peatland Restoration Agency (Govt. of Indonesia)
- Peatland re-wetting & alternative plantation species – initial trials

Are you cooking the planet?

Tropical forests: peat swamp forest	Deforestation and drainage	High demand for palm oil	High GHG emissions from forest loss & drained peatlands
Carbon dense, biodiverse ecosystems	Conversion to oil palm plantations → loss of forest C + oxidation of soil organic C + fire → GHG emissions	A cheap vegetable oil with many uses - from groceries to biodiesel. Growing consumer demand.	Contribution to global climate change

Are you cooking the planet?

(Image: http://blogs.wwf.org.uk/blog/green-sustainable-living/green-sustainable-living-food/palm-reading-should-we-buy-or-boycott-products-containing-palm-oil/)