Promoting the Production and Use of Sustainable Palm Oil

Dr. Ir. Arina Schrier, WI
For the PLWG, RSPO
Impacts of oil palm production on peat

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Objectives Peatland Working Group

- Objective RSPO: promote sustainable oil palm products
- The Peat Land Working Group (PLWG) is part of the RSPO and functions as a work stream of its 2nd Working Group on Green House Gases.

  - Objective 1 PLWG: Scientific review on the influence of oil palm plantation development on peat and recommendations for reducing greenhouse gas emissions
  - Objective 3 PLWG: Study possibilities of verifying carbon pools and greenhouse gas emissions in peatlands
Outline

- History and land use change
- Impacts of drainage and deforestation (carbon losses, greenhouse gas emissions, fires, soil subsidence)
- Monitoring
- Recommendations on sustainable production
- Conclusions
Tropical peat swamp forest

- Ecosystem with a high biodiversity
- Important carbon store
Transect peat bog

A peat bog is rain water fed

Peat swamp forest

Organic matter + 90% water
# Deforestation: facts

<table>
<thead>
<tr>
<th>Area</th>
<th>Period</th>
<th>Reference</th>
<th>Peat Swamp conversion to other LU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insular SE Asia</td>
<td>2000-2005</td>
<td>WI Malaysia 2010</td>
<td>1.47</td>
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<tr>
<td>Sarawak</td>
<td>2005-2007</td>
<td>SarVision 2011</td>
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<tr>
<td>Sarawak</td>
<td>2009-2010</td>
<td>SarVision 2011</td>
<td>8.9</td>
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<td>Malaysia &amp; Indonesia</td>
<td>2000-2010</td>
<td>Miettinen et al 2011</td>
<td>2.2</td>
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<td>Borneo</td>
<td>1997-2002</td>
<td>Fuller et al 2004</td>
<td>2</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1990-2000</td>
<td>Hansen et al 2009</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Sources:
- Miettinen et al. 2011
- Hansen et al. 2009
- Fuller et al. 2004
- SarVision 2011
- WI Malaysia 2010
• **Malaysia** (Peninsular Malaysia, Sabah and Sarawak):
  – 0.6 - 0.67 million ha is on peat (Posa *et al.*, 2011; Agus *et al.*, 2011)

• **Indonesia**:
  – 1.3 million ha on peat, 1.0 million ha in Sumatra and 0.3 million ha in Kalimantan (Page *et al.*, 2011; Agus *et al.*, 2011). Concessions until 2020: 2.5 million ha on peat.

• Global demand food and biofuels is likely to put further pressure on peat swamp forests (Rijenders and Huijbregts, 2008; Fargioni *et al.*, 2008).
Drainage for production

Natural situation:
- Water table close to surface
- Peat accumulation from vegetation over thousands of years

Drainage:
- Water tables lowered
- Peat surface subsidence and CO₂ emission starts

Continued drainage:
- Decomposition of dry peat: CO₂ emission
- High fire risk in dry peat: CO₂ emission
- Peat surface subsidence due to decomposition and shrinkage

End stage:
- Most peat carbon above drainage limit released to the atmosphere within decades,
  unless conservation / mitigation measures are taken

Page et al., 2011
1. Initial rate 20-60 cm per year, mainly compaction
2. Subsidence rate 4.6 cm per year, shrinkage/compaction + oxidation
3. Final rate 2-5 cm per year, mainly oxidation: 92% of cumulative subsidence was caused by peat oxidation

(e.g. Hooijer et al., 2011; Wosten et al., 1997; Couwenberg et al., 2010; Mohammed et al, 2009)
Risks of Soil Subsidence

- Salt water intrusion
  - Impact on fisheries (Cruz et al., 2007; Loukos et al., 2003)
  - Impacts on biodiversity (Cruz et al., 2007)
  - Impacts on coastal agriculture (Silvius et al., 2000).
Loss of Carbon

- Natural swamp forest into plantation: release of C above ground: 153 – 359 t C ha\(^{-1}\)

- Logged forest to plantation release of C above ground: 47 – 214 t C ha\(^{-1}\).

- Drainage: ongoing release of C: 7-40 t C ha\(^{-1}\) yr\(^{-1}\).
9.1 t CO$_2$ ha$^{-1}$ yr$^{-1}$ per each 10 cm drainage depth (Couwenberg et al., 2010); range 26-178 t CO$_2$ ha$^{-1}$ yr$^{-1}$ (Agus et al., 2009; Lamade and Bouillet, 2005; Hooijer et al., 2011).

86 t CO$_2$-eq ha$^{-1}$ yr$^{-1}$ for drainage depths of 60 – 85 cm (Page et al. 2011; Hooijer et al., 2011).

With higher water tables (40-60 cm as is advised in the BMP) this emission will be lower.
Water management

- BMP: maintaining water levels in the field drains at 40-60 cm, however, if palms are young, even water levels of 35-45 cm are sufficient to obtain high yields

MPOB Research Station in Sessang, Sarawak (Source: Mohammed et al., 2009).
Greenhouse gas emissions

**CH4:**
- Land: ~ 0 emissions
- Waste- and open water fluxes: about 0.8 – 1.2 t CO$_2$-eq ha$^{-1}$ yr$^{-1}$ from palm oil mill effluents and possibly up to 8 t CO$_2$ ha$^{-1}$ yr$^{-1}$ for fluxes open water.

**N2O:**
- 0.56 t CO$_2$-eq ha$^{-1}$ yr$^{-1}$ (Melling et al., 2007)
- 4.1 t CO$_2$-eq ha$^{-1}$ yr$^{-1}$ (IPCC default value for tropical histosols)
Greenhouse gas and Carbon measurements

- Chamber (direct measurements: low temporal coverage, high spatial coverage)
- Eddy Covariance (direct: high temporal coverage, low spatial coverage)
- Proxies (indirect measurements: soil subsidence, water table, temperature)
Chamber measurements

- Use short (4-5 minutes) closure times
- Use regression if possible, not integration for temporal upscaling
- Take into account the components that differ in emissions
- Distinguish between auto- and heterotrophic respiration
Monitoring

- System boundaries
- Stratify/determine sources and sinks
- Estimate emissions within the strata by e.g. measuring soil subsidence
- Determine emission reductions and/or carbon gains by estimating or measuring changes over time

8 years subsidence in Woodman plantation, Sarawak
Fires

- Primary undisturbed rainforests usually do not burn.

- The increased fire frequency due to drainage of peat results in the release of high amounts of $\text{CO}_2$ and $\text{CH}_4$.

- Average of 261 t C ha$^{-1}$ yr$^{-1}$ for the years 1997, 2001 and 2002 was released.

- Fires affect the climate worldwide and affect social life, economy and human health (respiratory illnesses).
Human disturbance

CO₂

- Russia: 60 Mt
- EU: 174 Mt
- USA: 72 Mt
- Central Asia: 115 Mt

• Deforestation
• Drainage
• Fires
Recommendations for sustainable palm oil production

**New plantation land:**
- Development on mineral soil and non-peat/low carbon degraded land
  - Emission reduction 70-80%

**Existing plantations on peat:**
- Introduction of BMP:
  - Good water management (= key factor!)
    - Drainage depth av. Max 50 cm (40-60 cm) in field drain
    - Emission reduction > 40%
  - Fire prevention and fire control, zero burning
  - Compaction, vegetation cover on bare soil
  - Recycling of wastes and pulvarizing old palms

- Consider cut-off point for peat rehabilitation,
  - Considering GHG, subsidence and flooding

MPOB, Mohammed et al., 2009
Conclusion

- Large subsidence following drainage -> future risk of flooding (-> high costs for flooding defense!)
- Large emissions from oil palm on peat because of drainage
- Water level is the main factor to reduce emissions. BMP: 40-60 cm in field drains.
- Avoidance of development on plantations on peat because not sustainable
- For RSPO: Consider ‘cut-off point’ for existing plantations on peat