Requirements for and operational aspects of water management in tropical peatlands

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Peatlands and carbon

- Peatlands worldwide store 528 Gigatonne (Gt) Carbon,
- Equivalent to:
  - 30% of terrestrial carbon
  - 75% of all carbon (C) in the atmosphere
  - 70 times current annual global emissions from fossil fuel burning
- Carbon storage in peat is very long-term

Peatlands store large amounts of carbon
Peatland degradation leads to CO₂ emissions which contribute to global warming
Wet situation leads to CO$_2$ sequestration

Intact peat:
- water table near surface allows accumulation of organic matter (carbon sink)
Drainage leads to CO$_2$ emissions

Drained peat:
- oxidation
- fires

Carbon source
Wet and dry periods vary over the year
Water balance
Mitigation strategy

Adequate water management is the key issue

In mitigating peat carbon losses due to drainage and fire
- Natural peat swamp forest

- Agricultural land use

- Plantation crops

Water management Requirements and Operational Aspects
Natural peat swamp forest
Natural peat swamp forest
Natural peat swamp forest

Reservoirs of:
- water
- biodiversity
- carbon
Water level fluctuations

[Graph showing water level fluctuations over time from 1/1/94 to 29/12/04]
Natural peat swamp forest
Simple dams using local available material
Effectiveness of simple dams

Head difference over the dam

<table>
<thead>
<tr>
<th>week</th>
<th>Dam1</th>
<th>Dam2</th>
<th>Dam3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.12</td>
<td>0.08</td>
<td>0.10</td>
</tr>
<tr>
<td>2</td>
<td>0.10</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>3</td>
<td>0.08</td>
<td>0.06</td>
<td>0.08</td>
</tr>
<tr>
<td>4</td>
<td>0.06</td>
<td>0.05</td>
<td>0.06</td>
</tr>
<tr>
<td>5</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
</tr>
</tbody>
</table>
Agricultural land use
Peat swamp forest deforestation

Relative total vs PSF area decline Insular SE Asia

- **Peatland deforestation:**
  - since 2000: 1.5%/yr which is double the rate for non-peatlands
  - currently 45% deforested

**Peat forest conservation**

- < 5% of total peatland area
Expansion of agricultural areas
Forest degradation
## Crop water requirements

<table>
<thead>
<tr>
<th>Crop</th>
<th>Water Management Requirements</th>
<th>Main constraints to yields or productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Optimum range of the water table (m)</td>
<td>Maximum period of flooding (days)</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>Oil palm</td>
<td>0.6</td>
<td>0.75</td>
</tr>
<tr>
<td>Cassava/Tapioca</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>Sago</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Horticultural crops</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>Aquaculture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paddy</td>
<td>-0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Pineapple</td>
<td>0.75</td>
<td>0.9</td>
</tr>
<tr>
<td>Rubber</td>
<td>0.75</td>
<td>1.0</td>
</tr>
<tr>
<td><em>Acacia crassicarpa</em></td>
<td>0.70</td>
<td>0.8</td>
</tr>
</tbody>
</table>

- Oil palm: low fertility, susceptible to termites, poor anchorage, drought stress
- Cassava/Tapioca: Mechanisation
- Sago: Mechanisation
- Horticultural crops: Mechanisation
- Aquaculture: water quality, construction of ponds, water control in ponds
- Paddy: water control in individual plots, plant nutritional problems, mechanisation
- Pineapple: Mechanisation
- Rubber: poor anchorage
- *Acacia crassicarpa*: poor anchorage
Simple relationship

subidence rate (cm/year) = X * groundwater level (cm)

X co-efficient varies:
0.1 Sarawak
0.04 Western Johore
Fire risk: comparison

Groundwater level < -40 cm
⇒ very high chance on fire
Sophisticated dams
Plantation crops
Livelihood ➔ Plantation

Drainage is needed to make peatlands suitable for agriculture

- Oil palm
- Sago palm in rice plot
- Aloe Vera
- Vegetables
Construction of drainage canals
Oil palm cultivation
Complicated dams
Road maintenance
Subsidence readings show that agricultural use of peat – thus also plantations – causes disappearance of peat. Whereas in a natural peat swamp forest peat is accumulated.

The deeper the drainage the more peat is lost.
Conclusions (continued)

- Adequate water management has a high carbon mitigation potential as it helps to minimise subsidence under a given land use type and associated groundwater level.

- More severe and longer dry spells as predicted from climate change is likely to increase carbon emissions due to drainage and fire.
Thank you for your attention