COASTAL DEVELOPMENT IN PLEATLANDS: A CHALLENGES OR A CURSE
are experiences from the Netherlands useful in the tropics?

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Are experiences from the Netherlands useful?

The Netherlands — 34,000 km²
16.5 million people
? ha peatland

Sarawak - 125,000 km² - 2.3 million people – 1.6 million ha peatland (13% of the land area)
The Netherlands: an man-made low land

At present:
- 25% of the land below MSL
- 65% of the land protected with dikes & dunes
Peatlands in the Netherlands

1000 years ago

today
Peat forming

Under natural conditions tropical peatlands consist of waterlogged organic soils with more than 35% organic matter in various stages of decomposition.

Accumulation rate: **2 – 5 mm/year**  (Charman 2002)
What happened during the last 1000 years?

Under natural conditions: peatlands are waterlogged

\[ \downarrow \]

drainage is needed to make these waterlogged lands suitable for agriculture or other land use

\[ \downarrow \]

drainage = changing the water balance

Negative consequences:

- irreversible drying
- excessive subsidence
- water stress during dry periods
Why is hydrology of peatlands important - subsidence

Under natural conditions peat accumulation: 2 – 5 mm/yr

Reclaimed: lower water table ➔ subsidence

Subsidence (cm/yr) = 0.1 x watertable (cm)

2 – 5 cm/yr

subsidence ≈ 10 x accumulation
Peatland management in the Netherlands

1200: gravity drainage

1500: pumped drainage

2000: 25% below MSL
    pumping 24 hrs/day
Never-ending subsidence in The Netherlands
Is this wise use?

“Wise use” is defined as use for which reasonable people, now and in the future, will not attribute blame (Joosten and Clark, 2002)
Differences between the Netherlands and Malaysia?

Subsidence rates

UK

1875

Sarawak

1978 ➔

2002 ➔

2007 ➔
Why is water management needed?

- **Wise use – reduce subsidence**: Control the water table
- **Nature & restoration**: Conserve the water
- **Other land use**: Remove excess surface and subsurface water

![Graph showing water management needs with data for various months.](chart.png)
Control of the water level
↓
In peat soils hydraulic conductivity is high
↓
Control of the water level is difficult
Peat has a large water-holding capacity

Storage capacity = change in watertable ↓
runoff is rather small compared to mineral soil areas

e.g. in Western Johore for 1 x 5 yrs rainfall:
• peatland 7 mm/d (0.8 l/s)
• mineral soil: 52 mm/d (6.0 l/s)
Drainability is based on the level of the mineral subsoil related to the water level in the adjacent river or stream.
Subsidence never-ending

<table>
<thead>
<tr>
<th>Peat depth (cm)</th>
<th>Elapsed time span (years) for peat disappearance</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Oil palm cultivation (watertable 0.50 m)</td>
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<tr>
<td>Shallow peat (&lt; 150)</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>250 – 500</td>
<td>30 – 80</td>
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<tr>
<td>500 – 1000</td>
<td>80 – 180</td>
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</tbody>
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If peat layers has disappeared:
- Gravity drainage ➔ pumped drainage
- Runoff will increase 5 to 10-fold,
Experiences from the Netherlands:

- Increased risk of flooding
- Unevenly distributed subsidence causes misalignment of roads, power cables, water and gas mains
Infrastructural options:

- Land fill
- Low pressure vehicle
- Floating roads
- Floating buildings
- Flexible connections between houses and sewerage & water mains, between roads and bridges, etc
Urban development on peat: higher costs

The diagram illustrates the investment costs and O & M costs for developing urban areas on various types of soil:

(i) Clay
(ii) Peat
(iii) Peat & Water
(iv) Peat & Sand

The costs are measured in million euros. The costs for each category are as follows:

- (i) Clay: Investment costs and O & M costs are similar, around 100 million euros.
- (ii) Peat: Investment costs are significantly higher, around 150 million euros, while O & M costs are around 50 million euros.
- (iii) Peat & Water: Investment costs are around 150 million euros, and O & M costs are around 50 million euros.
- (iv) Peat & Sand: Investment costs are around 200 million euros, and O & M costs are around 50 million euros.

The higher costs for developing on peat are due to the need for specialized infrastructure and environmental considerations.
Spatial planning on peat: dynamic process

- Groundwater model (PMWIN or SIMGRO)
- GIS based (ArcView)
- Expert Knowledge on:
  - Agriculture
  - Water Management
  - Subsidence
  - etc.
Model approach to predict consequences of land use

Two types of land use in one catchment: is that possible?

A: Oil palm  
B: Vegetables
Effect of land use on subsidence

Different depths of the watertable ➔ different rates of subsidence

Vegetables: WT = 0.30 m, S = 3 cm/yr

Oil palm: WT = 0.75 m, S = 7.5 cm/yr
Conclusion: Eco-hydrological approach

Two types of land use in one catchment: is that possible?

A: Oil palm
B: Vegetables

Conclusion:

Do not mix different types of land use in a peat catchment
Developments?

- Regional planning
  - effects (subsidence, water quality, etc)
  - stakeholder communication

- Management:
  - monitoring land use
  - water management
  - yield prediction (agriculture, forestry, etc)
Peatlands will always change over time

Smart solutions will create safety

Can we adopt ourselves
COASTAL DEVELOPMENT IN PLEATLANS:
A CHALLENGES OR A CURSE?

Terima kasih
&
Thank you