Paludiculture and rivers

Wendelin Wichtmann
Natural status of a growing fen. Example: percolating mire (until ~ 1770)

- Mineral soils
- River
- Peat soils
- No extraction of phytomass
- River or lake
- Groundwater level
- Groundwater supply
- Low surface runoff into the fen

- < 0.5 mg N/L
- < 100 mg SO$_4^{2-}$/L

changed after M. Succow Zak 2019
Intensively used, deeply drained fen since ~ 1970)

Mineral soils

Ditches

Peat soils

River or lake

River or lake

Dike

Pump

strong surface runoff into the fen

groundwater level

low groundwater supply

harvest of phytomass up to four times a year

mineralisation rate

high fertilizer input

> 50 mg N/L

> 200 mg SO$_4^{2-}$/L

changed after M. Succow

Zak 2019
Rewetting of peatlands

Two options:

• leave the site to its own devices → natural development
• implement paludiculture → regular management

→ → provision of ecosystem services with different focuses
Agricultural or silvicultural use of wet and rewetted peatlands → spontaneously grown or cultivated biomass from wet peatlands is used under conditions in which the peat is conserved or even newly formed → allows the re-establishment and maintenance of additional ecosystem services of wet peatlands

*Wichtmann et al. 2016
Paludiculture is
Peat preservation + agriculture/silviculture
→ wise use of peatlands
What are the main requirements

• **Site conditions (e.g. fen peatlands in temperate zone)**
  • permanent wet conditions in which the peat is conserved or even newly formed
    → low emissions of greenhouse gases and nutrients

• **Agriculture**
  • Paradigm shift from drainage to management of rewetted peatlands
  • Vegetation: spontaneously grown or cultivated plant species
    → productive use of biomass
Plants that thrive in temperate wet peatlands

Gramineous, mosses or arboreal vegetation

- Reed Canary Grass
- Common Reed
- Cattail
- Sedges
- Black Alder
- Peat Mosses
Nitrogen fluxes (kg N ha^{-1} a^{-1}) in fen peatlands in Northern Germany (Trepel et al. 2000, Schleuß et al. 2002, Schrautzer 2004)

<table>
<thead>
<tr>
<th>Vegetation type</th>
<th>Sedge reed</th>
<th>Intensive grassland</th>
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</thead>
<tbody>
<tr>
<td>utilisation</td>
<td>no</td>
<td>3 cuts</td>
</tr>
<tr>
<td>Medium water table</td>
<td>-10</td>
<td>-50</td>
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<tr>
<td>deposition</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>fertilization</td>
<td>0</td>
<td>160</td>
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<tr>
<td>mineralisation</td>
<td>30</td>
<td>200</td>
</tr>
<tr>
<td>Sum of inputs</td>
<td>50</td>
<td>480</td>
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<tr>
<td>export by harvest</td>
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<td>200</td>
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<tr>
<td>Denitrification</td>
<td>20</td>
<td>80</td>
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<tr>
<td>N-leaching</td>
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<td>20</td>
</tr>
<tr>
<td>Sum of outputs</td>
<td>25</td>
<td>300</td>
</tr>
<tr>
<td>N-saldo</td>
<td>25</td>
<td>180</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Peat formation</td>
<td>Degradation and eutrophication</td>
</tr>
</tbody>
</table>

If the sedges are harvested once a year, the saldo will even be negative
Mix of different land use options in a rewetted polder
Management / Harvesting

One step – bundles

Two steps – chopped biomass

Three steps – round bales
Products from reeds (Quality Reed and Cattail)

- Bundles for roofing
- Culms for mats production
- Construction boards
- Insulation material
- Form bodies
- .......
Options for energetic utilisation

- Round bales
- Pellets
- Briquettes

→ Direct burning

- Silage for biogas
- Bio-char
- BTL
- Bio-refinery
- ….
A field study of Paludiculture plant species
on rewetted/wet organic and mineral soils

Typha latifolia

Phragmites australis

Typha latifolia

Phragmites australis

Rewetted organic soils

Rewetted mineral soils

Biomass production 10-30 t dm (ha⁻¹ y⁻¹)
Nutrient removal potential N 100-600 kg • P 20-80 kg • K 50-450 kg (ha⁻¹ y⁻¹)
N:P ratio T. latifolia N:P 5-9 • P. australis N:P 8-25

Harvest period Summer, Autumn, Winter
Stand age younger < 3 years > older
Soil characteristics broad range

Geurts et al. 2020
Providing different Ecosystem-Services is the driving force for implementation of Paludiculture

- **Production services - biomass for**
  - material and energetic use
  - use as fodder or food (comestibles)

- **Regulation services**
  - Soil protection
  - Site adapted biodiversity (nature near habitats)
  - Water quality protection (retention of nutrients)
  - Water quantity (harmonisation of discharge)
  - Climate protection (mitigation of GHG emissions)
  - Climate adaptation (resilience to flooding)
  - Archives (landscape and human history)

Many thanks for your attention