Projects for MSc and junior researchers Peatland Science, Water Management and Paludiculture

Background: Draining peat soils causes problems: land subsidence, increased flooding risk, $CO_2$ + $CH_4$ emissions and eutrophication. Higher water levels are necessary to avoid these problems. Paludiculture combines biomass production at higher water levels by using both light-weight harvesting machines and flood tolerant crop species (eg. *Typha, Azolla, Sphagnum, Phragmites, Salix* and *Alnus*). Paludiculture is a tool to reduce $CO_2$ emissions substantially. The following research questions can help to identify improve management options related to carbon footprint and nutrient turnover.

1. **Productivity of Dutch peat soils reliant on (smart) water table management and Paludiculture**

a) Total surface area per region

b) Drainage depth distribution and seasonal drainage regimes

c) Pumping costs and infrastructural investments on annual bases

d) Yields of grasslands, maize, potato, reed and willow on peat

e) Field work Drentse Aa, Ilperveld

f) Estimation carbon footprint per unit yield and comparison with mineral soils

g) Estimation water management cost and water footprint analysis

h) Synthesis what is environmental fingerprint of peatland use for farming and how does it compare with water smart farming techniques aka Paludiculture

2. **Greenhouse gas emissions from Dutch peatlands - a modelling study**

a) Compare methodologies to assess GHG on the field scale.

b) Do IPCC emission factors apply to Dutch agricultural fields on peat soils (organic soils)?

c) How do site emissions from Dutch sites compare with peat soil sites in Denmark, Germany and UK?

d) In what range is water level most predictive indicator for methane release? Which soil characteristics have additional explanatory power?

e) Derive indicators for nitrous oxide emissions for mapping on a hectare scale. Make a sensitivity analysis of the (range of) indicators.

f) Apply so derived emission factor model peat rich catchments in the Netherlands (Hunze en Aa & Friesland)

**3. Measuring Greenhouse gas emissions in along a water table gradient in Friesland**

a) Does reducing drainage level also reduce carbon dioxide emissions from peat soils?

b) Review key variables for land-based gas flux measurements (net ecosystem exchange, ecosystem respiration, gross primary production)

c) Do you know how to use gas flux measurement equipment?

d) Join the flux-net comparing deeply drained peatland sites with a shallow drained peatland site

e) Measure photosynthesis rates at different along a soil moisture gradient - do plants benefit from higher water tables?

**4. Paludiculture and wet farming practices as management tools for water framework directive and trade of ecosystem services. What is the potential for Dutch peatlands for Dutch water authorities and Nature organizations?**

a) Footprint analysis of Paludiculture practices

b) Fate of nitrogen in wet soils - comparison of existing models

c) Upper threshold calculation of nitrogen and phosphorus removal potential

d) Field data on nitrate reduction from large scale reed beds and constructed wetlands

e) Evaluating field data using the Wettrans model

f) Quick assessment tool from using the MoorFutures 2.0 methodology

g) Comparison cost-effectiveness nutrient removal Paludicultureand conservative approaches

**5. Quick assessment of upper threshold methane emissions â€“ can we forecast methane emission hotspots on a landscape scale?**

a) What is written about it?

b) What do we know from other fields where we have to deal with few data (spatial statistics)

c) Testing different approaches (high emission period vs. normal)

d) Improving emission data by proxies (soil methane, water level)

e) Field measurements and data collection

f) Cost-benefit analysis of a range of measurement intensities @ variable $CO_2$ price