Effects of paludiculture products on reducing greenhouse gas emissions from agricultural peatlands

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Finnish case-study

Two sources of GHG emissions:

Peat energy use

In 2017, 5.8 Mt CO_2-ekv. (10% on national GHG emissions, LULUCF excluded) were caused by peat energy use

Peat energy use should be halved by 2030 from the current level

Decreasing peat energy use will inevitably decrease the availability of peat for other uses such as growing media and animal bedding

Abandoned agricultural peatlands

In Finland, there are about 30 000 ha agricultural peatland that do not produce food or feed but generate substantial amount of emissions

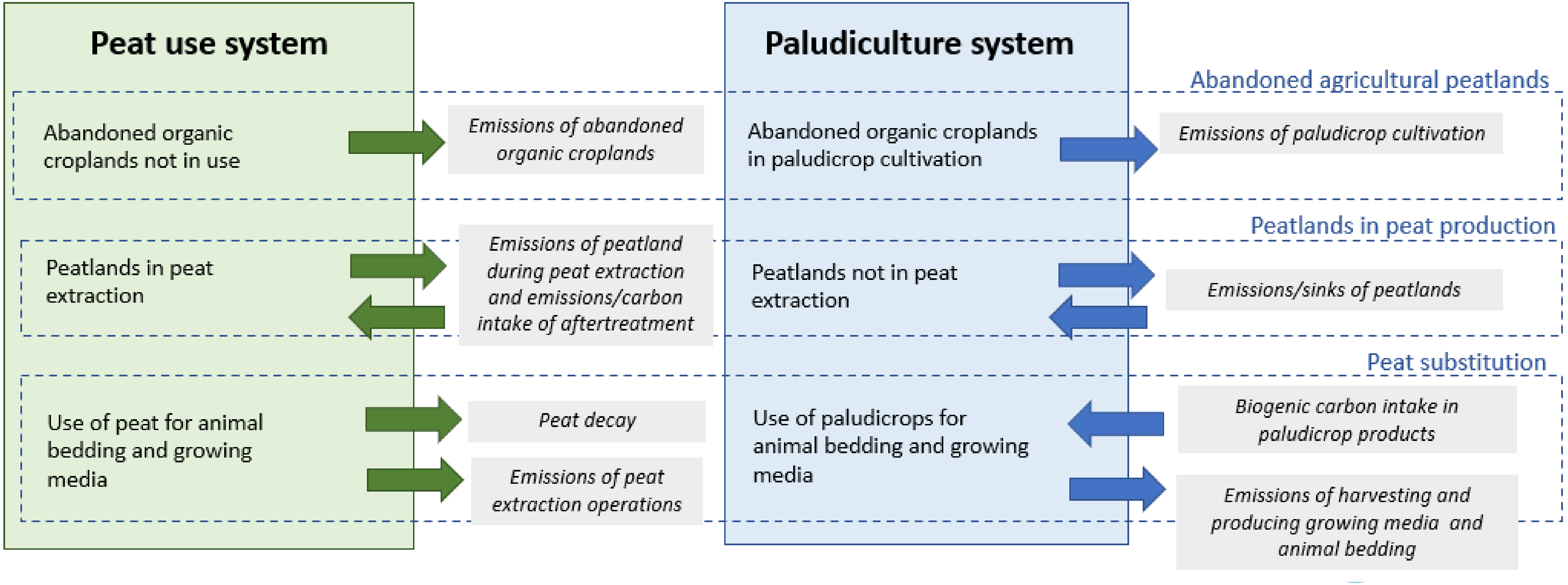
Possible solution: convert abandoned agricultural peatlands into paludiculture cultivations sites

Win-win situation?

-> Decreasing emissions originating grom soil

-> Replacing peat

How to estimate GHG emission balance of paludiculture in abandoned agricultural peatlands



GHG emissions of peat use system

Currently peat is used as a raw material for growing media and animal bedding material

GHG emissions of peat use primarily result from peat decay but also peat extraction sites, machinery and aftertreatment of peat extraction sites generate emissions

In peat energy use, carbon is instantly released into the atmosphere but when peat is used as a growing media or animal bedding material, peat is used as a soil improver after use

In this case, peat decay is a slow process (up to hundred years)

It was assumed that abandoned peatlands remain unaltered, and their emissions were assumed as 20.45 t CO_2 eq./ha (IPCC 2013)

Emissions of paludiculture system

Five promising plants are: phragmites, willow, cattail, sphagnum, and reed canary grass.

We assumed that in 2050 each plant would be cultivated in an area of 6 000 ha.

We assumed that an average GHG emissions of paludiculture cultivation were about 15 t CO_2 eq/ha/y

Emissions caused by establishment and maintenance of paludiculture sites were considered as well as emissions caused by manufacturing the end products (growing media and bedding material)

Substituting peat with paludiculture products?

Peat is a suitable raw-material for both growing media and animal bedding material uses

Alternative raw-materials should meet the quality requirements

It is not clear what would be the substitution ratio, i.e. how much paludicrops are needed to replace peat

It was assumed that substitution ratio would be $1 m^3/1 m^3$

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Impacts of time-horizon

GHG emissions take place in a long time frame, especially peat decay is a slow process

Climate change mitigation is considered as an urgent target, thus, more weight should be given actions that provide climate change mitigation now or in the near future

GHG emissions were weighted according to Helin et al. (2016)

For instance, GHG emissions taking place in 2020 are multiplied with a weighting factor of 1.0 whereas emissions in 2040 is given a weight of 0.82

Paludiculture generates GHG emissions savings (preliminary results)

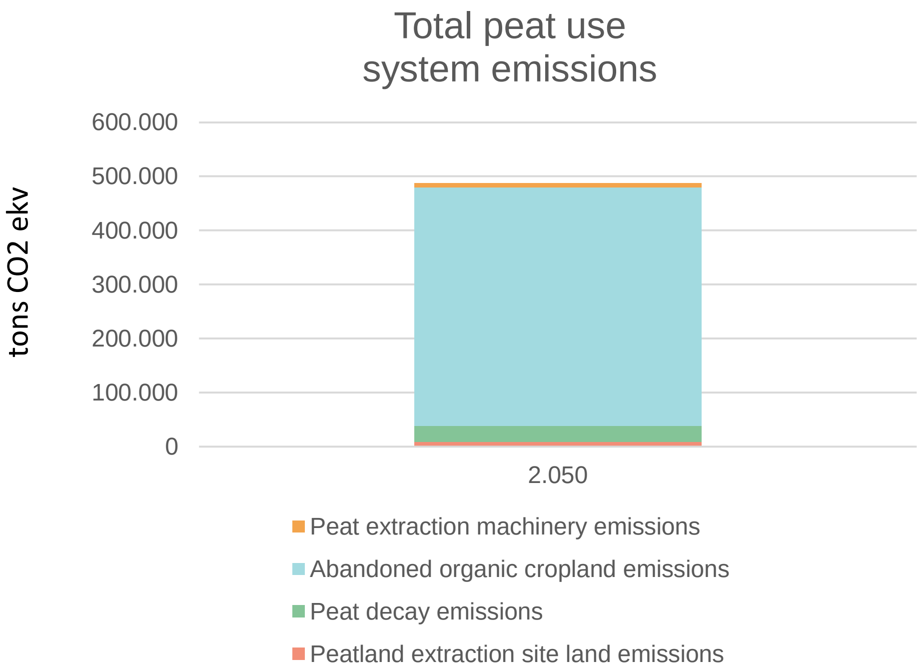
GHG emissions of the paludiculture systen are smaller than emissions of peat use system

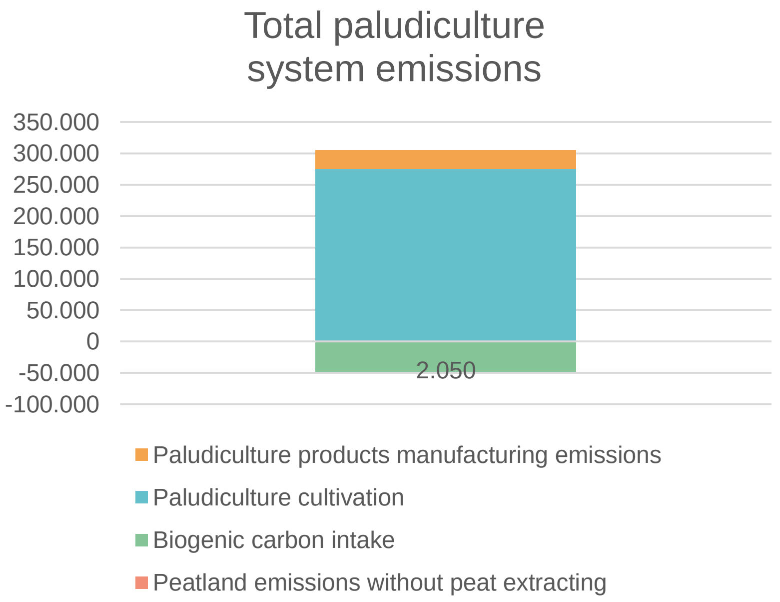
Estimated emission savings in 2050 would be on average 229 000 tons CO_2 eq. (about 0.5% of the current Finnish national annual emissions, LULUCF excluded)

	tons CO2 (Average)
Avoided peat system emissions 2030	203 000
Avoided peat system emissions 2040	366 000
Avoided peat system emissions 2050	486 000
Paludiculture system emissions 2030	93 000
Paludiculture system emissions 2040	190 000
Paludiculture system emissions 2050	259 000
GHG emissions savings 2030	**110 000**
GHG emissions savings 2040	**177 000**
GHG emissions savings 2050	**229 000**

Emissions of peatlands dominate results (preliminary results)

Most of the GHG emissions originate organic croplands:
In the peat use system, they are assumed to remain unaltered whereas in paludiculture system they are used for paludicrop cultivation
In both scenarios, they are major source of emissions
Other sources of emissions, such as peat extraction and manufacturing of the end products are of minor importance
Also peat decay and biogenic carbon intake of paludicrops are less contributional factors





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Peat decay and biogenic carbon intake

Majority of peat use emissions (when emissions of abandoned organic cropland not included) are caused by peat decay

It has been assumed that GHG emissions of peat use are the same regardless of end use (energy or growing media/animal bedding material)

Using discarded growing media and animal bedding material as a soil improver delays peat decay -> emissions takes place in the future

With paludiculture it is possible to increase biogenic carbon intake

In this study biogenic carbon intake was only about 20% of emissions of paludicrop cultivation -> under what circumstances carbon intake would exceed cultivation emissions?

How to improve reliability of GHG saving estimates?

What are the actual emissions of paludiculture and how do they change (most likely decrease) after establishment of a cultivation site

What is the actual substitution ratio of peat vs. paludiculture crops (mixes of different raw-materials)

How do the use-phase differ (or do they) when using peat vs. paludiculture products

Other land-use options available for abandoned agricultural lands and peat extraction sites not assessed in this study

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With paludiculture it is possible to decrease the net GHG emissions in Finland

Paludiculture system generated GHG emission savings in several ways

1) Decreasing emissions from abandoned organic croplands

2) Replacing peat

3) Increasing (temporary) biogenic carbon storage

Although substantial sources of uncertainty involved, all (preliminary) simulations suggested that paludiculture system generates less emissions than peat use system

Importance of minimizing GHG emissions of organic croplands

Although paludiculture appeared to generate less GHG emissions compared to the current peat use system, is it the *optimal* solution?

GHG emissions of paludiculture are smaller than emissions of abandoned agricultural peatlands but GHG emissions of other treatment options could generate less emission (afforesting, restoring etc.)

Based on this study it is crucial to minimize emissions of abandoned organic croplands, peat substitution appears less contributional factor (although alternatives for peat are needed in the future)

Attention: More data on GHG emissions of peatlands still needed!

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