Extended abstract No. 372

PALUDICULTURE - AGRICULTURAL USE OF REWETTED FEN PEATLANDS IN NORTH EAST GERMANY

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SUMMARY

Mainstream land use of peatlands requires drainage, which causes severe environmental problems including soil degradation, greenhouse gas emissions, nutrient efflux and loss of biodiversity. Paludiculture, i.e. wet peatland agriculture can avoid these negative effects and offers a new sustainable land use option. The VIP Project (Vorpommern Initiative Paludiculture) develops and implements paludiculture on degraded peatlands in NE Germany. New techniques for harvesting biomass from wet peatlands and for using wetland biomass as a raw material for industry and for energy generation are tested. The first results of newly developed processing lines provide additional arguments for rethinking current agricultural use of peatlands.

KEYWORDS: peatland agriculture, biomass, processing, caterpillar

INTRODUCTION

Peatlands cover only 3 % of the global land surface, but contain one third (550 Gton) of the global soil carbon. About 10% of the world’s peatlands (0.3% of the land area) are drained for various purposes, mainly agriculture and forestry, and emit 2 Gton CO_2 per year (Barthelmes *et al.*, this volume).

Peatland drainage induces decomposition and constant subsidence (lowering of the surface level) of the peat body, which requires continuously increasing investments in deeper drainage. The peatlands of the German federal state of Mecklenburg-Western Pomerania emit 6 Mio t CO_2eq a^{-1} equating to 27% of the state’s overall greenhouse gas (GHG) emissions (MLUV 2009). Because most emissions from peatlands worldwide result from non-sustainable land use, alternative land use options must be developed and implemented to mitigate GHG emissions. A promising option is paludiculture: the production of biomass on rewetted peatlands.

Paludiculture (Latin ‘palus’ = swamp) provides land use opportunities that avoid peat degradation by installing and maintaining permanently water saturated conditions (Wichtmann *et al.*, 2010). The concept of paludiculture has primarily been developed as a land use alternative for cut-over peat bogs, e.g. for the cultivation of peat moss (Sphagnum farming) (Gaudig *et al*., this volume) and for drained and degraded agricultural peatlands. Furthermore, biomass from protected area management can be utilized in the processing lines developed for regular paludicultures. Depending on land use intensity, paludiculture can provide a strategy to integrate nature conservation management in mainstream agricultural land use.

Requirements to establish paludiculture

Paludiculture is a new, interdisciplinary and applied concept that still needs substantial research and development. Showcase and pilot projects are needed to stimulate the interest of landowners and farmers. Within the project 'VIP – Vorpommern Initiative Paludiculture' new experiences are being gathered on establishing paludiculture on degraded fens. New products and applications are being developed that will strengthen the demand for paludi-biomass. New techniques also have to be developed to adjust the biomass to the needs and demands of existing markets in order to substitute fossil raw materials. For example, site adapted harvesting machines or conditioning techniques for fibers are needed to bring large amounts of common reed in adequate condition. The development of new processing lines (Fig.1) offers wide perspectives for the future use of peatlands but is a challenge for all involved players. The VIP project addresses all these aspects and tries to bring the results into practice.

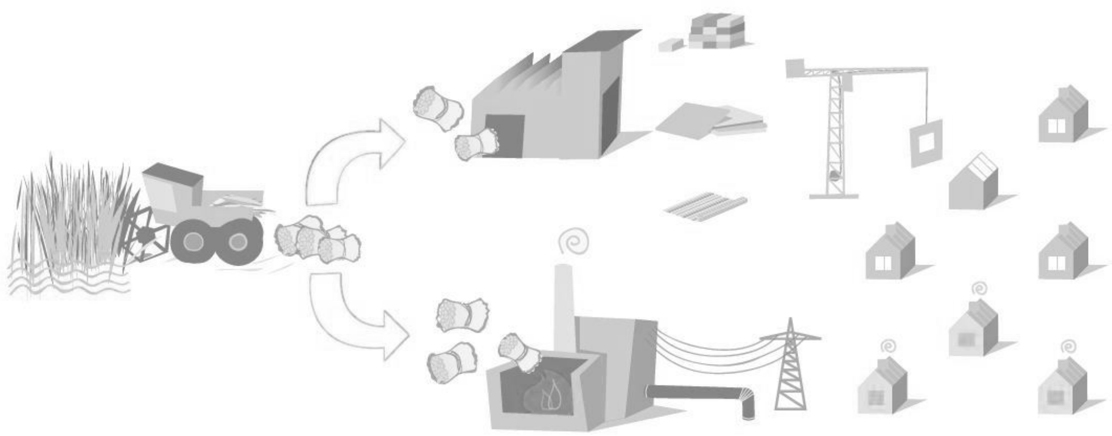

Fig. 1. Processing paludi-biomass. After harvesting, the peatland biomass can be used regionally as construction and insulation material or for energy generation.

Implementing paludiculture

Paludi-biomass - Productivity and Use

Especially under the nutrient rich conditions which prevail on many degraded fens, high biomass yields can be achieved (Schulz *et al*., 2011). Common reed produces large amounts of biomass that is suitable for e.g. energy generation (Wichmann, S. & Wichtmann, W. 2009) and can compete against other biofuels (Table 1).

Table 1: Productivity of various biofuel crops (changed after [1]FNR 2007 and [2]Wichmann and Wichtmann 2009)

	biomass	yield as dry weight [t/ha/a]	Energy content [MJ/kg]	Energy production [GJ/ha/a]
Crops[1]	cereals (e.g. *Triticale*)	11	17.0	187
	miscanthus	12.8	17.6	225
	willow, poplar (short rotation forestry)	10.2	18.4	188
residual[1]	straw	5.1	17.1	87
	hay	3.8	17.4	66
	Forest residuals	0.9	18.5	16.7
paludi-biomass[2]	Reed (*Phragmites australis*)	12.5	17.6	220
	reed canarygrass (*Phalaris arundinacea*)	6.7	16.9	113

Studies have already shown that winter harvested common reed has higher ash content than firewood, but contains less elements problematic for combustion than cereals or straw (Oehmke & Wichtmann, 2011). Besides direct combustion the processing of pellets or briquettes (Wichtmann *et al*., this volume) can be reasonable to enhance energy density and improve biomass transportability (Dahms and Wichtmann, this volume).

Furthermore, the biomass from wet peatland agriculture can be used as a construction material. To extend the established use for thatching and paper (Haslam 2010; Wichtmann 1999), new products for reed and other wetland plants are now developed within the VIP project. Especially cattail (*Typha* spec.) offers perspectives as an insulation material because of its aerenchymatic tissue. When paludiculture biomass is used in construction, the sequestered carbon can be stored for decades, creating a climate mitigation benefit additional to peatland rewetting.

Also outside the (sub) tropics, rewetted peatlands can be grazed with water buffaloes. Water buffaloes (*Bubalus bubalis*) are resistant against cold, have low demands to fodder quality and can supply an interested market.

Harvesting techniques

Wet peatland soils have low load-bearing capacity. Because of lack of appropriate harvesting techniques, modified snow groomers (with improved cooler capacity for summer harvest!) are used for large scale harvesting (Fig. 2). Wide tracks lower ground pressure to below 100°g°cm^{-1} making the machine suitable for working under extreme wet conditions. To minimize ground pressure and shear force during cornering of caterpillars, special summer tracks made of rubber or plastic are recommended.

Standard harvesting devices enables appropriate working widths and adequate acreage performances. Although snow groomer producing companies already offer special models for the agricultural market or the management of nature conservation areas, new harvesting machines have to be constructed to satisfy the special demands of efficient and economical paludiculture. Especially the transport of biomass from the field to the nearby paved area where it can be picked up by tractors and trucks is still challenging.

Fig. 2. Modified snow groomers for harvesting peatland biomass. Left: mulching and collecting biomass in a single process step in Belarus (W. Wichtmann). Right: Chopping and collecting biomass in Germany in a second step after mowing and setting in a swath (C. Schröder).

Regional and global potential of paludiculture

Hot spot regions of peatland degradation are Central and Eastern Europe, Northeast China, Indonesia and USA. As degraded peatlands are found in almost every country of the world (Barthelmes *et al*., this volume), the concept of paludiculture needs regional adaptation especially with respect to the cultivated species. Many wetland species have the potential to develop into new crops for paludiculture. An overview of these species is currently being compiled in the 'Database of Potential Paludiculture Plants' (Abel *et al*., this volume). For the 267,000 ha of degraded peatlands in Mecklenburg-Western Pomerania promising species include common reed (*Phragmites australis*), cattail (*Typha* spec.), reed canary grass (*Phalaris arundinacea*), sedges (*Carex* spec.) and alder (*Alnus glutinosa*).

Sustainability and evaluation of external effects

Paludiculture offers many environmental benefits next to the direct products it supplies (Wichmann *et al*., this volume). On degraded peatlands the raised water tables reduce the emissions of greenhouse gases. This reduction can be traded on the voluntary carbon market under the Verified Carbon Standard (VCS) (Joosten, this volume). Within the VIP project we also study the effect of harvesting on GHG emissions, especially with respect to the question whether biomass removal can reduce the emissions of CH_4 since CH_4 emissions are directly linked to the availability of fresh biomass (Couwenberg and Fritz, 2012). All in all the GHG

balance of paludiculture must be evaluated along the entire life cycle including all processing lines (Dahms and Wichtmann, this volume).
Other ecosystem services of paludicultures include biodiversity conservation, flood control and water retention and purification.

CONCLUSION

The necessity to address the problems associated with mainstream land use of peatlands is now being recognized by the UN Climate Convention and being incorporated in international protocols and mechanisms like the Kyoto Protocol and REDD+. The voluntary carbon market already provides opportunities to account for the reduction of greenhouse gas emissions from peatland rewetting (Joosten, this volume, Wichtmann and Tanneberger, 2011). These international developments underline the need to change current agricultural practice into a sustainable direction. Many open questions still exist, but it is clear that with respect to peat soils, only wet management like paludiculture can provide a sustainable future for land use.

ACKNOWLEDGEMENTS

The VIP Project is promoted by the German Ministry of Education and Research (BMBF) within the program “Sustainable Land Management”.

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