Reducing GHG Emissions by Abandoning Agricultural Land Use on Organic Soils – A Cost Assessment

Norbert Röder & Bernhard Osterburg

Introduction

Undrained peatland accumulates plant remains in waterlogged conditions. If these areas are drained the peatland turns from being a net sink of greenhouse gases (GHG) into a net emitter. Emissions from peatland account for 40% of Germany's agricultural GHG emissions (UBA, 2010). In most cases GHG emissions from the cultivation of peatland can only be markedly reduced if the water table is altered, implying an abandonment of agriculture or at least a significant reduction of the land use intensity (Höper, 2007).

To optimise the effectiveness of this mitigation strategy we calculate for each municipality the average mitigation costs per ton of CO_{2eq} based on the Standard Gross Margin (SGM), as it is advisable to abandon production first in areas with the lowest cost.

Material & Methods

The analysis is based on the entire German farm population in 2007. We use different data sources to describe the agricultural use of German peatland and calculate the SGM:

- Geological Map of Germany (BGR, 2003) to delimit peatland
- Digital Landscape Model (BKG, 2008) maps location and distribution of grassland and arable land
- Farm Structural Survey (FDZ, 2010) provides stocking levels and crop rotations
- KTBL (2008) provides the SGM per activity.

We used POSTGRES®8.213 and POSTGIS®1.3.3. to manage the geographical data and SAS®9.2 for statistical analyses.

Results

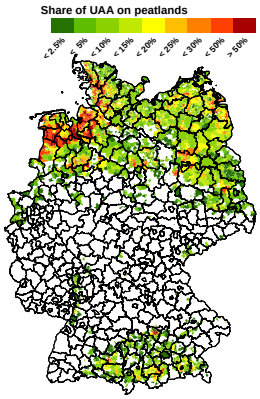

Fig. 1: Distribution of the UAA on peatland.
Source: Own presentation based on BGR (2003) and BKG (2008).
Note: UAA: Utilized agricultural area

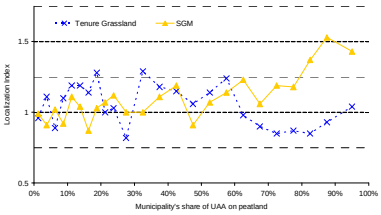

Fig. 2: Localization index for the Standard gross margin (SGM) in 2007 and tenure for grassland (1999) as a function of the share of UAA on peatland
Source: Own calculation based on BGR (2003), BKG (2008) and FDZ (2010).

Peatland covers large contiguous areas in the North and East of Germany (Fig. 1). In the South, peatland can mainly be found south of the river Danube. Lower Saxony has the largest area of utilized agricultural area (UAA) on peatland. Apart from the North West (NW) where in a large area more than 50% of local UAA is located on peatland, in most other areas the local share of UAA on peatland does not exceed 10%. In total, roughly 4.9% of Germany's UAA or ~840,000 ha is located on peatland.

About 75% of the UAA on peatland are used for forage cropping. This area feeds roughly 8% of the German dairy herd. The high importance of dairy farming on peatland is mirrored by the positive correlation between the share of peatland and the SGM while tenure is not affected by the share of peatland (Fig. 2) .

Based on the farm level data the median SGM per ha is about 550 € per ha in the North East (NE) (Fig. 3). This is only a third of the other areas. Furthermore, the variability of the SGM per ha is much lower (interquartile range of 400 € per ha vs. 1000 € in NW and SO).

The abandoning of the agricultural use of peatland would induce on average mitigation costs of less than 40 € per ton of CO_{2eq}. Especially in the North-East of Germany the mitigation costs are fairly low (Fig. 4). The highest mitigation costs are found in areas where dairy farms are dominant and grassland is a major fodder source.

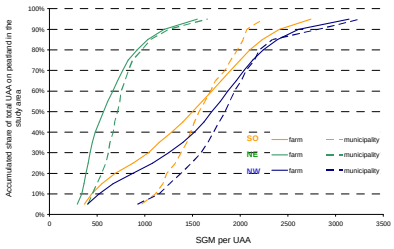

Fig. 3: Accumulated density distribution of UAA on peatland as a function of the SGM (€ per ha UAA) in the four study areas at farm and municipality level in 2007.
Source: Own presentation based on BGR (2003) and BKG (2008).
Note: SO: Bavaria & Baden-Wurttemberg; NE: Brandenburg, Berlin & Mecklenburg-Western Pomerania, NW: Schleswig Holstein, Hamburg, Lower Saxony & Bremen.

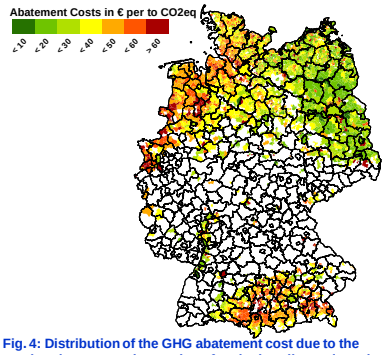

Fig. 4: Distribution of the GHG abatement cost due to the abandonment and rewetting of agriculturally used peatland.
Source: Own presentation based on BGR (2003), BKG (2008) and FDZ (2010).
Note: based on SGM's for the year 2007

Conclusions

Compared to the options presented by Vermont & DeCara (2010) the abandonment of the agricultural use of peatland is a comparatively cost efficient measure to reduce GHG-emission in the agricultural sector. The presented approach is a first approximation only. On the one hand, the medium and long term opportunity costs in particular in areas dominated by dairy farming are overestimated as costs of labor and for reinvestments are not considered. On the other, engineering and planning costs will add to the stated costs. From an economic point of view the rewetting and abandonment of the agricultural used peatland is in particular in North East Germany a very rewarding GHG mitigation option for the following two reasons:

- compared to the other areas the SGM (= short term opportunity costs) is lower.
- due to prevalent agricultural structure dominated by large farms, access to large contingent and hydrologically self-contained areas is easier.

An efficient national program to reduce GHG emissions would need to include financial transfers between the *Länder* to exploit the regional differences in the mitigation costs.

References

BGR (Bundesanstalt für Geowissenschaften und Rohstoffe) (2003): Geologische Uebersichtskarte der Bundesrepublik Deutschland 1:200 000. Hannover.
BKG (Bundesamt für Kartographie und Geodäsie) (2008): Digitales Basis-Landschaftsmodell 1:25 000. Frankfurt / Main.
FDZ (Research Data Centres of the Federal Statistical Office and the Statistical Offices of the Länder) (2010): AFID-panel agriculture: 1999, 2003 and 2007, own calculation.
KTBL (Kuratorium für Technik und Bauwesen in der Landwirtschaft) (2008): Datengrundlage zum Standarddeckungsbeitrag. Wissenschaftszugriff. Darmstadt.
Höper H. (2007): Freisetzung von Treibhausgasen aus deutschen Mooren. Telma (37,):85-116.
UBA (Umweltbundesamt) (2010): National Inventory Report for the German Greenhouse Gas Inventory 1990 - 2008. (http://www.umweltdaten.de/publikationen/fpdf-l/3958.pdf). Lastly modified: 14.06.2010.
Vermont B., de Cara S. (2010): How costly is mitigation of non-CO2 greenhouse gas emissions from agriculture? A meta-analysis. Ecological Economics (69):1373-1386.

Norbert Röder **Institute of Rural Studies of the Johann Heinrich von Thünen-Institute (vTI), Bundesallee 50, 38116 Braunschweig, Germany**
www.vti.bund.de, Fax +49-531-596-5599, E-Mail norbert.roeder@vti.bund.de, Phone +49-531-596-5215