A Decision Support System (DSS) for the sustainable use of peatlands

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Background and objective

Fig. 1: soil degradation of a peatland due to unadapted management of farming , photo: Christian Heller

Conventional agricultural and forestry use of wetlands require increasing drainage intensity. Due to drainage, cultivation and fertilization, wetlands emit large amounts of nutrients into adjacent ecosystems, and greenhouse gases into the atmosphere. Associated with these processes are the degradation of the organic soil and the loss of biodiversity (Fig. 1).

We have developed a **Decision Support System** (DSS) that provides basic information to farmers and planners to enable them to use peatlands in a sustainable fashion by conserving peat. The DSS proposes new land use options both for peatlands currently used for agricultural purposes and uncultivated, degraded ones.

What is paludiculture?

Paludiculture (“palus“ – lat. “mire, morass”) is the cultivation of biomass on wet or rewetted peatlands, which aims to conserve peatland and reduce greenhouse gas and other emissions that are a byproduct of drainage.
On the one hand it includes traditional processes of peatland cultivation (reed mowing, litter usage), on the other hand new processes, for example the energetic utilization of biomass of the marshes, are used.

Basic structure of the DSS

The DSS consists of two main stages. In the **first stage** land-use options (for example reed, typha, water buffalo) are generated that are suitable for the type of land in question. In the **second stage**, the most suitable measures for land conversion are identified. The basic structure of the DSS is shown in figure 2.
Dichotomous decision trees (with YES-NO-questions) build up the main model elements with the identified parameters relevant to decision-making. The DSS gives a basic instruction to every branching point, explaining the criteria and classification scheme, and providing further information such as references, weblinks or visual materials.

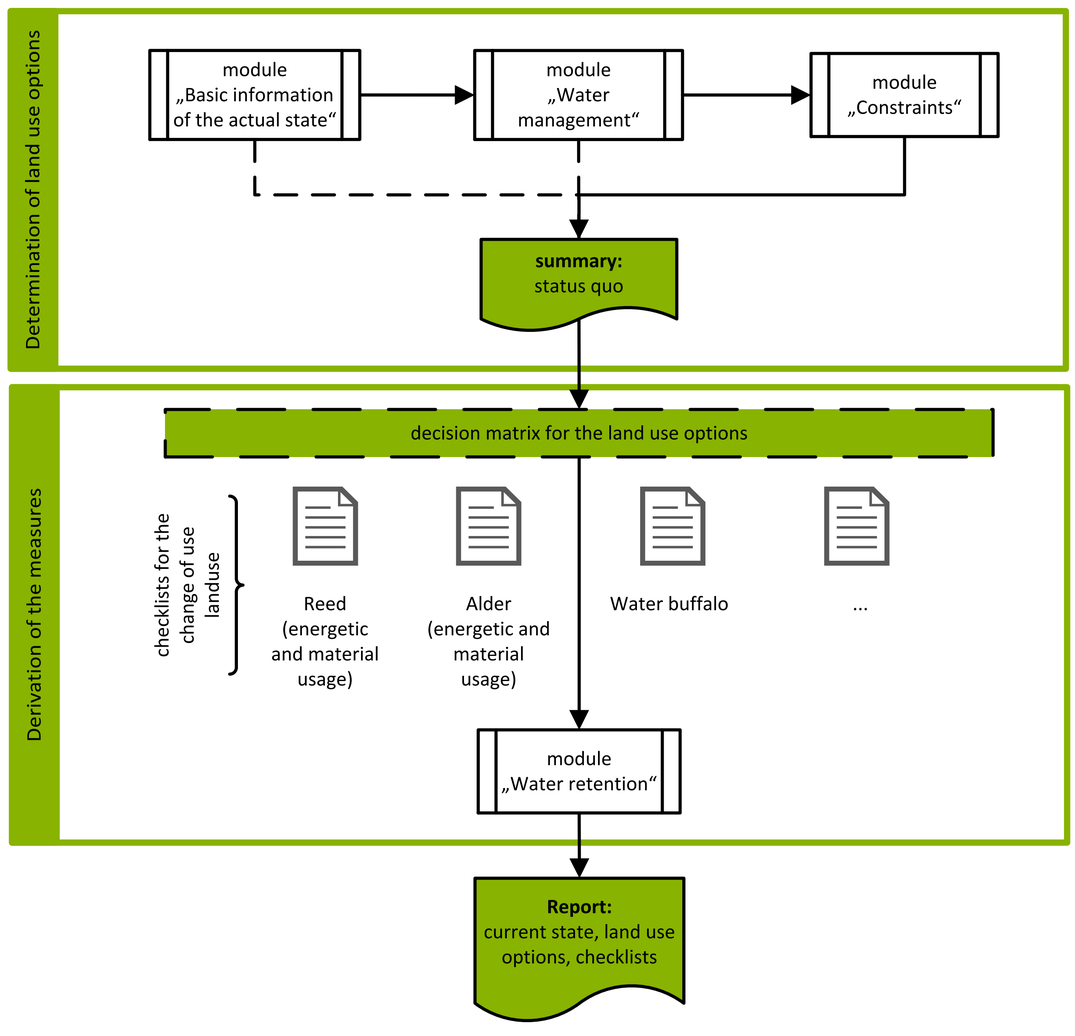

Fig. 2: basic structure of the DSS with a modular concept

Modules of the DSS

The DSS is based on a modular concept. In the first module **“basic information of the actual state”** site-related parameters were queried. The collected data includes average groundwater level, peat thickness and actual land use. Through the module **“water management”**, the water availability will be assessed in the catchment area of the peatland, to check whether it is sufficient to raise the water level either directly or indirectly. The module **“restrictions”** provides an estimate of the spatial resistance toward waterlogging and a change of land use. Furthermore, it is checked if adjacent and protected areas, such as “natural parks”, “nature preserve” or any other biotope protected by law, are affected by waterlogging. The aim is to remove sensitive habitats and protected species and rare and endangered ecosystems from the focus of **Paludiculture**.
The DSS processes all collected data following a decision matrix. Then the most suitable land use options are identified. Finally the user is given a report containing a list of measures that need to be adopted to facilitate the conversion to the new type of land use, and a summary of every parameter relevant to the decision-making process.

Potential land use options

To enable the use of peatlands in a sustainable fashion by conserving peat, the following land use options will be integrated into the DSS. **Reed** and similar plants require very high water levels, even overflow. When grazing on very moist and wet grassland with a high heterogeneity of the water levels the **water buffalo** *(Bubalus bubalis)* has advantages over conventional domestic cattle species. The cultivation of **black alder** *(Alnus glutinosa)* can occur in riparian and marsh areas with a wide range of water levels. However for the production of valuable wood balanced moist conditions are required. The common land use on peatlands (extensive pasture or meadow) can only be recommended for sites where no higher water availability exists. More suitable land use options can be integrated in the future.

Fig. 3: adapted management of farming
photo: Paul Schulze (left) Christian Schröder (right)

Application

The DSS will run without installation on all major operating systems, including Windows, MacOS and Linux – only a web browser is required. The user interface consists of an embedded application inside a webpage. The first draft of the DSS will be published in 2013.

What is a decision tree?

A rational decision-making process in a DSS can be based on a dichotomous decision tree (YES-NO-questions). The reduction to a single issue per question will lead to faster and better decisions by the user. Additional and appropriately processed information supports the use by the decision maker.

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