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DEVELOPMENT OF A HOLISTIC EVALUATION METHOD FOR ECOSYSTEM SERVICES OF PEATLANDS

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SUMMARY

Dependent on the specific natural conditions and anthropogenic impact, peatlands provide different ecosystem services to society. Near-natural mires with their potential to accumulate and store materials, regulate the local climate and as habitat for specialised and endangered species, have an outstanding importance especially in times of climate change. In contrast, peatlands used for agriculture or degraded ones have a negative influence on local and global climate and adjacent ecosystems like lakes and flowing waters but provide diverse provisioning services for hundreds of years (Joosten & Clarke 2002). In this area of conflict it is important to gather a complete set of interests and carefully evaluate costs and benefits of contrasting services as a basis for conservation and sustainable management. The concept of ecosystem services provides a suitable framework for such analyses and evaluations.

There are various approaches to classify and assess ecosystem services but a consistent evaluation method that can be applied under a broad range of conditions is still missing. This shortcoming impedes a systematic comparison of results of the numerous studies on ecosystem service assessment worldwide. As a consequence, the realised results remain case-specific and shortcomings are often difficult to detect. Using the example of peatlands, we propose a ‘holistic’ approach to assess ecosystem services that can be applied independently from specific system features and that allows to compare results across system boundaries.

Ecosystem services are defined in different ways. The most known and often used is the definition of the Millennium Ecosystem Assessment (MA 2005). It defines ecosystem services as “the benefits that people derive from ecosystems” (MA 2005). Four categories of ecosystem services are distinguished: (i) provisioning services, (ii) regulating services, (iii) cultural services and (iv) supporting services (MA 2005). Although, supporting services are the necessary conditions for all other three categories of services, they are not treated in a separate way. This definition and classification allows no precise distinction between ecosystem services, functions, and benefit.

In contrast to the MA (2005), definitions presented in recent literature (Boyd & Banzhaf 2007, Wallace 2007, Fisher & Turner 2008, Haines-Young & Potschin 2010) track the idea

of a “production chain” and by that distinguish between ecosystem functions, ecosystem services and benefits. The production chain is visualized by the model of the ‘service cascade’ by Haines-Young & Potschin (2009). “The model attempts to capture the prevailing view that there is something of a ‘production chain’ linking ecological structures and processes on the one hand and elements of human well-being on the other” (Haines-Young & Potschin 2009). In between there are potentially a series of intermediate stages (Haines-Young & Potschin 2009).

Boyd and Banzhaf (2007) define final ecosystem services as “components of nature, directly enjoyed, consumed, or used to yield human well-being” (Boyd & Banzhaf 2007). Final ecosystem services (FES) are end-products of nature. It is essential to distinguish between end-products and intermediate components. Intermediate components are necessary to the production of ecosystem services but are not services themselves (Boyd & Banzhaf 2007), e.g. the buffering function of *evaporation* is an intermediate component for the FES *local climate*. FES refer always to a benefit that people obtain from them. In our example *Recreation* is a benefit from *Local climate* among other FES. Benefit we define as measure for capability of ecosystem services to satisfy or please stakeholders/ society’s needs, based on Gabler (2000) and Vahlens (1993). The term stakeholder we use for all groups of persons who directly or indirectly (i) affect, (ii) can be affected by or (iii) have a special interest in the future development or actual state of an ecosystem.

Based on the approach by Boyd and Banzhaf (2007), we developed a methodological framework, which includes (i) the identification of the individual *demand* from stakeholders, (ii) the identification of the *potential* of the examined ecosystem type to provide ecosystem services, (iii) the *classification* of specific final ecosystem services and their intermediate components and (iv) the *indicator-based evaluation* of all identified ecosystem services and their intermediate components. By that, we achieve an “Ecosystem Service Pedigree” with four levels: from stakeholders, benefits, ecosystem services to intermediate components. Beginning with the ecosystem group of peatlands, we developed a list of potential stakeholders, a list of the potential peatland ecosystem services and their individual benefits to people and an inventory of intermediate components. By listing a wide repertoire on each level of the pedigree, multiple options are offered and allow individual adaptation to the conditions of the study area. The purely anthropocentric concept of ecosystem services is enhanced by causal linkage with ecosystem functions and processes as intermediated components.

The schematic diagram (Figure 1) shows the structure of our classification system and evaluation method as “Ecosystem Service Pedigree” (Schröder et al. in prep.). On the left the notations of every level according to the underlying idea of the production chain are depicted. At the first level the stakeholders are located. To these belong *Local population, Regional population, Global population, Tourists, Farmers, Forest managers, Commodity trader, Water Companies* among others. In the second level the benefits are situated, generated from the FES in the third level. *Food* as example for a benefit is generated by the FES *Drinking water* and the FES *Eatable natural products*. Above in the pedigree the intermediate components are arranged. The intermediate components are the functions and processes

which are necessary for the production of FES. For example the FES *Drinking water* depends on the intermediate components *Water storage, Water purification* and *Groundwater recharge*. On the top of our pedigree the indicators are situated. They are necessary for the evaluation of the actual state – the quality and quantity - of the intermediate components. For each intermediate component we defined a set of indicators. Some indicators are used several times, but the set is individual for each intermediate component. The evaluation of the quality and quantity is made by a three step graduation 1 – low, 2 – moderate, 3 – high. On the basis of threshold values of each indicator the total range of potential possible indicator values is assigned to these three categories.

To realize a comprehensive analysis and evaluation of ecosystem services and their intermediate components, a valid data base is essential. All data needed for the evaluation are summarized in a form for data acquisition, which has been developed for user friendly application of our method.

The proposed evaluation method is currently applied to selected peatlands in Northeast Germany. Results of the proposed approach can also serve as decision support tool to weigh up land use options and management options in planning processes especially in the context of sustainability, climate change and efficient use of subsidies.

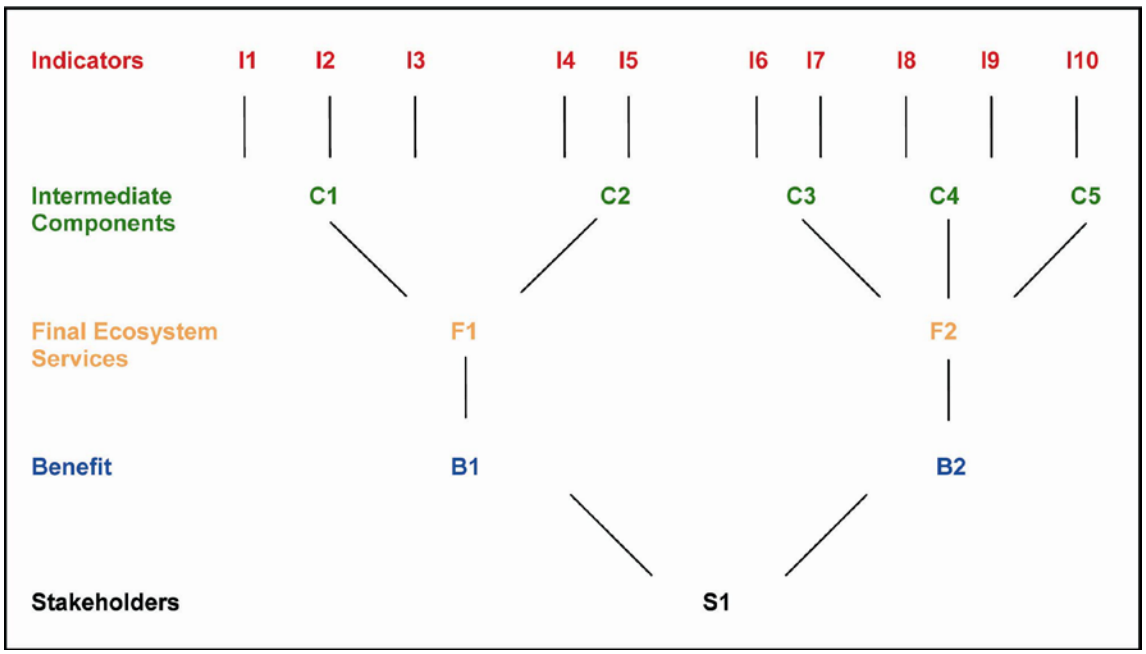

Fig. 1: Structure of the classification system and the evaluation method as “Ecosystem Service Pedigree” in a schematic diagram. (Schröder et al. in prep.)

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