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Application of the ecosystem service concept for climate protection in Germany

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ABSTRACT

The implementation of the ecosystem services (ES) concept in planning and administration has gained momentum in Germany, so far the focus has been on landscape planning. We extend this research by exploring other legal domains such as urban planning and climate protection strategies and focus on climate protection and the use of renewable energies. This study analyzes all existing (n=13) climate protection laws and their drafts on federal state level in Germany, assessing their implicit and explicit use of the ES concept. 26 communal climate protection concepts on local level were also examined. Additionally, the sector of urban planning was considered through analysis of the climate protection amendment of the German Building Code (BauGB).

Results show both biotic and abiotic ES to already be a significant part of other planning domains besides landscape planning. The sector of climate protection addresses mostly abiotic ES both implicitly and explicitly to implement and strengthen the use of renewable energies. Consequently, a specific category of ES related to renewable energies is introduced in this paper: *REES* (renewable energy ecosystem services). On the federal state level, REES are clearly highlighted with a strong strategic focus on mitigation and the promotion of renewable energies. In contrast, regulative ES in connection with adaptation measures were more frequently addressed on the local level. Still, REES were most frequently named when addressing measures, stakeholder and target groups. An enhanced incorporation of abiotic ES into classification systems seems necessary to enable a fair and balanced representation of biotic and abiotic services in evaluation studies or in the trade-off analysis of different land-use options.

1. Introduction

The need for climate protection has gained momentum worldwide in recent years. The last conference in Paris (December 2015) has again shown the urgency to act both internationally and at the national level to limit rising global temperatures (Center for Climate and Energy Solutions, 2015). In addition to national governments, subordinate levels, especially regions and cities, need to contribute to climate protection actions. Globally, municipalities have experienced extreme weather events and face the necessity to adapt urban structures to these impacts of climate change (Boero et al., 2015; Geneletti and Zardo, 2016; Huang-Lachmann and Lovett, 2016; Melgarejo and Lakes, 2014). Adaptation has gained a lot of attention from municipalities in addition to mitigation measures – both measures are subsumed under the term “climate protection” in the remainder of this text.

While the implementation of the ecosystem services (ES) concept in planning and administration has gained momentum, its potential to assist climate mitigation/adaptation actions has still to be explored. Research initiatives such as OPERAs - Operational Potential of Ecosystem Research Applications (OPERAs, 2016) and OpenNESS - Operationalisation of Natural Capital and Ecosystem Services (European Centre for Nature Conservation, 2016) and the related joint knowledge hub OPPLA (OPPLA, 2015) focus on operationalizing the ES concept for application in praxis. Linking the ES concept to the legal system of a country is an important step in its operationalization. This has been demonstrated for a number of countries: the USA (Bear, 2014; Salzman et al., 2001; Schaefer et al., 2015; Woodruff and BenDor, 2016), Australia and Sweden (Wilkinson et al., 2013), Vietnam (Hanh et al., n.d.), China (Liu et al., 2008), the USA (Hansen et al., 2015), Europe (Hansen et al., 2015; Schleyer et al., 2015) and Poland (Maczka et al., 2016). In Germany, so far focus has been on the linkage with landscape planning (Albert et al., 2016, 2012; Von Haaren and Albert, 2011). However, there is a significant potential of the ES concept to mitigate climate change that needs further attention.

Climate protection strategies and related laws may give way to an

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intensified use of renewable energies to reduce CO_2-emissions. This offers a completely new perspective on how ES can help to support climate mitigation and adaptation. For the EU, work on connections between the ES-framework and climate policies is expected in the upcoming years (Matzdorf and Meyer, 2014). Until now, most ES studies related to climate change have focused on the impacts of climate change on ES (Civantos et al., 2012; Mooney, 2010; Nelson et al., 2013; Scholes, 2016; Shaw et al., 2009; SwedBio). Other scholars have addressed spatial planning in terms of possible instruments for energy crop regulation and used the ES concept to assess the impacts of energy crops on ecosystems, also shedding light on the energy policies of Germany and the EU (Lupp et al., 2015, 2014) and addressing the more critical impacts of bioenergy plants on ecosystems. However, the potential of ES for mitigation and adaptation has received less attention.

The focus on climate change also helps us to broaden our view towards the systematization of the ES-concept and its operationalization for practical affairs. We hypothesize that the clear focus of climate protection on CO_2-reduction implies a strengthened use of renewable energies and demands more widespread consideration of abiotic ES.

The linkage of ES with urban land-use planning is another seldom explored field. Recent studies show that the ES concept gives additional input for urban planning with regard to land-use conflicts, resource protection or valuation (Gómez-Baggethun and Barton, 2013; Gómez-Baggethun et al., 2013; Haase et al., 2014; Hansen et al., 2015; Nielsen et al., 2012; Niemelä et al., 2010).

The sector of urban planning provides direct options and regulations for climate change mitigation, the use of renewable energies and adaptation via land-use regulations, thereby demonstrating additional ways to include the ES concept in practical planning.

In this paper, we use the CICES-classification (European Environmental Agency, 2016) as a reference system for ES that is frequently applied in Europe. The classification tries to avoid the problem of double accounting by focusing on so-called final services that are directly consumable. In contrast to other classifications such as MEA (Millenium Ecosystem Assessment (2005) or TEEB (The Economics of Ecosystems and Biodiversity, 2010), it therefore does not include supporting services and groups ES solely into provisioning (e.g. by crops), regulating (e.g. climate regulation) and cultural services (e.g. bird watching). It distinguishes further between biotic and abiotic services – the classification of abiotic ES has however been criticized as incomplete (Van der Meulen et al., 2016).

Biotic ES are all ES depending on living processes and biotic ecosystem outputs. Abiotic ES cover abiotic outputs such as sunlight, wind, hydropower, topographic control of wind erosion and also cultural settings, which refer to abiotic structures such as caves (European Environmental Agency, 2016). Within the framework of climate protection, the differentiation of CICES into biotic and abiotic ES is urgently required, as demonstrated in our consideration of both mitigation and adaptation measures in this paper.

Adaptation measures based on ecosystems (e.g. Geneletti and Zardo, 2016) and on green infrastructure have focused mostly on biotic ES such as temperature or water regulation (Emmanuel and Loconsole, 2015; Gill et al., 2007; Matthews et al., 2015). Mitigation measures, that aim to reduce CO_2-emissions and expand renewable energies (Hastik et al., 2015), draw more attention towards abiotic services such as wind energy or sunlight. However, selected biotic ES such as carbon sequestration (Melaku Canu et al., 2015) or biomass-energy (European Environmental Agency, 2016) are also relevant for climate mitigation. The inclusion of renewable energies in existing ES classifications such as CICES is not yet well developed. This paper aims to fill this knowledge gap.

To estimate the importance of ES – especially abiotic ES – in the two legal domains of climate protection and urban land-use planning in Germany we analyzed all climate protection laws (CPL) of the federal states and climate protection concepts (CPC) of 26 cities and counties in Germany. We also analyzed the ES-relevant implications of the amendment of the federal building code (BauGB), which determines the framework for urban land-use planning at local level.

We focused our analysis on the following research questions:

1. To what extent has the concept of ES been integrated in the legal and organizational framework of climate protection in Germany?
2. Which ES are highlighted by climate protection?
3. How could potential renewable energy ecosystem services be integrated into ecosystem service assessments?

2. Legal and organizational framework of climate protection in Germany

Climate protection is a cross-cutting topic and affects many legal domains in Germany. To understand the legal framework in which our analysis is located, we need to provide an overview of the jurisdictional framework that allows the German federal states and the subordinate levels to define climate protection goals and measures.

2.1. Climate protection in Germany

According to article 70 of the German Constitution, the federal states (*Bundesländer*) have legislative power unless otherwise explicitly specified by additional regulations in the constitution. Legislative power can be divided between the federal government and the federal states in two different ways:

- Type 1 (enumerated powers): For a set of nationally highly relevant topics (art. 71, 73 Constitution) the legislative power lies with the federal government (e.g. aviation, telecommunication, nuclear energy).
- Type 2 (competing legislative power): For other sectors the federal states have the legislative power as long as the federal government does not enact competing regulations (art. 72 Constitution). Examples are the energy sector, the economy or the traffic system (art. 74 Constitution) (Biedermann, 2011).

Climate protection as a cross-cutting topic that spans different legislative sectors – mostly in the energy sector promoting renewable energies (ARL - Akademie for Raumforschung und Landesplanung) – is part of a multi-faceted legislative framework.

2.2. Laws and regulations

The climate protection laws of the federal states (CPL) complement existing German climate-relevant laws in the sectors of energy, urban land-use planning and landscape planning (Fig. 1). The CPLs comprise regulatory contents on climate protection targets, define reporting and monitoring on the achievements of the climate protection targets, define targets and measures of the respective federal state government and clarify how land-use planning laws on the federal state level are affected. In contrast, federal laws and regulations of the energy sector (e.g. EEG, EnEV) directly affect the realization of urban development projects by – for instance – defining energy standards for new buildings, or determine – for instance – technical preconditions for power plants using renewable energies, standards that have to be respected by house owners, business companies and local planning authorities.

By June 2016, six of the 16 German states had enacted climate protection laws, which in most cases address both the climate and energy sectors, and another seven had at least developed drafts laws without enacting them. It is not clear whether these drafts will be enacted as they first need to undergo political discussion. Analysis of the draft CPLs reveals that all drafts have been developed by the Green party. The example of the Saarland shows that the draft CPLs will not