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Policy coherence in climate change mitigation: An ecosystem service approach to forests as carbon sinks and bioenergy sources

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ABSTRACT

Policies governing forest ecosystems can mitigate climate change in many ways, making use of various ecosystem services. Although identification of ecosystem service trade-offs has received increasing analytical attention, the policies and mixes of policies generating the trade-offs have remained outside the focus. To advance the policy relevance of ecosystem service trade-off analysis, we analyse the coherence of Finnish policies affecting forest bioenergy and carbon sequestration, two contrasting means to use forests for climate change mitigation. In particular, we focus on the interactions that different policy outputs have with respect to these two ecosystem services. The analysed policy outputs represent different foci and levels and rely on different mechanisms. We identify the direct and indirect impacts that the policy outputs have on the supply and demand of the services by utilizing natural science and policy assessment approaches. We find forest bioenergy, representing a tangible ecosystem service exchanged in the market, to be governed more positively and with more explicit instruments compared to carbon sequestration. Carbon sequestration policies remain at a higher level of abstraction, stating merely strategic objectives, possibly because these markets are only emerging and remain political and highly uncertain. Our analysis shows that trade-offs between the two ecosystem services are generated by policies supporting bioenergy, whilst general policies advance both services. The entire mix of policy outputs and its differentiated impacts on ecosystem services should be thoroughly considered when assessing the strategies for mitigating climate change and designing new policy instruments.

1. Introduction

Ecosystem services have been suggested as an important way to frame complex socio-ecological problems and governance challenges (Carpenter et al., 2009). The ecosystem service approach stresses the functions of the ecosystems and the benefits people derive from them (Daily, 1997; MA, 2005). One of the main expectations placed on the ecosystem service concept is that it could support decision making and governance of the entire range of assets in nature, which humans use and depend on (Norgaard, 2008; Daily et al., 2009; TEEB, 2009; Potschin and Haines-Young, 2011). The social, economic, and ecological aspects of these assets would be weighed against each other when designing policies and evaluating their impacts. However, the degree to which ecosystem services have been addressed in policies varies, and policies address different services in different ways (Primmer and Furman, 2012; Hauck et al., 2013). A general postulate is that those services that have market value are duly recognised, whilst those services that are not exchanged in the market must be given a value to be weighed properly in decision-making (e.g., Fisher et al., 2009). Policies can integrate these values to safeguard those ecosystem functions and services that remain outside the market. These assumptions have not been rigorously tested in real world policy settings, let alone in contexts where multiple policies interact. Greater understanding of how policies that already are in place influence ecosystem services is required for developing policies in a coherent way.

Especially trade-offs in ecosystem service provision pose a challenge for governance because they create a need to make choices (Rodriguez et al., 2006). In general, increasing use of provisioning services, which often have market value, is prone to conflict with enhancing or safeguarding the less tangible supporting, regulating and cultural services (Tilman et al., 2002; Rodriguez et al., 2006; Martín-López et al., 2012; Hauck et al., 2013). However, trade-offs between ecosystem services are often unintentional and not generated by deliberate governing (Rodriguez et al., 2006; Hauck et al., 2013). Often, the demand to acknowledge the trade-offs at the policy level is triggered only after the policy generates unintentional negative consequences for some ecosystem services (Hauck et al., 2013). The apparent incoherence of policies is identified through these indirect impacts.

Policy incoherence or coherence has been addressed in forest and environmental policy mainly outside the ecosystem service framework and its trade-off analyses (Howlett and Rayner, 2007; Mickwitz et al.,

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2009; Nilsson et al., 2012). Analyses of the interaction of multiple environmental policies have also addressed policy integration (Lenschow, 2002; Kivimaa and Mickwitz, 2006; Jordan and Lenschow, 2010) and policy interplay (Young, 2002; Urwin and Jordan, 2008). Policy coherence analysis, which deals directly with the compatibility of policies, is particularly suitable for analysing the entire chain, from policy objectives to impact (Nilsson et al., 2012). Policy coherence analysis is, moreover, used for analysing the ability of different policies to provide actors with coherent signals of desirable behaviour (Mickwitz et al., 2009). Therefore the policy coherence approach is suitable for analysing how policies contribute to the simultaneous maintenance of different ecosystem services.

Climate change mitigation presents an important area to investigate policy coherence in relation to ecosystem services, and forest ecosystem services in particular. The use of wood for energy production and the management of forests for carbon sequestration both rely on the functions of forested ecosystems; however, potentially resulting in trade-offs (Obersteiner et al., 2010; Mitchell et al., 2012; Vanhala et al., 2013). These ecosystem services contribute to climate change mitigation through different mechanisms and with very different consequences. Forest carbon sequestration absorbs CO_2 from the atmosphere and stores it in the forest carbon pools, i.e. biomass and forest soil, whilst wood-based energy production can be used to substitute fossil energy and consequently reduce greenhouse gas (GHG) emissions. Whether woody biomass should be harvested and combusted in order to produce energy or, whether it should be left in the forest in order to increase carbon stocks in standing biomass and soil, poses a fundamental trade-off between these two services. However, the services can also be seen to be synergistic as the same forests are envisioned to provide both of these ecosystem services to mitigate climate change: "In the long term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, whilst producing an annual sustained yield of timber, fiber, or energy from the forest, will generate the largest sustained mitigation benefit" (Nabuurs et al., 2007. p. 453). Thus, policies promoting these climate change mitigation strategies face the challenge of weighing trade-offs and searching for synergies.

In this article, we present an interdisciplinary coherence analysis assessing the (likely) direct and indirect effects that the policy outputs have on demand and supply of forest bioenergy production and carbon sequestration. Most ecosystem studies do not combine analyses of supply (provision) and demand (use) although a chain from the ecosystem service provisioning to the service user can be traced in the ecosystem service approach (Ruhl et al., 2007; Potschin and Haines-Young, 2011). As mapping analyses have highlighted the need for producing knowledge of the production functions and the processes of societal use (van Jaarsveld et al., 2005; McDonald, 2009; Paetzold et al., 2010; Burkhard et al., 2012; Kroll et al., 2012), our study explicitly recognises the distinction of provision and use. We, moreover, seek to decrease the gap between governance and ecosystem service analyses by examining the effects that policies have on the ecosystem services, and by identifying the possible coherence problems. The possible coherence problems are examined by identifying trade-offs that are generated or aggravated by policies. This leads to three research questions: 1) Do specific policy outputs strengthen bioenergy production, which is a tangible service with established markets, more than carbon sequestration, which is an abstract service with less clear market-value, 2) Which of the specific policy outputs create trade-offs between the climate mitigating forest ecosystem services and which simultaneously support both services, and 3) Is the ecosystem service concept useful for analysing policy outputs and their coherence.

We analyse forest related policies in Finland, where per capita GHG emissions are among the highest of the European Union member states (EEA, 2013). Finland's forest policies illustrate the tensions in the governance of forests for climate change mitigation in an interesting context, as forests have traditionally had high socio-economic significance. Three quarters of Finland's land surface is covered with forests with more than half of this forest area being privately owned (Finnish Forest Research Institute, 2012). Forest policies have earlier promoted timber growth and removals, subsuming other goals (Hyytiäinen and Tahvonen, 2001; Ollonqvist, 2001; Primmer and Kyllönen, 2006; Kotilainen and Rytteri, 2011; Saarikoski et al., 2012). In line with global and European policy development, the national forest and energy policies have been recently reformed to adopt the goal of climate change mitigation (e.g. Ministry of Agriculture and Forestry, 2010; Ministry of Employment and the Economy, 2011). The coherence of the resulting mix of policies is a major point of interest in examining how trade-offs between ecosystem services can be balanced.

2. Materials and methods

2.1. Definitions

In this study we focus on two forest ecosystem services that mitigate climate change, are recognised by policies and for which there is actual demand, i.e., they are currently used by humans. For carbon sinks this definition requires temporal operationalization. Generally the timescales needed for carbon sequestration assessments are long (decades, even centuries) due to slow changes in the carbon storages. In this study, the carbon sink is specified by the Kyoto treaty and its changes are evaluated over a timescale of less than 10 years. We have separated the supply and demand sides of ecosystem services by taking the definitions given by Burkhard et al. (2012) as a starting point: The demand for ecosystem service is the actual or potential usage or consumption of the service in a particular area over a given time period, and the supply of ecosystem service is the capacity of a particular area to provide the service. More specifically, in this study we have considered the borderline between supply and demand from a policy point of view. Thus the policies affecting forest owners were considered to affect the supply and the policies affecting all other actors further down the value chain (e.g. power plants, industry, consumers) were considered to affect the demand.

Policy coherence is understood as an ability of policies to provide target groups with non-conflicting signals related to desired action (Mickwitz et al., 2009). Coherent policies thus succeed in reducing conflicts and promoting synergies between and within different policy areas (Nilsson et al., 2012). As there is a general agreement to promote both bioenergy and carbon sequestration, a coherent policy would consider both of these aims in a balanced manner and would make the potential trade-offs explicit. The signals in this study were examined by policy outputs, i.e. objectives and instruments defined in acts and policy programmes (Nilsson et al., 2012). The policy objectives and instruments cover policy components from objectives to mechanisms/tools according to the classifications by Howlett and Cashore (2009) and Dupuis and Biesbroek (2013). A policy can include one or several outputs and the policies that were selected for our study were assessed at the level of objectives such as strategic aims as well as fine-tuned instruments such as subsidies or obligations. For the purpose of this study, it was unfeasible to refine the classification of policy components beyond objectives and instruments.

2.2. Materials and analysis

The material we analysed included policies that govern forest bioenergy and/or carbon sinks or the use of forests in general. Thus the overall policy areas we examined were related to forestry, energy and climate, and land use and nature conservation. The analysed policies were national, including those that implement EU policies and international treaties. In addition to the contemporary policies in force at the time of writing this paper, we also included all the policies that were in preparation at either the ministerial or the governmental level (Table 1). From the policies we identified the specific outputs, which have relevance regarding one or both of the ecosystem services. The