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Research article

Is enhanced biodiversity protection conflicting with ambitious bioenergy targets in eastern Finland?

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ABSTRACT

The study describes how qualitative stakeholder feedback can be used in quantitative scenarios to simulate forest resource use under alternative management objectives. In earlier studies in the region of eastern Finland, stakeholders did not see a possible conflict between increased bioenergy use and nature conservation; this finding is contrary to the results of other studies. The aim of this study was to test with a quantitative modelling approach whether the stakeholder expectation holds and whether forest management in eastern Finland can simultaneously increase biomass utilization and biodiversity protection. Prior to this study, three alternative scenarios on forest resource use were created in a participatory stakeholder process, involving a broad range of stakeholders, with half of them being from research and education. In the current study, a large-scale forest resource planning model (MELA) and a sustainability impact assessment tool (ToSIA) were used to simulate the different alternative scenarios and present the results back to the stakeholders in order to evaluate them. The scenarios were evaluated by stakeholders using multi-criteria analysis. In a survey, the stakeholders indicated that biodiversity, employment, recreational value and greenhouse gas emissions were the most important indicators to them, whereas growing stock, amount of harvested roundwood, energy wood and protected forest area were considered less important. Of the created scenarios, the scenario combining bioenergy and biodiversity targets was the most preferred by the stakeholders as it performed well on those indicators that were identified by stakeholders as the most important. In this scenario, the area of protected forest and bioenergy production were increased simultaneously. With this study we offer a framework for evaluating different alternatives for future land use. The framework helps to identify key issues that are important to the stakeholders so that they can be taken into consideration in future land-use planning. In addition, the results confirm the stakeholder expectation that by protecting more forests while simultaneously increasing the mobilization of potentially available wood resources, both targets can be met without compromising too much other forest functions such as timber production and recreation.

1. Introduction

Over the last few years a policy debate disputed how forest management should be changed in the future. On one side there is strong demand for more intense utilization of biomass potentials to meet our renewable energy targets (Ministry of Employment and the Economy of Finland 2008; European Commission, 2009). On the other hand, biodiversity is declining and most ecosystems are not suitable to provide an appropriate habitat for many threatened and endangered species (EEA, 2010; Rassi et al., 2010). Therefore, more effective nature conservation measures are also needed and there are policy targets to halt the ongoing loss of biodiversity (European Commission, 2011). Demands for forest-based energy and biodiversity protection are often considered to be conflicting (Eggers et al., 2009; Verkerk et al., 2011, 2014; Pedroli et al., 2013; Forsell et al., 2016) and it will be challenging to meet both targets. In this study we explore different scenarios to see if it is

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possible to find a balance between the often conflicting demands on forests: is it possible to increase forest-based energy production while at the same time preserving and even improving biodiversity?

In the context of this resource use challenge, it was found in an earlier study that stakeholders did not believe that there is a conflict between bioenergy and biodiversity, at least not in the region which was part of our study area, eastern Finland (Haatanen et al., 2014). The current study used a quantitative modelling approach to test whether the stakeholder expectation holds and whether forest management in this region can simultaneously increase biomass utilization and biodiversity protection. In order to do so we have used a wider sustainability assessment framework and multi-criteria analysis tools to be able to include some economic, environmental and social factors in the analysis.

The aim of this work was to explore possible synergies and trade-offs between different ecosystem provisioning services under different future development trajectories. This was done by developing and simulating alternative forest resource use scenarios related to current and proposed strategies and policies. The current Finnish Long-term Climate and Energy Strategy (Ministry of Employment and the Economy of Finland 2008) and the EU target of halting biodiversity loss (European Commission, 2011) were chosen as the background policies due to their possibly conflicting objectives and impacts on forest ecosystems. In an exercise prior to this study, three scenarios were created in a participatory process with stakeholders (Haatanen et al., 2014). Our primary aim in this study was to carry out a sustainability impact assessment related to the proposed scenarios and to evaluate the scenario results again with stakeholder participation. In order to do so, a large-scale forest resource planning model (MELA) and a sustainability impact assessment tool (ToSIA) were used to simulate the different alternative scenarios. The modelled scenarios were evaluated by the stakeholders in a questionnaire in order to obtain their preferences regarding the future forest resource alternatives.

2. Material and methods

The study area consisted of five Forestry Centre areas in eastern Finland: Kainuu, North Savonia, South Savonia, North Karelia and South-East Finland. On average, about 87% of the area of these five regions is covered by boreal mixed coniferous forest and about 64% of the net annual growth is harvested each year (Finnish Forest Research Institute 2011). The major part of the forest area is under multi-objective forest management and 3.6% of the forest area is protected for landscape and biodiversity conservation (strictly protected forests, class 1; and protected forests where cautious fellings are allowed, class 2a) (Finnish Forest Research Institute 2011).

The scenario-creation process started with the development of storylines (Haatanen et al., 2014). Forest management alternatives for the five Forestry Centre areas were created using the forest resource projection model MELA (Siitonen et al., 1996) and the Tool for Sustainability Impact Assessment (ToSIA) (Lindner et al., 2010; Päivinen et al., 2012) combined with a stakeholder interaction process, where stakeholders could provide input for scenario development and give feedback on the developed scenarios (Haatanen et al., 2014). The scenarios present three forest resource management alternatives up to the year 2030: (1) biodiversity 2030 (bioD), (2) bioenergy 2030 (bioE), and (3) a scenario combining bioenergy and biodiversity targets, called bioE-bioD 2030 (Haatanen et al., 2014) (Table 1). In order to compare the results with previous work, we also included two scenarios from previous studies (Finnish Forest Research Institute, 2014) in the analysis (Table 1). We selected the business-as-usual (BAU) and the maximum–sustainable-cutting (MaxSus) scenarios for comparison, as they are used frequently in forest resource planning in Finland. In the BAU scenario, the average realized roundwood removals and average usage of energy wood in 2007–2011 were assumed to continue for the whole simulation period from 2009 to 2030. In the maximum sustainable cutting scenario (MaxSus), total roundwood removal, sawlog removal, energy wood removal and net incomes were maximized to the highest level that could be maintained without declines between consecutive periods. This alternative was not based on analysis of future wood demand, but rather reflected the potential sustainable wood supply of the study area.

2.1. The MELA forest resource projection model

Growing stock, forest growth and amounts of wood harvested were simulated using the MELA resource projection model which produces alternative feasible management schedules and simulates how the forest develops if the suggested management takes place (Redsven et al., 2011). The sample plot data of the Finnish national forest inventory from the years 2007–2011 from the study area were used as input for the MELA calculations. The MELA simulation and parameter settings followed the prevailing forest management recommendations (Tapio, 2006) and the specific modifications for different scenarios are presented in Table 1. In the bioE-bioD scenario, the adoption of former forest management recommendations (Tapio, 2001) resulted in an extension of the minimum rotation lengths by about 10 years.

2.2. ToSIA application

ToSIA (the Tool for Sustainability Impact Assessment) was used to quantify environmental, economic and social sustainability indicators for the situation in 2009 and to evaluate sustainability impacts of the alternative scenarios for 2030. The MELA resource projection model was used to make projections for future forest development. For each scenario, the simulated forest resource data were used to initialize the material flow in ToSIA. The ToSIA Database Client program was used to create a forest wood chain (FWC) for each study area. More detailed information on the ToSIA tool, the methodology, and its possible applications is provided in Lindner et al. (2010, 2012). The FWCs were based on a similar chain for the North Karelian forest centre constructed by den Herder et al. (2012). This chain was updated with more recent data (2009) and expanded with four additional forestry centre areas in order to cover the whole region of eastern Finland. The production processes were similar for the forest wood chains of the five forestry centres; however, material flow input data such as the growing stock, tree growth and harvested wood products, were adjusted to simulate the material flow of each region as closely as possible. In our assessment, whole value chains for different forest wood products (sawlogs, pulpwood, energy wood, wood chips, firewood and wood pellets) were evaluated, from planting trees to the end use of products (see Supplementary material for a more detailed description of the value chains). ToSIA assesses sustainability impact by quantifying changes in the material flows which are linked to the production processes of a value chain. These processes are linked to social, economic and environmental indicators. ToSIA calculates the material flow through the processes of the value chain and combines these process-by-process with the indicator results. Based on the selected indicators, sustainability impact comparisons can be made of changes inside value chains, between value chains, and between the present situation and different future scenarios.