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Research article

Decision support framework for evaluating the operational environment of forest bioenergy production and use: Case of four European countries

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ABSTRACT

Complex policy-making situations around bioenergy production and use require examination of the operational environment of the society and a participatory approach. This paper presents and demonstrates a three-phase decision-making framework for analysing the operational environment of strategies related to increased forest bioenergy targets. The framework is based on SWOT (strengths, weaknesses, opportunities and threats) analysis and the Simple Multi-Attribute Rating Technique (SMART). Stakeholders of four case countries (Finland, Germany, Norway and Slovenia) defined the factors that affect the operational environments, classified in four pre-set categories (Forest Characteristics and Management, Policy Framework, Technology and Science, and Consumers and Society). The stakeholders participated in weighting of SWOT items for two future scenarios with SMART technique. The first scenario reflected the current 2020 targets (the Business-as-Usual scenario), and the second scenario contained a further increase in the targets (the Increase scenario). This framework can be applied to various problems of environmental management and also to other fields where public decision-making is combined with stakeholders' engagement. The case results show that the greatest differences between the scenarios appear in Germany, indicating a notably negative outlook for the Increase scenario, while the smallest differences were found in Finland. Policy Framework was a highly rated category across the countries, mainly with respect to weaknesses and threats. Intensified forest bioenergy harvesting and utilization has potentially wide country-specific impacts which need to be anticipated and considered in national policies and public dialogue.

1. Introduction

Renewable energy polices in the European Union (EU) have developed gradually since the 1990s, with the EU Renewable Energy Directive, hereafter EU-RED (2009/28/EC, 2009), as an important cornerstone which set a 20% renewable energy target at the EU level for the year 2020. The EU-RED also set mandatory targets for all member states. The national target share in EU27 varies between countries, the median figure being 18% (2009/28/EC, 2009). Non-member states have also set national targets for 2020. For example, this target is 67.5% for Norway (Energy, 2013). Recently, the EU has prepared the climate and energy framework for 2030, including a 27% renewable energy target that is binding at the aggregate European level but voluntary for individual member states (Commission, 2014). This new policy of flexible targets gives more freedom and responsibility to individual countries to select and apply renewable energy targets and policies that fit their

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operational environments.

Parallel to EU-RED, European countries have developed and implemented their own means, e.g. National Renewable Energy Action Plans (NREAPs), to reach renewable energy targets (Commission, 2010). In many countries forest bioenergy has become one of the key elements in the renewable energy palette. NREAPs and means to increase its use include regulative (e.g. deregulation to foster wood mobilization), economic (e.g. mechanisms for financing, markets and marketing) and informative (e.g. advising forest owners) instruments which emphasize both the supply and demand side of bioenergy provision and use (Hillring, 1998; Jacobsson et al., 2009; Mantau et al., 2010). The portfolio of the applied instruments in a certain country forms the country strategy, a concept that is used further in this study to mean the more or less explicit plan that defines the use of different instruments that aim at reaching the country level forest bioenergy targets.

The possibilities to increase the use of forest bioenergy are affected by various factors (e.g. technical, environmental, economic, political and social) (Mantau et al., 2010; Pelkonen et al., 2014; Verkerk et al., 2011) and depend on country specific conditions, such as role of forests, forest bioenergy and forest ownership structure. Thus, integrated and tailored policy framework for mobilization of resources incorporating national requirements, towards 2020 and 2030 targets is under preparation (Biomasspolicies, 2016). This, of course, has also shaped both the target levels for forest bioenergy and the contents of country strategies. Nevertheless, a common feature throughout Europe is that the current production of forest bioenergy has mainly been a by-product of round wood production for the pulp, paper and timber industry (McKendry, 2002). The residues from thinning and final felling areas make up most of the forest wood assortments delivered to the energy industry (EEA, 2007). Therefore, a decline in the capacity of the traditional forest industry (Toland, 2007) and resulting changes in harvesting levels could result in both positive (excess raw material) and negative (less bioenergy as a by-product of roundwood harvesting) effects on the production and use of forest based bioenergy.

Nevertheless, mobilization of the biomass potential from European forests implies a far more intensive use of forest resources and involves trade-offs in relation to other forest functions (Kärkkäinen et al., 2014; Mantau et al., 2010) as well as potentially emerging conflicts (Söderberg and Eckerberg, 2013) that need to be taken into account when defining and implementing the country strategies for achieving forest bioenergy targets. For this reason, the current state and the expected development of the operational environment in the whole EU and in individual countries is crucial.

One traditional and commonly used tool to assess operational environments is SWOT analysis, which enables a systematic examination of an organization's internal (strengths and weaknesses) and external (opportunities and threats) operational environments (Lussier, 2006). The analysis of operational environment includes uncertainties, as emerging changes may take place or the development of some operational environmental factors can actually be faster or slower than expected in the strategy creation process. Because of this, scenario analysis, among other uncertainty analysis tools, has become a commonly used tool to consider alternative future development paths and uncertainties when important decisions are to be made. Thus, the use of SWOT can be applied to scenario analysis (Leskinen et al., 2006).

The major objective of this research was to form a three-phase decision-making framework for analysing the operational environment of forest bioenergy production, integrating SWOT analysis, Simple Multi-Attribute Rating Technique (SMART method) and participatory approach that enables to include stakeholders' opinions in the decision-making process. The framework was designed to be transferable to other countries where public bioenergy policy needs to be aligned with the operational environment. To demonstrate the framework, data from four case countries (Finland, Germany, Norway and Slovenia) were gathered and analysed. These countries represent different forest structures, forest management practices and forest utilization intensities. They also differ with respect to the energetic use of forest resources. Through analysing the cases with the proposed framework, the further aim was to identify needs for forest policy and management changes that may be country-specific or have wider European relevance. Thus, policy makers could use the results when pursuing the more flexible EU 2030 targets of the production and use of forest bioenergy. In addition, the demonstrated mixed-methods framework may be used in other fields where public policy relies on stakeholders' perception of operational environment.

2. Materials and methods

A three-phase decision-making framework for analysing the operational environment of strategies related to increased forest bioenergy targets was formed (Fig. 1) and applied in four case countries as described in more detail below.

2.1. Phase 1 – preparation of SWOT analysis

Earlier expert and stakeholder interviews carried out in 2013 and described in more detail in Peters et al. (2015) and Leban et al. (2015) were utilized to identify the potential effects of increased bioenergy use on other forest uses and functions (Fig. 1). Stakeholder workshops were organized in Finland, Germany and Norway between November 2013 and April 2014 in which the preliminary SWOT analysis based on the above-mentioned interviews was used as a starting point.

When selecting the stakeholders, a priority was given to participants who were experienced with respect to bioenergy issues. In these countries a varying number of stakeholders with diverse backgrounds (i.e. business, policy, research) from variety of sectors (i.e. energy, nature conservation, practice) were identified and invited to participate in order to gain a comprehensive picture of the operational environment and to create legitimacy of the final decision (Kangas et al., 2010). The number of stakeholders who participated in the workshops and the number of participants in the subsequent weighting of SWOT groups, categories and factors are presented in Table 1.

With the aim to facilitate comparison across countries, stakeholders were offered four pre-determined categories associated with each of the SWOT groups. Thus, in preparing the SWOT analysis, the stakeholders were asked to consider the bioenergy production and use targets of the country strategy from the perspective of the following four categories: a) Forest Characteristics and Management – FM (factors affecting the potential use of forest biomass for energy), b) Policy Framework – PF (political drivers, policy making environment etc.), c) Science and Technology – S&T (scientific knowledge and results and technological development affecting the use of forest biomass for energy) and d) Consumers and Society – C&S (consumer behaviour and societal aspects affecting the country strategy). This categorization was chosen as a modification of typical PESTLE (political, economic, socio-cultural, technological, legal and environmental) analysis (Burt et al., 2006).

In Finland and Norway a preliminary list of SWOT factors under each category was prepared based on the results of the earlier interviews, while in Germany the interview results were presented to stakeholders at the beginning of the workshop, but they were not