Eesti Maaülikool
Estonian University of Life Sciences

THE ROLE OF INSTITUTIONAL INNOVATION IN THE DEVELOPMENT OF THE ESTONIAN FOREST SECTOR

INSTITUTSIONAALSE INNOVATSIOONI ROLL EESTI METSASEKTORI ARENGUS

MEELIS TEDER

A Thesis
for applying for the degree of Doctor of Philosophy in Forestry

Väitekiri
filosoofiadoktori kraadi taotlemiseks metsanduse erialal

Tartu 2016

Eesti Maaülikoodi doktoritööd

Doctoral Theses of the Estonian University of Life Sciences

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According to verdict No 6-14/19-5 of 22 December 2016, the Defence Board of PhD Theses in Forestry of the Estonian University of Life Sciences has accepted the thesis for the defence of the degree of Doctor of Philosophy in Forestry.

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Defence of the thesis:
Estonian University of Life Sciences, room 2A1, Kreutzwaldi 5, Tartu
on 13 February 2017 at 10:00.

The English in the current thesis was revised by Mrs Tiia Kaare
and the Estonian by Ann Veismann, PhD.

ISSN 2382-7076
ISBN 978-9949-569-70-0 (trükis)
ISBN 978-9949-569-71-7 (pdf)

CONTENTS

LIST OF ORIGINAL PUBLICATIONS

The thesis is based on the following papers, which are referred in the text by their Roman numerals. The papers are reprinted by the permission of the publishers.

I **Teder, M**., Ukrainski, K., Prede, M., Kaimre, P. 2007. Assessing the alignment and integration of innovation and development policies for the forest sector in Estonia. Metsanduslikud Uurimused | Forestry Studies, 46: 102─117.

II Bouriaud, L., Kastenholz, E., Fodrek, L., Karaszewski, Z., Mederski, P., Rimmler, T., Rummukainen, A., Sadauskiene, L., Salka, J., **Teder, M**. 2011. Policy and market-related factors for innovation in forest operation enterprises, in: Weiss, G., Pettenella, D., Ollonqvist, P., Slee, B. (Eds.). Innovation in Forestry: Territorial and Value Chain Relationships. CAB International, pp. 276─293.

III Nybakk, E., Niskanen, A., Bajric, F., Duduman, G., Feliciano, D., Jablonski, K., Lunnan, A., Sadauskiene, L., Slee, B., **Teder, M**. 2011. Innovation in the wood bio-energy sector in Europe, in: Weiss, G., Pettenella, D., Ollonqvist, P., Slee, B. (Eds.). Innovation in Forestry: Territorial and Value Chain Relationships. CAB International, pp. 254─275.

IV **Teder, M**., Mizaraitė, D., Mizaras, S., Nonić, D., Nedeljković, J., Sarvašová, Z., Vilkriste, L., Zalite, Z., Weiss, G. 2015. Structural changes of state forest management organizations in Estonia, Latvia, Lithuania, Serbia and Slovakia since 1990. Baltic Forestry, 21(2): 326─339.

V Bouriaud, L., Nichiforel, L., Weiss, G., Bajraktari, A., Curovic, M., Dobsinska, Z., Glavonjic, P., Jararský, V., Sarvašova, Z., **Teder, M**., Zalite, Z. 2013. Governance of private forests in Eastern and Central Europe: An analysis of forest harvesting and management rights. Annals of Forest Research, 56(1): 199─215.

The contributions of the authors and other scientists to the papers:

	I	II	III	IV	V
Original idea	**MT**, KU, MP	EK, TR, AR	All	DM, GW, ZS, **MT**, JN	LB, LN, GW
Study design	**MT**, KU, MP	EK, TR, AR	All	DM, GW, ZS, **MT**, JN	LB, LN
Data collection	**MT**, KU, MP	AR, JS, LB, LF, LS, **MT**, PM, TR, ZK	All	DM, SM, DN, JN, ZS, **MT**, LV, ZZ	AB, MC, **MT**, PG, SZ, VJ, ZD, ZZ
Data analysis	**MT**, KU, MP	AR, JS, LB, LF, LS, **MT**, PM, TR, ZK	All	DM, SM, **MT**, DN, JN, ZS, LV	AB, MC, **MT**, PG, SZ, VJ, ZD, ZZ
Manuscript preparation	**MT**, KU, MP, PK	LB, EK, **MT**	All	**MT**, DM, SM, DN, JN, ZS, LV, GW	LB, LN, **MT**

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ABBREVIATIONS

AI	Aquino Index
CHP	Combined Heat and Power
COST	European Cooperation in Science and Technology
EFDP	Estonian Forestry Development Programme
EFI	European Forest Institute
EFICEEC	European Forest Institute Central-East European Regional Office
ERDS	Estonian Rural Development Strategy
EU	European Union
FAOSTAT	Statistics Division of the United Nations Food and Agriculture Organization
FMP	Forest Management Plan
GPS	Global Positioning System
GVA	Gross Value Added
KBE	Knowledge-Based Estonia
NFI	National Forest Inventory
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
RC	Revealed Competitiveness
RCA	Revealed Comparative Advantage
RMA	Relative iMport Advantage
RMK	State Forest Management Centre (*Riigimetsa Majandamise Keskus* in Estonian)
RTA	Relative Trade Advantage
RXA	Revealed comparative eXport Advantage
SITC	Standard International Trade Classification
UN Comtrade	United Nations Commodity Trade Statistics Database
USSR	Union of the Soviet Socialist Republics
WTO	World Trade Organisation

1. INTRODUCTION

Estonia is a country where forests cover half of the land territory (EEA, 2016), thus the use of this resource is very important to national economy. In 2010, the forest related sectors employed 29 thousand persons, which is 5.1% of the total number of employed persons. In foreign trade the balance of forest related sectors is positive. From 1995 to 2010, the share of the export of forest related sectors in the total export was between 17.9% (2008) and 27.2% (1999), while the corresponding import share was between 6.3% (2000) and 7.5% (2007) (EEA, 2016).

Within the last 25 years, Estonia has gone through major social and economic reforms. After Estonia regained independence in August 1991, the national economy has transferred from a centrally planned economic system to a market economy and private entrepreneurship, from only public ownership to different ownership categories. The privatisation and restitution processes are still not fully finished. The amendment of the Land Reform Act envisages that the land reform has to be finished by the end of 2016 (Land Reform Act, 2013).

According to the National Forest Inventory 2014, the Estonian forest land (2.27 million hectares) is distributed by ownership categories as follows (EEA, 2016):

1. Private forests 48%
    a. Physical persons forest land 745 350 ha (33%),
    b. Juridical persons forest land 346 105 ha (15%),
2. State forests 44%
    a. State Forest Management Centre (*Riigimetsa Majandamise Keskus*, RMK) 926 349 ha (41%)
    b. Other state forest land 78 830 ha (3%),
3. Forest land subject to privatisation 177 066 ha (8%).

The public and private forest ownership is almost equal and the national forest policy should cover all groups of owners.

There is no unanimously accepted definition of forest or forestry sector; different countries as well as different organisations interprete these terms differently. Hereby the definition according to the EU Forest Action Plan is used: '*The forest sector includes forestry (forestry, logging and related services) and manufacturing of wood and articles of wood, and manufacturing of paper and paper products*'.

The forest based industries include the following sectors: woodworking (excluding wooden furniture), cork and other forest based materials; pulp, paper and board manufacturing; paper and board converting; and printing (Pelli et al., 2009). Thus, the wooden furniture industry is normally not a part of forest sector policy documents. This is also true about Estonia, where only in the first national forestry programme the furniture industry and the wood and paper industries are the main utilisers of national forest resources (EFDP, 2002). However, the economic review of Estonian forestry yearbook includes the furniture industry as a part of the forest sector (EEA, 2016). Further, in this study, the Estonian forest sector and the furniture industry together are defined as forest related sectors.

Despite the economic importance of the forest sector in the Estonian economy, little attention has been paid to innovation of this sector. The available studies (Ukrainski and Varblane, 2005; Ukrainski, 2008; Ollonqvist et al., 2011; Ukrainski and Kajanus, 2011) mainly focus on the wood and furniture industries. The current thesis concentrates on the institutional innovations in Estonian forest policy and their influence on the forestry and wood industries. The thesis describes the main changes in forest policy or forest acts, which can be considered as innovation. Further, the thesis analyses what kind of influence the policy changes have had on the activities in the forest sector.

2. REVIEW OF THE LITERATURE

2.1 Innovation

Innovation ideas were first described by Joseph Schumpeter in 1911 in the German language; the first English translation was published in 1934. The definitions of Schumpeter's (2008) innovation concept are as follows:

> *'This concept covers the following five cases: (1) The introduction of* ***a new good*** *– that is one which consumers are not yet familiar – or a new quality of a good. (2) The introduction of* ***a new method of production****, that is one not yet tested by experience in the branch of the manufacture concerned, which need by no means be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity commercially. (3) The opening of* ***a new market****, that is a market into which the particular branch of manufacture of the country in question has not previously entered, whether or not this market has existed before. (4) The conquest of a* ***new source of supply of raw materials or half manufactured goods****, again irrespective of whether this source already exists or whether it has first to be created. (5) The carrying out of* ***the new organisation of any industry****, like creation of the monopoly position (for example through trustification) or the breaking up of a monopoly position.'*

Later, in the European Union, the base for different statistical data collection and research projects has been the Oslo Manual (OECD, 2005), which defines innovation as *'… implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.'* The Oslo Manual (OECD, 2005) also defines the minimum requirement for an innovation of the product, where '… *process, marketing method or organisational method must be new (or significantly improved) to the firm. This includes products, processes and methods that firms are the first to develop and those that have been adopted from other firms or organisations.'*

Four types of innovation are described as follows (OECD, 2005):

- *'A* ***product innovation*** *is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics.'*

- *'A **process innovation** is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.'*

- *'A **marketing innovation** is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.'*

- *'An **organisational innovation** is the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations.'*

The previous four types of innovation are generally taking place at the firm level. Some improvements or novelties cannot be implemented by the market actors alone, but they depend on the changes in the political-institutional framework of the sector (Weiss, 2011). For analysing institutions and policies, in the framework of COST Action E51 'Integrating Innovation and Development Policies for the Forest Sector', the fifth type was added – **institutional innovation** (Figure 1). Institutional innovation means innovation in the field of public policy and it may include '*new or adaptation of existing organizations, new or significantly modified rules as laid down in laws, decrees or policies as well as new or significantly modified procedures in developing and implementing policies*' (Weiss et al., 2010).

The difference between invention and innovation is as follows: invention is the creation of something new, whereas innovation is the act of introducing something new (**III**). Difference in degree of novelty can be explained by radical and incremental innovation. Incremental innovation means improvements within a given frame of solutions ('*doing better what we already do*'), radical innovation is a change of frame ('*doing what we did not do before*') (Norman and Verganti, 2014); in other words incremental innovation involves smaller and more subjective solution adopted by the firm or entrepreneur, but radical innovation is new and different from previous solutions (**III**).

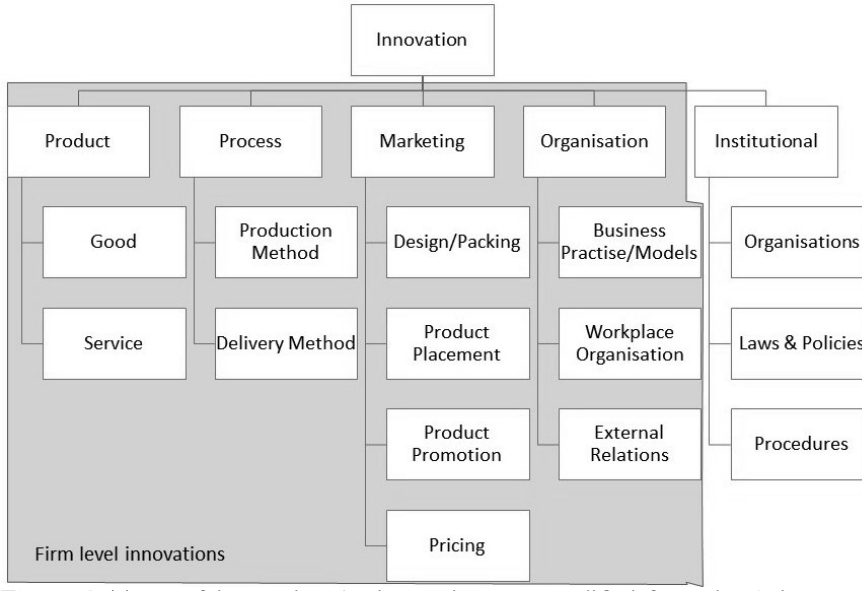

Figure 1. Types of innovation (Weiss et al., 2010, modified from the Oslo Manual (OECD, 2005)).

Traditional innovations are linear processes ('science push' or 'market pull' models) from research and development (R&D) to the market (**I**). In addition to creation, systemic approaches in innovation studies observe interactions of different actors, e.g. learning processes, diffusion (knowledge transfer), etc. Innovation systems can be defined in various ways; they can be national, regional, sectoral or technological (Carlsson et al., 2002). All of them consist of different (i) components and (ii) relationships between them and (iii) characteristics or attributes.

Regional innovation systems are regional clusters surrounded by supporting local organisations (Asheim and Isaksen, 2002). Sectoral innovation system is a set of products and a set of agents carrying out market and non-market interactions for the creation, production and sale of those products (Malerba, 2002). Breschi and Malerba (1997) described five major sectoral innovation systems, of which one, suitable for agriculture, forestry, wood and paper industries, is called traditional sector. In traditional sectors there are many innovators, who are geographically dispersed with no specific knowledge of spatial boundaries. The knowledge base is relatively simple and general, focusing on equipment and materias, thus the innovations are targeted to reducing production

costs. Buttoud et al. (2011) concluded that theoretically non-timber forest products and services are not expected to be much supported by the forestry sectoral innovation system.

The regional and sectoral innovation systems are relevant and widely used for the analysis of innovation in forestry and forest industry sectors. The regional approach is important when observing territory-based forest ecosystem services, e.g. recreation or environmental services; sectoral approach is used for analysing innovations in the wood value chain (Weiss, 2011).

Nybakk (2009) described four levels of factors that affect innovation: individual, organisational, inter-organisational and societal levels; Weiss (2011) renamed the last level to institutional–societal level.

Certain innovative individuals have a significant role in the innovation processes. Innovators are (entrepreneurial) persons, whose innovativeness is linked to the entrepreneurial attitude (Weiss, 2011). The factors influencing the impact of that kind of innovation champions is analysed by Jennsen and Jørgensen (2004), who defined the innovation champion as *'an individual that is willing to take risks by enthusiastically promoting the development and/or implementation of an innovation inside a corporation through a resource acquisition process without regard to the resources currently controlled'.*

The second level is organisational, focused on organisational culture and structure. The third level focuses on relationships between organisations.

At the institutional–societal level, the factors that are beyond the firms and their interactions are analysed: legislation and other institutional arrangements (e.g. property rights), the roles and functions of public institutions or interest groups and the general characteristics of societies. This level also analyses the effect of regional clusters on national competitiveness. The institutional innovation patterns in forestry and woodworking sectors are different (Ukrainski and Varblane, 2005; Carvalho Mendes et al., 2011; Ukrainski and Kajanus, 2011).

While in the late 1980s and early 1990s innovation was seen as the main force behind economic growth, then according to current interpretations innovation is a central element of economic performance and competitiveness. Firms seldom innovate alone; innovation requires interactions with other agents, such as suppliers, consumers and competitors (Rametsteiner, 2010).

2.2 Property right analysis

There are various and inconsistent definitions of property rights; economic and legal literature use distinctly different meanings (**V**). Several typologies are suitable for conceptualising forest related property rights (Jagger, 2014). The current thesis uses the framework suggested by Schlager and Ostrom (1992), which defines five basic natural resource related bundles of rights, the additional samples are given by Agrawal and Ostrom (2001):

- *'Access – the right to enter a defined physical property,*
- *Withdrawal – the right to obtain the "products" of the resource'* (e.g. harvesting of roundwood or mushrooms),
- *'Management – the right to regulate internal use patterns and transform the resource by making improvements'* (e.g. forest planting, thinnings),
- *'Exclusion – the right to determine who will have an access right and how that right may be transferred,*
- *Alienation – the right to sell or lease either or both of the above collective-choice rights'.*

Additionally Schlager and Ostrom (1992) defined four types of resource system users; their distinctions related to bundles of rights are shown in Table 1.

Table 1. Bundles of rights associated with positions

	Owner	Proprietor	Claimant	Authorised User
Access and Withdrawal	X	X	X	X
Management	X	X	X	
Exclusion	X	X		
Alienation	X			

Source: Schlager and Ostrom, 1992.

Different researchers analyse bundles of forestry related property rights all together (Coleman, 2011; Nichiforel and Schanz, 2011) or by various combinations of them, e.g. access and withdrawal rights (Jagger, 2014). Galik and Jagger (2015) proposed an additional bundle of rights – alteration, which is the ability to change the goods and services provided by the resource, e.g. clearing the forest for agricultural production (Jagger, 2014).

The withdrawal and management rights on timber are directly forest management related. The forest owners' income is determined by the rules about when, where, how (in terms of technology) and how much can be cut. The rest of the rights (access, exclusion and alienation) have only indirect impact on the owners' income. Management and withdrawal rights are regulated by specific legislation and policies, various restrictions apply (Hickey and Innes, 2006; Šálka et al., 2006; Bouriaud and Nichiforel, 2010; Weiss et al., 2011; Appelstrand, 2012; Brukas et al., 2015).

2.3 Revealed comparative advantage as an indicator for sectoral competitiveness

Innovation analysis at the institutional–societal level includes analysis of sectoral competitiveness. Competitiveness is a multifaceted target; there are no single and fully comprehensive measures for its determination. Competitive performance can be measured with various indicators (Peneder et al., 2009), for example:

- Growth: gross value added (GVA), growth of employment;
- Productivity: labour productivity, multifactor productivity;
- Profitability: net profit margin, return on assets;
- International trade: revealed comparative advantage (RCA), export market share;
- Foreign direct investments.

The analysis of Estonian indicators related to the forest sector growth are given as follows: GVA in Figure 3 and employment in Figure 4. The current study focuses on analysing competitiveness on the basis of international trade data; a detailed analysis of the method is given in section 4.2.

2.4 Porter's model of five forces

For analysing the competitive situation inside an industry, Porter (1979) described five competitive forces that shape a company's strategy (Figure 2). Nearly 30 years later Porter (2008) updated his Five Forces Framework. The basic forces remained the same, but some of the important descriptors were modified. According to Porter the five forces are

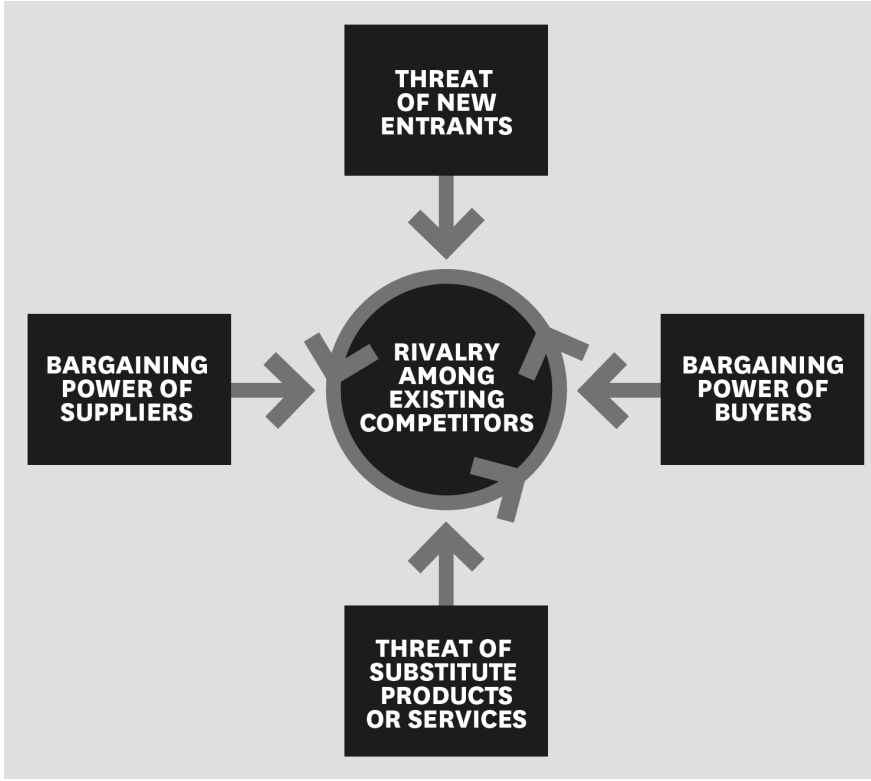

Figure 2. Forces governing competition in an industry (source: https://hbr.org/visual-library/1979/03/the-five-forces-that-shape-industry-competition).

1. Jockeying of rivals or existing competitors for positions, where they may use different tactics, like price discounting, new products introduction, advertising campaigns and improvements in services. High rivalry limits the profitability of an industry, as the price competition transfers the profits directly from the industry to its customers.

2. Threat of entry. New entrants create additional production or sales capacity, their willingness to obtain a market share puts pressure on prices, costs and extent of investments needed for competing. The threat of entry puts limits to the profitability of an industry: the existing firms have to hold down their prices or to increase investments to deter new competitors. The threat of entry is related to the level of entry barriers. If entry barriers are low and newcomers expect little reaction of long-established competitors, then the threat of entry is high and the industry's profitability is moderated. There are several barriers to entry, e.g. supply

side economies of scale, capital requirements, incumbency advantages, unequal access to distribution channels or restrictive government policy.

3. The power of suppliers. Powerful suppliers catch up more of the value for themselves by assigning higher prices, setting measures to quality or services, or shifting costs to industry participants. Powerful suppliers can extort profitability out of the industry, which cannot add the cost increases in its own prices. A supplier group is powerful if e.g. it is more concentrated than the industry that is buying the products, if suppliers offer differentiated products or if there are no substitutes for the products provided by the supplier group. A powerful supplier group can also threaten to integrate forward into the industry: if industry participants generate too high profits compared to suppliers, suppliers could be motivated to enter the market.

4. Powerful customers can earn more by forcing down prices, demanding higher quality or more services (forcing to higher costs). Powerful customers have negotiating advantage and usually they are playing industry participants against one another, which will lead to a decrease in the profitability of an industry. The customer group has a negotiating advantage e.g. if there are few buyers, each of them buying in large volumes, or if industry products are standardised or identical. If vendors are too profitable, buyers can threaten to integrate backward and produce the industry's product themselves.

5. The threat of substitutes. A substitute performs the same or similar tasks as an industry product by a different means. When the danger of substitutes is high, the industry profitability suffers. Substitute products are setting barriers to industry profits, by setting the upper limits of prices (Porter, 1979; Porter, 2008).

After Porter first published his Five Forces Framework (Porter, 1979), there have been several critical opinions about it (Nalebuff and Brandenburger, 1996; Narayanan and Fahey, 2005; Besanko et al., 2009). Different authors showed that some other important forces are missing, e.g. digitalisation, globalisation, deregulation (Downes, 1997) or government activities. The governments intervene in firm activities by setting up and enforcing property rights and environmental regulations, to which firms have to respond. Therefore, government intervention (the non-market environment in a broader sense) composes the sixth force guiding industry's competition (Rugman and Verbeke, 2000).

In the second version of his paper, Porter (2008) additionally argues that strategists should keep in mind all the five forces, instead of gravitating to any one element. There are also other factors, which are not forces – industry growth rate, technology and innovation, complementary products and services. Government is not the sixth force, because its involvement is neither inherently good nor bad for industry profitability. Government's impact on competition should be analysed in a way that helps to find out how the specific government policies influence the five competitive forces. Government is active on multiple levels with many different policies, each of them having different influence (Porter, 2008).

3. AIMS OF THE STUDY

Innovative activities of forest sector firms are influenced by and derived from different policies, such as forest policy, innovation policy, rural development policy and energy policy. Due to different backgrounds, every country has its own development, so the policies and their implementation are different as well. The importance and urgency of studies on forest sector innovation on the European level was proved in 2005, when the COST committee decided to support COST Action E51 'Integrating Innovation and Development Policies for the Forest Sector', which was active in 2006–2010.

Additionally, under the European Forest Institute Central-East European Regional Office (EFICEEC) the project 'Innovation and Sustainability in Forestry in Central and Eastern Europe: Challenges and Perspectives' was carried out in 2009–2010.

The research into forest sector innovatitions and innovativeness is still important and it is acknowledged by the international organisation European Forest Institute. A side event of the European Forest Intitute (EFI) 2016 Annual Conference is a scientific seminar 'Forest-based innovations: a key for Europe's bioeconomy', which will focus on the role of innovation in the forest-based sector and its implications towards European bioeconomy.

The thesis covers the period from 1990 until 2010, as under the project 'Innovation and Sustainability in Forestry in Central and Eastern Europe: Challenges and Perspectives' (represented here by papers **IV**, **V** and Dobšinska et al., 2011) it was agreed to compare the changes **before** the transition period (in many collaborating countries 1990) and **now**, which referred to the year 2010.

The research questions are:

- What are the main developments of the Estonian forest sector in the context of policy changes and vice versa?
- To what extent and in what form is innovation included in forest policy documents?
- Are the main forestry related policy changes fostering or impeding factors for innovation activities in the forest sector?
- What are the main policy-driven innovations in Estonian forestry governance, management of state-owned and privately owned forests and in forest industries?

- Have the forest policy changes influenced the international competitiveness of the sub-sectors of the Estonian wood industries?

From the bundle of the various rights, the property right analysis covers only withdrawal and management rights on timber (section 5.5.3), because they are directly related to forest management and they mostly influence the income of the forest owner.

Porter's five forces model is discussed and analysed only in the context of policy influence on the competition in the forest sector and policy influence on activities of various actors in the forest sector.

4. MATERIALS AND METHODS

4.1 Policy analysis

The current study uses several methods.

The analysis of legislative, policy and strategy documents is used in all papers **I**–**V**. Paper **I** analyses different policies (Table 2), but the current thesis focuses on how the innovation related terms are described in forest policy documents. In papers **II**–**V** the forest policy and legislation are analysed in the context of the topics of papers.

Table 2. Analysed Estonian policy and strategy documents in Paper **I**

Document Name	Description
Innovation Policy and Strategy Documents	
Knowledge-Based Estonia (KBE): Estonian Research and Development Strategy 2002─2006	The earliest R&D strategy of Estonia, approved by Parliament in December 2001. No specific implementation plan was included
Knowledge-Based Estonia: The Estonian Research and Development and Innovation Strategy 2007─2013	Successor of the previous KBE, approved by Parliament in February 2007. An implementation programme was included
Action Plan for Growth and Jobs 2005─2007 (Riigikantselei, 2005)	The broadest in coverage and most general, regulating the general development strategy of the country
Organisation of Research and Development Act	The main document regulating the functioning of Estonian R&D system. Approved by Parliament in March 1997, significantly amended in 2001
Forest Sector Policy and Strategy Documents	
Forest Acts	From 1993, 1998 and 2006
National Forest Policy	Approved by Parliament in July 1997
Estonian Forestry Development Programme until 2010 (EFDP)	Approved by Parliament in November 2002
Rural Development Policy and Strategy Documents	
Estonian Rural Development Strategy 2007─2013 (ERDS)	Approved by Government in July 2006.
Estonian Rural Development Plan 2007─2013 (ERDP)	ERDS policy implementation document, approved by Government in February 2007

Papers **II—IV** use a case study approach (Rowley, 2002; Yin, 2009) to understand how the innovation is implemented and how it occurs in the firm.

According to Bernard (2006), a semi-structured interview is the best when a researcher can not get more than one chance to interview, e.g. when dealing with high-level bureaucrats and elite members of a society or with persons who are eager to use their time efficiently. Semi-structured interviewing is based on the use of an interview guide, which is a written list of questions and topics that need to be covered in a particular order. A semi-stuctured interview demonstrates that the researcher fully controls the planned outcomes of the interview, but it leaves to both participants the freedom to follow new leads.

Papers **I—III** were prepared within the framework of COST Action E51 'Integrating innovation and development policies for the forest sector'. The preliminary data for paper **I** were collected following the guidelines of Bauer and Rametsteiner (2006), the further analysis was made by the authors of the paper. Data collection guidelines for papers **II** and **III** were prepared by members of specific workgroups of COST Action E51, who are also the co-authors of the papers. The data collection protocols of papers **II** and **III** were established in 2008. In addition to the analysis of the different policy documents, the semi-structured oral interviews with owners and/or chief executive officers of the Estonian case-study firms were carried out in 2008—2009. In paper **II**, the Estonian case-study firms were selected to be innovative and untypical compared with their competitors. In paper **III**, the innovators of combined heat and power production, Mr Priit Maran and Mr Tiit Veeber, were interviewed and data on their companies were used in case studies. The pellet production case-study firm (**III**) was selected because it was innovative and untypical at the time of data collection.

Papers **IV** and **V** were prepared in the framework of an EFICEEC project, where the preliminary data were collected under the project 'Innovation and sustainability of forestry in Central-Eastern Europe: challenges and perspectives'. The cross-country comparisons were made for the year 2010, additional political changes within previous 20 years were analysed. Both papers are based on the analysis of policy documents and literature, a standardised data collection protocol with different key questions was used. In case of doubts or misunderstandings, additional spoken (direct face-to-face meeting or telephone conversation) or written (E-mail) comments were asked from different anonymous forestry specialists.

For assessing the withdrawal and management rights (Schlager and Ostrom, 1992), a set of key questions from the standardised data collection protocol was applied in paper **V**. This method is specific for a positive law analysis approach. In economic analysis of law, the positive analysis observes how agents behave in response to legal rules (e.g. *'How will the law affect human behaviour? What will individuals' likely response to changes in the rules be?'*) and how legal rules are shaped (Jolls et al., 1998).

The forest acts and timber harvesting related specific regulations were analysed to find their main influences on management and withdraval rights. To evaluate the management rights, the authorities that regulate the forest resource internal use pattern were identified. The withdrawal rights were evaluated by identifying the authority that determines how, when and where the harvesting from the resource may occur.

4.2 Analysis of forest sector competitiveness by revealed competitive advantage

4.2.1 Method

For analysing competitiveness in international trade the RCA index is widely used. For RCA analysis different mathematical formulas can be applied; here the Balassa index (Balassa, 1965) is used.

$$\mathrm{RCA}_{ij} = \frac{\frac{x_{ij}}{\sum_i x_{ij}}}{\frac{\sum_j x_{ij}}{\sum_i \sum_j x_{ij}}} \quad (1)$$

where X = export value, i = commodity class, j = country.

Here the numerator describes the share of the country j export value in the world total export value of the commodity i. This share can be called the country's market share of the total world export market. The denominator shows the share of the export of the country j in the total world export. If $\mathrm{RCA}_{ij} > 1$, then a country has a comparative advantage; the country of interest is specialised in producing the commodity of interest. The country that has relatively cheaper production factors exports the goods. If $\mathrm{RCA}_{ij} < 1$, then the country is at a comparative disadvantage with this product (Dieter and Englert, 2007; Han et al., 2009).

Formula 1 observes only export; in the literature the same RCA index is also called Revealed comparative eXport Advantage (RXA) index. There are two problems: (i) the RCA index double counts the product and/or country information in the same formula (Vollrath, 1991; Bojnec and Fertő, 2009), and (ii) only export is analysed. For import analysis, a similar index, Relative iMport Advantage (RMA), is used.

$$\mathrm{RMA}_{ij} = \frac{\frac{M_{ij}}{\sum_j M_{ij}}}{\frac{\sum_i M_{ij}}{\sum_i \sum_j M_{ij}}} \tag{2}$$

where M = import value, i = commodity class, j = country. If $\mathrm{RMA}_{ij} > 1$, then the country has an import advantage: import exceeds export.

Vollrath and Huu Vo (1988) firstly introduced a concept of revealed competitiveness (RC), which according to Vollrath (1991) is

$$\mathrm{RC}_{ij} = \ln\left(\mathrm{RXA}_{ij}\right) - \ln(\mathrm{RMA}_{ij}) \tag{3}$$

Additionally Vollrath (1991) proposed a Relative Trade Advantage (RTA) index

$$\mathrm{RTA}_{ij} = \mathrm{RCA}_{ij} - \mathrm{RXA}_{ij} \tag{4}$$

In case of both previous indices, RC and RTA, positive values indicate a competitive/comparative advantage, while negative values indicate a comparative/competitive disadvantage.

The Aquino index (AI) is also based on Balassa's RCA concept; its detailed interpretation is given by Algieri (2004).

$$\mathrm{AI} = \frac{\mathrm{RCA}_{ij}}{\mathrm{RXA}_{ij}} \tag{5}$$

In further study, based on Statistics Division of the United Nations Food and Agriculture Organization (FAOSTAT) and World Trade Organisation (WTO) data, the RTA and AI indices are not discussed in details; they were calculated to show the similarities or differences with the RC index.

4.2.2 Data

For RCA analysis the data of three different databases were used:

- FAOSTAT Forestry Production and Trade database, countries import and export values of aggregated item 'forest products total',
- WTO Statistics Database for countries total export and import values,
- United Nations Commodity Trade Statistics Database (UN Comtrade). The queries were made according to the Standard International Trade Classification (SITC) Revision 4 (SITC, 2006).

The FAOSTAT database does not have total export and import values of the countries, thus FAOSTAT and WTO databases were combined. The FAOSTAT database item 'forest products total' includes products like roundwood, sawnwood, wood-based panels, pulp and paper, but it does not include forest and furniture sectors final products such as joinery, prefabricated houses and furniture.

The UN Comtrade database allows queries related to wood products, but the limit is shortness of time series, as the data starts from 2007, thus here the data of 2007–2010 are analysed. For further analysis of the UN Comtrade data the pulp and paper products were excluded, because with a few exceptions (packaging paper produced at Kehra and aspen Bleached ChemoThermo Mechanical Pulp (BCTMP) in a factory in Kunda), the pulp and paper products are imported to Estonia. The list of analysed commodities is given in Table 3. According to SITC classification the group 811 – prefabricated buildings – is a part of section 8 – miscellaneous manufactured products, not necessarily wood products. In the current study, we assume that prefabricated buildings are wood products, either log houses or factory-made prefabricated modules, in which the main construction frames and most other components are made from wood.

The data analysis of this part was done in April 2012, results are not published, but two oral presentations have been made; one at the Bi-annual meeting of Scandinavian Society of Forestry Economists in May 2012 and the other at the 4th International Faustmann Symposium Forest Economics under Multiple Challenges in September 2012.

Table 3. Anlysed commodities and their technological categories

Group or subgroup	Description according to SITC Revision 4	Term used in further data analysis	Product by technological categories *
245	Fuel wood (excluding wood waste) and wood charcoal	Fuel wood	Primary products
246	Wood in chips or particles and wood waste	Chips & particles	Primary products
247	Wood in the rough, whether or not stripped of bark or sapwood, or roughly squared	Roundwood	Resource-based manufactures: agro/forest based products
248	Wood, simply worked, and railway sleepers of wood	Sawnwood	Resource-based manufactures: agro/forest based products
634	Veneers, plywood, particle board, and other wood, worked, n.e.s.	Wood panels	Resource-based manufactures: agro/forest based products
635	Wood manufactures, n.e.s. (packing boxes, builders' joinery and carpentry, etc.)	Other manufactured wood	Resource-based manufactures: agro/forest based products
811	Prefabricated buildings	Prefabricated buildings	Medium technology manufactures
821.5	Furniture, n.e.s., of wood	Wooden furniture	Low technology manufactures
	Wood product total – calculated sum of all the groups listed here	Wood products total	

n.e.s. — not elsewhere specified
*Sources: Lall (2000), UNCTADSTAT (2000).

5. RESULTS

5.1 The dynamics of main economic indicators

After regaining political and economic independence (1991) and joining the European Union (2004) Estonia has witnessed great changes in forest related sectors. The GVA of the forest sector and furniture industry has played an important role in Estonian gross domestic product, comprising 4.0–6.2% between 1995 and 2014. The share of forestry in the GVA has been 0.8–2.0% and of the wood processing industry 1.7–2.7% (EEA, 2016).

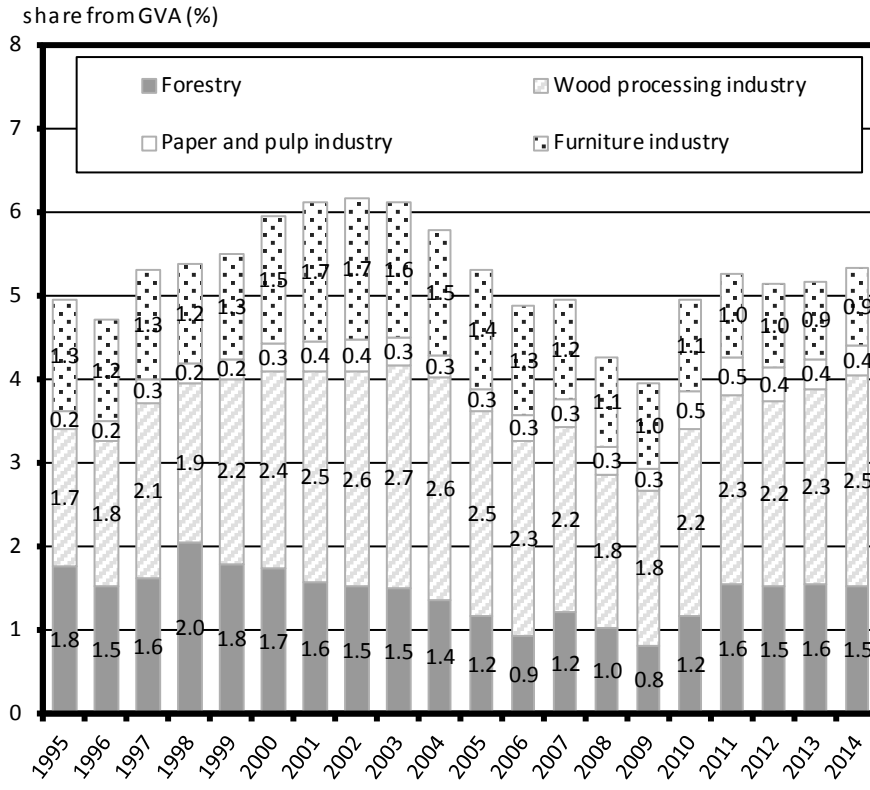

Figure 3. Share of forest related sectors in the gross value added (GVA) in 1995–2014, at current prices (EEA, 2016).

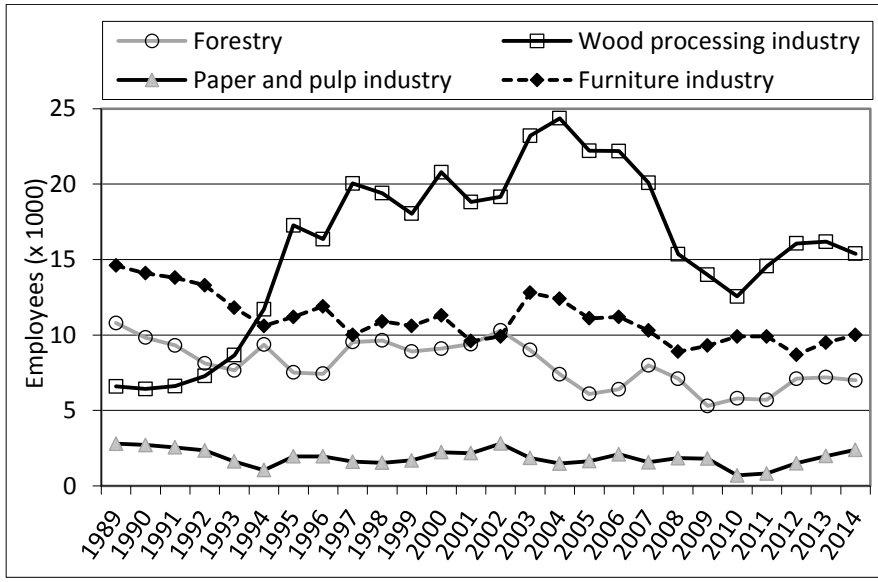

Figure 4. Employment in forest related sectors in Estonia in 1989–2014 (EEA, 2016).

The total employment in forest related sectors has varied between 29 thousand (2010) and 46.9 thousand (2003) employed persons; the lowest figure is probably a result of the world economic crisis in 2009. The employment in different forest and furniture related industries (Figure 4) between 1992 (the first full year after Estonia regained independence in August 1991) and 2014 is as follows:

- Forestry, logging and related service activities between 5.3 and 10.3 thousand employed persons, the share in the annual employment of the forest related sectors between 14.9% and 28.6%;
- Wood processing industry between 7.3 and 24.4 thousand employed persons, the share in the sectoral annual employment between 23.5% and 54.1%;
- Paper and pulp industry between 0.7 and 2.8 thousand employed persons, the share in the sectoral annual employment between 2.4% and 7.6%;
- Furniture industry between 8.7 and 13.3 thousand employed persons, the share in the sectoral annual employment between 23.5% and 42.8%.

The total number of employed persons[1] in Estonia was between 568 thousand (2010) and 761.4 thousand (1992); therefore the forest sector accounted for 4.1% of the total employment in 1992 and for 7.8% in 2003 (EEA, 2016).

1 1989–1996: employed persons aged 15–69, 1997–2013 employed persons aged 15–74.

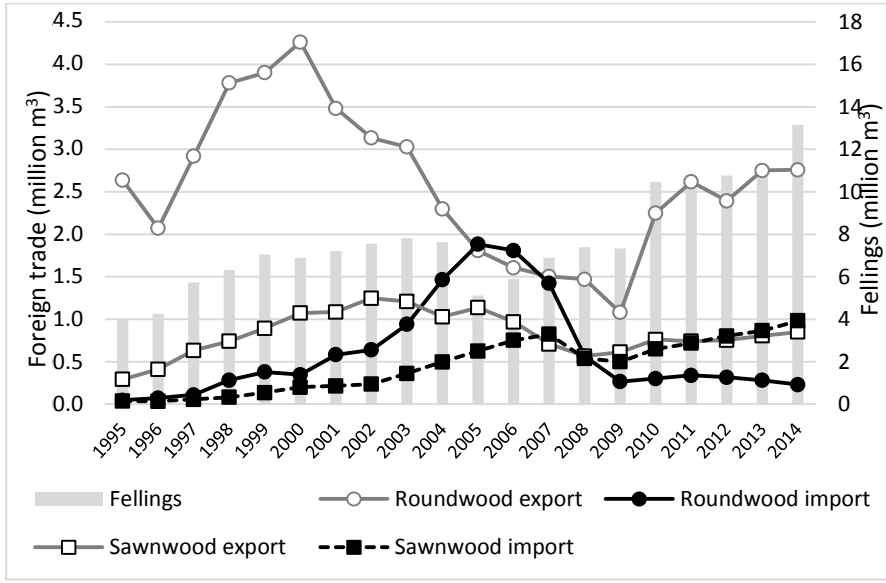

Figure 5. Estonian fellings and quantities of roundwood and sawnwood foreign trade in 1995–2013 (EEA, 2016).

After Estonia regained its independence, the 'sawmilling boom' was the first step in developing the wood processing industry (Muiste et al., 1998). In addition to the old frame-saws small circular saws were taken into use. A major process innovation in the woodworking industry started in 1995, when the first modern sawmills were built. Within the next ten years, the sawmilling and other wood processing industries were constantly expanding. In several cases the investments were started by local firms (e.g. Sylvester AS), but as a result of delocalisation of the wood processing industry, foreign companies (e.g. the Finnish companies Finnforest, Stora Enso Timber, UPM-Kymmene Wood) acquired ownership (Ollonqvist et al., 2006). The investments into the wood processing industry and increased production capacity created certain problems, e.g. the lack of some assortments of raw material (Kaimre et al., 2001). In addition to the domestic supply, the import of sawlogs, mainly from Russia, increased (Figure 5). Due to the lack of modern domestic pulp industries for birch timber and coniferous species, pulpwood has been mainly exported. However, as a result of investments for utilising the small-dimensional coniferous roundwood, the pulpwood quality round timber is now better sorted and only softwood of such pulpwood quality that can not be processed in Estonia is today exported.

5.2 Stakeholders of Estonian forest policy

At the beginning of the 1990s the majority of forestry professionals participating in policy formulation processes acted in their individual capacity (Sootla, 2004) because representative organisations within the forest sector were weak or non-existing. Nowadays the Forest Department of the Ministry of the Environment is responsible for the forest policy formulation. Additional support is given by officials of other authorities under the same ministry, i.e. the Environmental Board, Environmental Inspectorate and Estonian Environemnt Agency. Also representatives of two centres, which operate in the administrative area of the Ministry of the Environment, have been engaged in policy formulation processes: Estonian State Forest Management Centre (RMK), which manages most state-owned forested land, and Private Forest Centre (PFC), a state-owned foundation that supports private forestry in Estonia. The most active non-governmental and private stakeholders in forest policy formulation are the following national umbrella organisations: Estonian Forest and Wood Industries Association (EFWIA), Estonian Private Forest Union (EPFU) and Estonian Council of Environmental NGOs. One more stakeholder group is forestry scientists, who mainly come from the Estonian University of Life Sciences (Teder and Kaimre, XXXX).

The performance of stakeholders varies in policy processes. Representatives of forest owners, forest industries and environmentalists are acting as "issue advocates", trying to take their interests to the policy agenda setting, e.g. EFWIA has stood for simplifying bureaucratic procedures and for efficient production, EPFU has advocated free use and management of properties. Forestry officials and policymakers are active in adopting international agreements or making decisions concerning national policies. Sometimes, during specific discussions, one stakeholders' group should take the balancing role between other stakeholders with individual interests, e.g. forest industires should balance private forest owners and environmental NGOs. Estonian experience shows that when an issue advocate (e.g. environmentalist) only advocates their ideas with weak arguments and does not provide additional in-depth analysis of potential consequences, then the idea is not supported by other stakeholders and it will be discarded (Teder and Kaimre, XXXX).

5.3 Innovative forest policy changes in Estonia

Since 1991, after regained independence, the Estonian parliament has approved a national forest policy (1997) and two national forestry programmes (until 2010 and until 2020). The major institutional innovation in national forest policy was the restructuring of the public forestry administration: forestry supervision (inspection) and state forest management were assigned to different organisations (Puustjärvi et al., 1998).

As of 1 June 2016, the forest acts have been changed 37 times:

- Forest act 1993 with 4 amendments (Etverk, 2005), valid until 08.01.1999;
- Forest act 1998, 12 amendments, valid from 09.01.1999 until 31.12.2006;
- Forest act 2006, valid from 01.01.2007, 18 amendments, the last one is valid from 18.01.2016.

The Estonian number of different forest acts and their amendments is one of the greatest in Europe. In 1991–2011 only Bulgaria made more changes in its forest acts (Dobšinska et al., 2011).

There are several important changes in Estonian forestry legislation, which according to the concepts of OECD (2005), Schumpeter (2008), Weiss (Weiss et al., 2010; Weiss, 2011) as well as others can be considered as direct innovation or fostering (although sometimes impeding) factors for innovation and competitiveness in the forest sector:

Amendments to the first Forest Act (1993), entry into force 25.06.1995:

- The notification of the forest owner's activities was taken into use in Estonia. The private forest owner has to notify state authorities (in the first version local forest district) about forest felling, reforestation, forest damages.
- Limited felling without the forest notification. The private forest owner has the right to fell from their forest the trees with breast height diameter less than 20 cm up to one cubic metre per hectare per year.

The second Forest Act (1998), entry into force 09. 01. 1999:

- Formation of State Forest Management Centre by merger of forest districts administered by the Ministry of the Environment, Forest Economics and Information Centre, Sagadi Training Cen-

tre, Räpina Forestry School, Marana Forest Nursery and Kullenga Forest Nursery, as the legal successor thereof as of 1 January 1999.

- Statement that the government shall establish the state register for the accounting of forest resource. The specific implementation regulation was released by the government in 1999.

Amendments to the second Forest Act from 28.01.20004, entry into force 27.03.2004:

- Reforms of forest survey and management planning.
  - The field persons, engaged in forest survey and management planning, must have special education in forestry and they have to pass special theory exams and practical tests.
  - Activity licence for firms dealing with forest management planning. The firm should have sufficient specific equipment for forest management planning and it has to employ persons who have passed a special exam and field test.
  - An authority authorised by the Minister of the Environment shall establish or refuse the forest management plan (FMP) prepared by the holder of the activity licence.
- Limitation on fellings. The exemption allowing clearfelling in fertile forest types, based on minimum average breast height diameter, was repealed. The clearfell age for pine and valuable broadleaved tree stands was set as 100 years, for spruce stands 80 years and for birch stands 70 years.

The third Forest Act (2006), entry into force 01.01.2007:

- Deposit for reforestation. Upon the clear cut (areas larger than two hectares) of three fertile spruce site types, private forest owners had to pay a mandatory deposit not less than 192 EUR and no more than 1278 EUR per hectare.
- A FMP is not obligatory for properties where the area of forest is less than two hectares.

5.4 Description of forest sector innovation in Estonian innovation, forest and rural development policies (I)

Estonian innovation strategy is primarily targeted to information and communication technologies, biomedicine and materials' technology. The

forest related sectors, as well as rural development, are not mentioned in Estonian innovation policy documents. Indirectly the innovation support to the forest sector can be found: for traditional industries (where forest related sectors should belong), the support is expanded to testing and certification procedures, design, productivity management projects, etc.

Table 4. Orientation of innovation support measures across policies towards forest sector innovation (**I**)

Policy orientation / aspect according to Bauer & Ramet-steiner (2006)	Innovation policy	Forest policy	Rural development policy
Research and Development	Measures existing and targeted to some extent towards traditional industries	Measures existing but funding is limited	Measures existing but not specified for forestry
Diffusion of Innovation	Measures existing and targeted to some extent towards traditional industries	Measures existing but oriented towards public sector	Measures existing but not specified for forestry
Strengthening knowledge base	Measures existing and also oriented to traditional firms	Measures existing but funding limited	Measures existing but not specified for forestry
Strengthening interaction	Measures existing also oriented to traditional firms (clusters). In some sectors respective academia partners are weakly developed	Measures existing but oriented towards public actors	Measures existing but not specified for forestry
Demand creation for innovations	No measures	No measures	Need for sustainable use of forest and quantitative goals of increasing labour productivity of forestry are indicated
Improving framework conditions	Measures existing, but not relevant for forest sector	Measures exist for improving innovations in public sector	Measures existing but not specified for forestry

In rural development policies, forestry is included, mainly due to European Union support programmes to agriculture, fishery, forestry and rural development. The ERDS is aiming to improve competitiveness of the agricultural and forest sectors, quality of life and environment in

rural areas by supporting local initiatives and co-operation for economic diversification.

In the observed Estonian forest policy documents, the term *innovation* is not directly mentioned. Some changes that can be considered as innovations were described earlier in this chapter. The closest innovation related term used in the Estonian Forestry Development Programme 2010 is *competitiveness*.

The forest sector related support measures of different policies are given in Table 4. In rural development policy, the support is given to NATURA 2000 areas and for afforestation to private forest owners. Additionally some support is targeted to the development of the bio- and renewable energy system.

The EFDP 2010 prioritised increasing international competitiveness of the forest and woodworking sector. For policy measures aimed at increasing international competitiveness and promoting the domestic use of the sector's products, the total budget allocation for the years 2002–2004 was 831 000 EUR. For the same period 192 000 EUR was foreseen for the development of private forestry advisory services, 64 000 EUR was allocated for the formation of a forestry education co-operation chamber and forestry science development co-operation chamber.

Thus, in the EFDP 2010, the measures for enlarging the innovation activities are described under R&D, diffusion of innovation and strengthening the knowledge base. National forestry programme focuses on the innovation in forestry governance and lacks adequate attention to innovative activities for private and public sectors.

5.5 Changes in forest policy and legislation, their relation to innovations in forest management

5.5.1 Illegal logging as a fostering factor for policy changes

The regaining of political independence caused the collapse of Soviet style agriculture, and many rural people lost their income sources. The restitution, together with privatisation, made a large number of people forest owners, many of them without any forestry skills. The lack of forestry skills and the need for income caused some illegal activities, e.g. overcut-

ting or even direct timber theft. Inappropriate taxation policy caused tax fraud: there were no tax abatements for silvicultural costs and private forest owners had to pay from the timber sales profit social tax (33.5%) and income tax (26%). All this caused the domestic environmental non-governmental organisations (NGOs) internationally report that the share of illegal logging in Estonia was 50% (Hain and Ahas, 2005).

To solve the domestic forestry problems and to get rid of bad international reputation, the forest act of 1998 and its amendments limited various felling types, improved the control in forestry, strengthened the forestry governance and related state authorities. As a result, felling volumes decreased for some period, being the lowest in 2005 (Figure 5). Additional restrictions for forest owners were established in the new version of the forest act, in 2006.

The gradual decrease of statistical data on logging offences verifies the positive effect of felling limitations and governance strengthening on the illegal logging. In 2001 the number of the illegal logging offences was 1010 and the related timber amount was 135 487 m^3, in 2005 the corresponding figures were 136 and 26 782 m^3. In 2007, when the new forest act was enforced, the number of illegal logging offences was 43 and the related timber volume was 1363 m^3. For the year 2010, the number of offences had declined to 22 and the related timber volume was 350 m^3 (EEA, 2016).

5.5.2 Policy driven innovations in forestry governance and in the state forest management

The extensive use of information technology solutions is an example of innovations in forestry. Compared with other countries, Estonia has been rather forward-looking. The information technology development in combination with control measures set up by legislation created innovative solutions first to forestry related state authorities, then to forest owners and forestry specialists and finally some of them were made publicly available. An example is the state register for the accounting of forest resource (aka forest register), which was created for storing forest inventory data, then map solutions were added and forestry officials started to use it in office or in the forests, finally it became available to the public via the internet.

There are several other infotechnology based solutions, e.g. different databases (land cadastral data, maps of protected natural objects or woodland key habitats, etc.) or internet based E-notifications, where a forest owner can submit the obligatory notification about planned forestry activities. From the controlling side, specialists of forestry administrative or controlling authorities could verify the reported and actual situation in forests using online databases with field computers, equipped with GPS and internet connection. For controlling the implementation of forestry regulations, illegal loggings were analysed by using satellite photos (**I**).

The restructuring of the management of state-owned forest was implemented stepwise. The first major reforms started in March 1992, where the management of state-owned forest was separated from the industrial parts (sawmills, etc.) of former state-owned forest enterprises and 186 legally independent state forest districts were established under the supervision of the National Forestry Board. The Estonian Forestry Development Program (1995–1997) prepared the next steps (EMAP, 1995; EMAP, 1996) for changes in state forest management (in the context of public forest policy is analysed by Kallas (2002)). By the beginning of 1998, there were 102 state forest districts in Estonia.

The second forest act (1998) created a legal base for a new structure in state forest management, after its commencement the State Forest Management Centre (RMK) was established. The RMK is a profit making state agency, the only that kind of institution in Estonia. The management of the majority (except mainly educational forests) of state-owned forests was centralised into one legal entity with a total staff of 2280 persons and the number of forest management districts was decreased to 77 (**IV**).

The second major structural reform in state forest management was carried out on 1 July 2008, when the previous territory-based management was replaced with a functional management scheme. The tasks as well as organisational structure changed to a large extent, e.g. the new structure has 17 state forest districts, but its activities are not comparable with previous ones. By the beginning of 2009 the RMK staff decreased to 836. After structural reforms, as of 2010, 99% of the timber was sold as harvested assortments, and the RMK had outsourced the majority of harvesting operations and half of the reforestation and forest protection activities. In 2010 the RMK employed 851 persons, according to its

estimation a total of 4000 persons were employed in state forests (RMK, 2011). The trend is similar also in other observed countries: state-owned forest management organisations are outsourcing the majority of forest management operations (**IV**).

Like in other countries, also in Estonia the state forest management organisation is dealing with ecosystem based services and their importance is increasing (**IV**). After other forestry governance reforms in 2008–2009, the RMK had to take over the management of national parks and some nature related educational activities. The high proportion of protected forests requires provision of an additional ecosystem based service. Of the RMK forest area 20.8% is strictly protected, in other (mostly private) forest ownership groups the respective share is 3.3%, the average for all Estonia is 10.4% (EEA, 2016).

5.5.3 Influence of policy changes on property rights and governance of private forests (V)

The decision-making freedom of forest owners as well as from the point of view of forestry specialists is analysed in relation to forest management planning. Forest management planning in Estonia is one of the most regulated [2] in Europe. Since 2004 special requirements to field persons and activity licence to firms are in force.

In comparison with nine other Eastern and Central European countries (Bulgaria, Czech Republic, Kosovo, Latvia, Macedonia, Montenegro, Romania, Serbia and Slovakia) the following issues specific to Estonia can be pointed out:

- The forest management plan (FMP) is compulsory if the forest owner is planning to do active forest management (since 2007 it is obligatory for forest holdings larger than two hectares). In many other countries a FMP is compulsory for all forests, differences in the minimum area may apply;
- In Estonia, the forest owner's interests or priorities can be considered within the limits set up by legislation. In some other countries the owner's interests can be recorded but not necessarily included in the FMP.

2 Unpublished research data. Data were collected under COST Action FP1201 FACESMAP (Forest Land Ownership Changes in Europe: Significance for Management And Policy), subgroup of advisory systems.

- The Estonian forest owner can harvest 3 m^3 of timber per year per hectare but no more than 20 m^3 per property without need to notify state authorities about the planned harvesting. For more than 20 m^3 of harvest, the owner has to notify state authorities and get a relevant permit. Thus, an average rural forest owner can get the annual quantity of firewood without much trouble. In many other observed countries, the harvest of any quantity of timber is a rather bureaucratic process.
- Estonian legislation does not require the marking of trees to be harvested. In other observed countries different requirements apply: e.g., the trees should be marked by an authorised forest manager or by a representative of a specific authority. Moreover, in several countries, forest owners have to pay for obligatory marking services.

Thus, in spite of the heavy regulation of the forest management planning activities in Estonia, the private forest owners have some limited freedom of actions in which forestry officials do not intervene.

5.6 Innovation in the forestry, logging and woodworking sectors

5.6.1 Background and some important milestones

The preparation of innovations in Estonian forestry and wood utilisation started at the end of Soviet era. As a follow-up of the *Isemajandav Eesti* (A Self-Managing Estonia) programme, the Development Programme for the Forest Sector Products Export was compiled in 1990. For forest related sectors, the only exported product was pulpwood, which was sold mostly to Finland for foreign currency. The furniture deliveries to other member states of the former USSR were not considered to be an export. The lack of modern harvesting technology was seen as the main obstacle for increasing felling volumes. The revenues for pulpwood export were targeted at foreign harvesting machinery; therefore the felling and export volumes had to increase. For the year 1995, the planned felling volumes were 3.2 million m^3 and pulpwood export 0.5 million m^3. In parallel, the building of a modern pulp or paper industry was planned. For 1996 the planned felling volume was 3.7 million m^3; the aim was to finish the pulpwood export and instead begin exporting pulp or paper products (MTEAP, 1990).

During Soviet era, the sawmilling industry was based on the requirements of centrally planned economic systems. The majority of the wood processing industries were built as plants of integrated production, from roundwood sawing to final commodities. Nearly all of the collective farms established their own small sawmills (Martikainen et al., 1996). Mostly frame saws were used in sawmills (EMAP, 1996).

In 1991, Estonia regained its independence and switched to the market economy, with it the structure of the sawmilling industry changed remarkably. Plants were privatised; sometimes the integrated production cycle was split between smaller firms, in addition new sawmills were established, partly together with foreign investors (EMAP, 1996; Martikainen et al., 1996). Agricultural production based on collective farms collapsed and many empty farm buildings were taken to use for small-scale sawmilling and other woodworking industries. The small circular saws became very popular in the production of sawnwood, their sales peak was in 1994 (Triisa, 1995). In 1994, 1250 wood industry companies indicated their main field of activities as follows: sawnwood 368, builders' joinery 196, furniture 188, prefabricated houses 33, veneer and plywood 1, particle board 1, fibreboard 1 and other 462 (EMAP, 1996). In 1995 first modern sawmilling industries were launched, which led to gradual decrease of small frame and circular saws in sawnwood production.

At the beginning of the 1990s, in small sawmills the sorting of sawlogs was limited and was mostly done manually, based on diameter and not on quality. Besides, the sawlogs were not debarked. The Estonian sawmilling industry was characterised by the shortage of kilning capacities, as small sawmills did not have kiln-drying facilities. The producers of glulam, furniture and builders' joinery products preferred to buy unseasoned sawnwood and do the drying themselves (EMAP, 1996).

One of the main obstacles for all sawmills and other woodworking industries was the limited availability of sawlogs. State forests were the major source (61.5%) for sawlogs. Their wood resources were traded on the stump and sold at forest auctions (1.2 million m^3 of clearfellings and thinnings in 1994), by forest management contracts (165 thousand m^3) or as individual felling areas for local customers (358 thousand m^3). For felling areas purchased at auctions, the initial deposit of 10% from the total sales price was required. The felling licence was issued upon payment of 90% of the remaining stand price value; for selected companies slightly different payment schemes were used. The auctions were

managed by Regional State Forest Departments. No long-term contracts for selling felling areas or roundwood assortments were allowed (EMAP, 1995; EMAP, 1996). The roundwood procurement was possible just for a short period and the price competition was high. Especially small sawmills (annual output below 5000 m^3) were not able to systematically plan their roundwood supplies. The auction prices were influenced by roundwood exporters, as noteworthy quantities of sawlogs were also exported. Sawmill owners had an opinion that the export of sawlogs should be restricted, but it might lead to inefficiency and its influence was difficult to forecast (EMAP, 1996); thus this idea was not approved in Estonia. In the middle of the 1990s, various sawlog export restrictions were set up by Latvia and Lithuania for some period (Ollonqvist et al., 2006). As Latvian experience showed, that kind of protective measures did not stimulate investments and increase in productivity, but instead enabled local companies to earn short-term profits (EMAP, 1996).

Storm damages have influenced Estonian forestry and forest owners (**I**), as well as forest harvesting and the sawmilling industry. Storm damages have a negative effect on timber production as well as on non-wood forest products and services. The timber from damaged areas can be sold at lower economic value (Urbel-Piirsalu, 2010). The positive influence of storm damages is the creation of additional (temporary) employment in the forest harvesting sector and an increase in the sawmilling industry production volumes. Some of the severest storms during the observation period were:

- 2001, reported windfall damages in forest on 6128 ha
- 2002, reported windfall damages on 15 953 ha
- 2005, reported windfall damages on 32 138 ha; in addition, in 2006, 10 155 ha of windfalls was reported (CFPS, 2008).

The changes in forestry legislation in 2004 led to a significant decrease in felling volumes (Figure 5). The sawmilling industry covered the deficit of domestic raw material with increased sawlog import volumes. As a result, Estonia turned from roundwood net exporter to net importer for two years, 2005 and 2006. A year later, in 2007, there were two main issues that affected Estonian woodworking industries.

1) By the government decisions, a statue called the 'Bronze soldier' (during Soviet era known as the Monument to the Liberators of Tallinn) was relocated from the centre of Tallinn to the Tallinn Military Cemetery. It led to heavy disputes between Estonians and

Russians in Estonia, but also political problems between the governments of the two countries (Wertsch, 2008; Astrov, 2009). As a result, the Russian rail company operating on the other side of the Estonian border stopped the roundwood deliveries from Russia to Estonia from 1 June 2007 (Rozental, 2007).

2) From 1 July 2007, Russia significantly increased the export duties on the coniferous roundwood (Turner et al., 2008; Solberg et al., 2010); as a result, imports of sawlogs from Russia nearly stopped to be replaced with imports from Latvia and other countries.

5.6.2 Process and product innovations in the use of forestry machinery

Based on the forest harvesting volumes in in 1999–2004 (Figure 5), the quantity of forest machines increased significantly by the year 2005; there were new machines as well as relatively old and second-hand units. For the majority of machine owners the 2005 decrease in felling volumes was not very sensitive at first, as Estonian companies were outsourced for the liquidation of 2005 storm damages in Sweden, and later in Central Europe (Muiste et al., 2006). One of two Estonian case enterprises of Paper **II** had experience in working abroad in 2005–2006.

The RMK as the biggest forest management organisation in Estonia is outsourcing most forest harvesting and timber transport operations (**IV**). The RMK has set up high standards of mechanised work and strict requirements for contractors, which eliminated the use of older harvesters and forwarders in the state-owned forests. The seasonality of forestry works forced entrepreneurs to find new ways of using forestry machinery in the non-harvesting period. As a result, some firms started to use mostly forwarders, but also harvesters, in operations like roadside slope fortification, other landscaping activities, recovering former wastelands or garbage areas, cleaning old ditches, etc. (**II**).

Thus, to be profitable logging companies have focused on the service markets, if possible rendering services to key clients such as the RMK. Their new markets include cleaning storm damages in foreign countries. Attention is paid to diversifying the services.

5.6.3 Process innovation of the roundwood utilisation in the bioenergy sector

The wood based pellet production in Estonia started in the 1990s. It was based on sawdust, a sawmilling and woodworking residue. Later the sawmilling production increased, but as a result of the investments in sawmilling bigger sawmills began to use the sawdust in heating their kilns. To overcome the shortage of raw material, pellet producers started to buy and chip kiln-dried woodworking residues. Pellets are mainly exported and the high demand in end-user markets forced producers to seek alternative sources of the raw material. As a result, roundwood from forest was taken into use.

In the sawmilling industry the sawlogs are debarked, thus their residues, used in pellet production, do not include bark. To get high quality pellets from roundwood, a stationary debarking facility was installed in front of the stationary chipper in 2006; the bark was used in the own boilers for heat production in a case study firm. The roundwood chips were wet ground in a flaker, followed by drying and dry grinding in a hammer mill. Nearly at the same time, competing Estonian pellet producers also started to produce wood chips from roundwood, but they used mobile chippers and they did not debark the roundwood (**III**).

The process innovations in pellet production as well as increased production volumes created an additional market for the low-quality timber. This led to an increase of domestic wood utilisation and a decrease in roundwood export.

5.7 Energy policy driven innovations in the forest sector

The main source for electricity production in Estonia has been oil shale while the wood has been used in the production of heat. The Long-term Development Plan for the Fuel and Energy Sector until 2015, adopted in 2004, set two important targets:

1) increase in the share of renewable electricity to 5.1% of the gross consumption by the year 2010,
2) 20% of the gross consumption of electricity in 2020 should be covered on the basis on cogeneration at combined heat and power (CHP) plants.

In 2007 the share of the production of renewable energy was 1.75% (ENMAK, 2009).

According to the Electricity Market Act, which was in force until 1 May 2007, based on the monopolistic state-owned and oil shale based electricity production, the network operator was obliged to buy renewable energy only in the amount of the grid losses at the price of 0.81 EEK/kWh (0.052 EUR/kWh). Moreover, there were no support systems for the development of efficient cogeneration in order to increase energy efficiency, which was one of the main targets of a specific EU directive[3], entered into force in 2004 (Government of the Republic, 2006).

The amendments of the Electricity Market Act (2007) established a legal basis for supporting entry of renewable energy producers and cogeneration producers into the market. The transmission network operator had to pay support[4] to the producers as follows:

1) 1.15 EEK/kWh (0.069 EUR/kWh) for electricity generated from renewable energy sources using a generating installation below 100 MW,
2) 0.81 EEK/kWh (0.052 EUR/kWh) for electricity generated in an efficient cogeneration regime from waste, peat or carbonisation gas, obtained as a result of oil shale processing.

The two first wood-based CHP productions in Estonia were initiated by innovative entrepreneurs. The driving sources for innovation were visits to foreign companies or further development of the existing vertical monopoly. The implementation of the ideas needed changes in legislation and active political 'lobbying' was made to break the state monopoly in electricity production. The two first privately owned CHP plants started to operate in 2009. As the use of wood in electricity production was supported by the state, the state-owned electricity producer Eesti Energia began to use wood in addition to oil shale in 2009 (III).

Because of big changes in timber markets the RMK created a new sub-department, the wood energy division (**III**). This can be considered as process and organisational innovation.

3 2004/8/EC, also known as Combined Heat and Power (CHP) directive.

4 In some other countries it is known as a feed-in tariff (or advanced renewable tariff or renewable energy payment), a policy mechanism designed to accelerate investment in renewable energy technologies.

5.8 Competitiveness of forest related sectors based on foreign trade indices

The analysis of the competitiveness of the Estonian forest sector relies on the following foreign trade based indices: export based RCA, import based RMA and three indices including both of them — RC, RTA and AI. Considering the FAOSTAT aggregated item 'forest products total', the RCA value (Figure 6) remained relatively stable, between 4 and 5 (exept for 3.93 in 2006 and 5.19 in 2006). As RCA > 1, Estonia has a comparative advantage in making forest products. The import based RMA was stable in 2001–2003 (1.12–1.26); then it increased, reaching 2.42 in 2007, and dropped slightly to the level of 2.05 in 2008–2009. Estonia has also a revealed comparative import advantage because RMA > 1. As the RMA is rather close to the level of 1, the importance of import advantage is not as high as that of export. It is also confirmed by other indices: during the whole observation period RC > 0, RTA > 0 and AI > 1.

Additional information can be found in observing the worldwide rankings of the main indices. The list of forest products export ranking (RCA) included 168 countries in 2001 and up to 181 countries in 2007–2010. In the list of forest products import ranking there were between 184 (2001–2002) and 187 (2006–2010) countries. The RC was calculated for 167 countries in 2001 and 180 countries in 2007–2010. The majority of countries are net forest products importers, in 2007 only 64 countries (34%) had a positive RC value and 65 countries had a positive RTA value. In 2010, 63 countries had a positive value for RC and 64 for RTA.

Estonian worldwide ranks in different forest product indices are given in Figure 7. The RMA index has the highest ranks for Estonia, especially since 2004, being between 3 and 7. In the RCA worldwide ranking Estonia was between the 11th and 19th places. In the RTA ranking Estonia was until 2004 between 14 and 18, since 2005 between 21 and 27. The RC and AI indices rankings are similar: until 2003 Estonia was on the 28th – 29th place, in 2004 it was 37th and in 2005–2010 Estonian ranks were between 20 and 45.

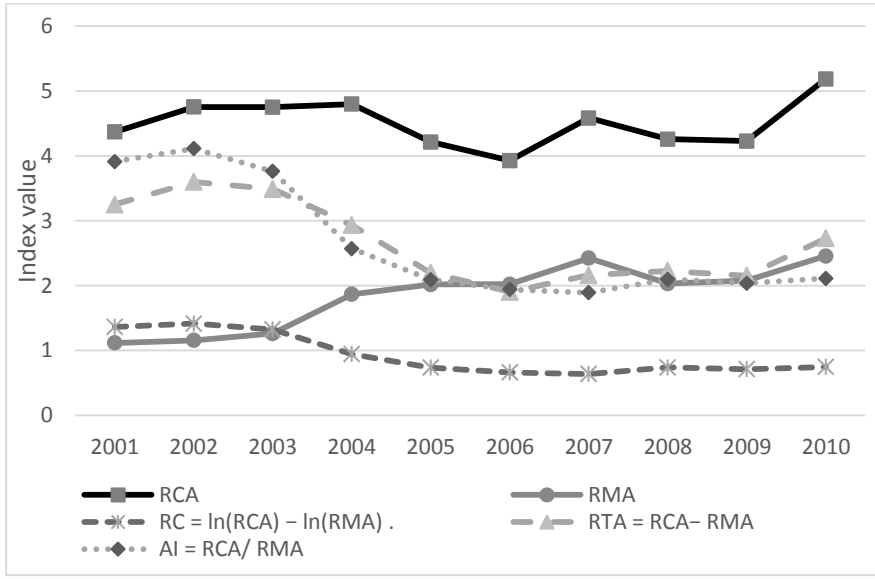

Figure 6. Values of Estonian forest sector foreign trade indices, based on the Statistics Division of the United Nations Food and Agiculture Organisation item 'forest products total'. RCA – Revealed Comparative Advantage, RMA – Relative iMport Advantage, RC – Revealed Competitiveness, AI – Aquino Index.

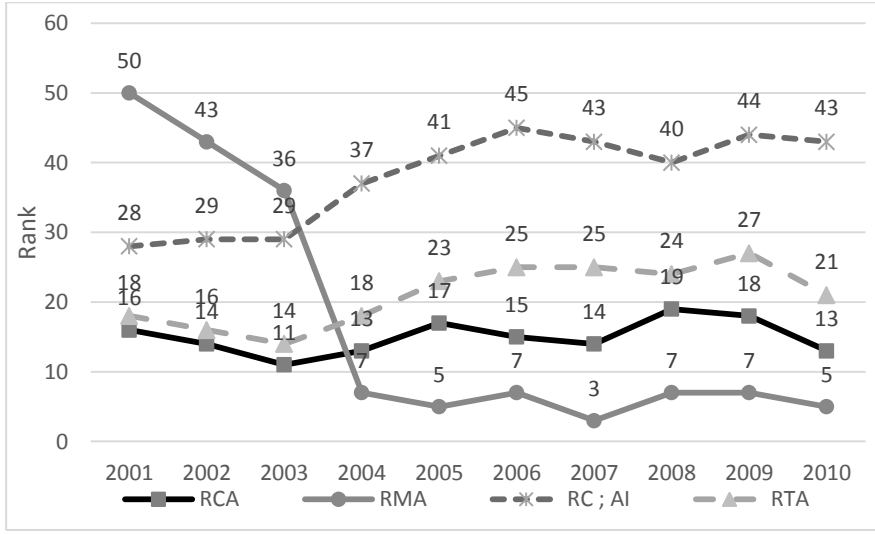

Figure 7. Estonian worldwide ranking according to foreign trade indices based on the Statistics Division of the United Nations Food and Agiculture Organisation item 'forest products total'. RCA – Revealed Comparative Advantage, RMA – Relative iMport Advantage, RC – Revealed Competitiveness, AL – Aquino Index, RTA – Relative Trade Advantage.

Table 5. Revealed Competitiveness (RC) of Estonian timber products in 2007–2010 and Estonian worldwide ranking in 2010

Product group	RC values				2010	
	2007	2008	2009	2010	No. of countries*	World-wide rank**
Prefabricated buildings	2.25	2.85	3.08	3.50	116	1
Other manufactured wood	2.00	2.10	2.10	2.01	130	8
Furniture of wood	1.00	0.95	1.29	1.31	129	16
Wood panels, wool	0.56	0.62	0.72	0.69	124	21
Chips & particles	3.51	3.18	2.83	3.23	94	22
Fuel wood	3.23	3.37	2.06	2.17	101	26
Roundwood	0.59	1.32	1.31	1.98	108	31
Sawnwood	0.73	0.73	0.66	0.56	125	47
Wood products total	1.11	1.31	1.32	1.32	132	18

*Total number of countries in product group (both export and import values >0).

**Estonian worldwide rank in product group.

The evaluation of the competitiveness of different forest related sub-sectors is based on UN Comtrade data. The RC index, which includes both export and import values, is used as the measure of competitiveness. The worldwide ranking is done for 2010 results (Table 5).

In all the observed product groups the export prevails (RC > 0). As of 2010, the highest ranks of Estonia were in final products groups (with the highest value added), where in prefabricated buildings Estonia held the 1st place, in other manufactured wood products the 8th and in wooden furniture the 16th place. Despite the importance of the sawmilling industry in the Estonian woodworking sector, the sawnwood foreign trade does not seem to be very competitive: in the observed product groups the sawnwood rank is the lowest. The sawnwood industry RC index is low; the reason is that a remarkable part of its output is used by other domestic industries (e.g. prefabricated buildings, wooden furniture and joinery industry), which are adding value to sawnwood. The higher RC value for final products indirectly shows competitiveness of intermediate products. The high values of the roundwood RC index can be explained with the fact that Estonia does not have modern pulpmills for pine, spruce and birch wood, so the pulpwood is exported.

6. DISCUSSION

In innovation related studies the forestry based sector is often described as a 'low-tech' economic sector (Rametsteiner and Weiss, 2006; Christensen et al., 2011), but it is also called as a traditional (Breschi and Malerba, 1997; Weiss, 2011) or mature (Slee, 2011) industry. Today the forest sector industries continue to produce mature products, but many new products have been introduced to the markets. Globally, even with the traditional (low-tech) products, the sector is aggressively adopting new technologies, the tools and technologies employed to extract the raw material and manufacture the products are becoming increasingly hi-tech (Hansen et al., 2013). By technological categories of international trade classification (Lall, 2000; UNCTADSTAT, 2015), the majority of currently observed timber based products are categorised as primary products or forest resource based products, the wooden furniture is low technology and prefabricated buildings are medium technology manufactures (Table 3).

Forestry as such is considered to be one of the less innovative fields of activity, whereas the wood processing industries are more innovative. The results of an innovation study of the Estonian forest sector from 2009 confirm it; the majority of the respondents ranked the forest and timber sector innovativeness as follows: the most innovative (1) is woodworking industry; followed by (2) forest industries and (3) the least innovative is forest management (Teder et al., 2010).

The innovation policy objectives are often economy related, e.g. economic growth, productivity growth, increased employment and competitiveness. After all, they may also concern any other area of desired improvements, such as cultural, social, environmental, political or military (Chaminade and Edquist, 2005; Rametsteiner, 2010). Chaminade and Edquist (2005) argue that innovation policy objectives should be specific and precisely formulated in relation to the current situation in the country or in comparison to other countries. In the analysed Estonian innovation policy documents (**I**) the forest policy is not integrated; however, there is a weak link between innovation policy and forest industries. Theoretical, methodological and conceptual approaches of policy integration and co-ordinations used in analyses of forest sector innovation are given by Rametsteiner et al. (2010). The international comparison of forest sector related case studies proves that conditions for innovation created by policies vary widely (**II**, **III**, **IV**, **V**).

According to the general understanding (Schumpeter, 2008; Drucker, 2009), innovations are made in firms where the entrepreneurs should be a pushing power for carrying out the changes targeted to be more effective or competitive, with the aim of profit generation. The implementation of different firm level innovations (product, process, marketing and organisation, or their overlapping combinations) sometimes can not be carried out by market actors alone, but it needs pushing or support from outside. That kind of support is called institutional innovation and it holds changes in the political-institutional framework of a specific sector, including changes in policies, legislation, authorities, etc. (Weiss, 2011). Thus, in addition to the market and/or competition driven innovations the changes of the policy and legislation are the ones that primarly influence the competitiveness of a firm or a specific sector. Not all the policy or legislation changes are innovations according to the Schumpeterian theory, e.g. several policy changes are targeted to nature protection on national or global level, which from the entrepreneurial or customers' point of view hinder making profits.

Estonian energy policy is an example of the need for additional support from institutions: industries were intitiators of legislative changes to increase the wood based bioenergy production. Some forest sector related institutional innovations are discussed below; however, there are also other types of institutional support, which are not analysed in the current thesis. One example is the national and EU subsidies for investing into forestry macinery and equipment, which were mainly targeted to forest owners and their organisations, but also to small logging companies.

Unexpected weather conditions, e.g. in Estonian case heavy storms (**II, IV**), or policy driven different legislative constraints, e.g. limiting the felling volumes in the forest sector (**I–V**), have been sources for several innovations.

Within the last 25 years, the forest harvesting technologies have changed, and the degree of mechanisation has significantly increased (Muiste et al., 2006). Within the same period, one of the main forestry innovations was the outsourcing of forestry operations, as the harvesting works are not performed by the staff of the forest holding but by contracted entrepreneurs (Kubeczko et al., 2006; Ollonqvist, 2006). In the majority of cases in bidding for forestry services the lowest price is the selection criterion, thus forestry services contractors are operating with negative

or rather small profit and their bargaining position is rather weak (Rummukainen et al., 2006; Ambrušová and Marttila, 2012; Ambrušová and Šulek, 2014). The big and powerful forest owners, among them state forest managers, can require high standards of services e.g. by setting the requirements on the age of forestry machinery (**II**).

Contractors who cannot meet the high standards set by powerful forest managers are working for less demanding forest managers (e.g. private forest owners). Another option is to be innovative and search for new market opportunities, to use forest harvesting machinery (especially during the non- or low-harvesting period) for other tasks, e.g. slope fortification, landscaping. Results of study **II** show the lack of coherence between innovation policies and activities of forestry contractors. Innovative applications used by forestry contractors are mainly incremental rather than radical. For supporting the contractors' role in the forest based value chain, the policy goal should be the further development of human resources and entrepreneurial capacities.

Innovative individuals, also known as innovation champions (Jennsen and Jørgensen, 2004), or the entrepreneurial (rent seeking) attitude of individuals are the driving force behind the innovations (**II**, **III**). For effective results in carrying out the innovation interpersonal skills are needed, the innovation leaders with those skills reach results even under adverse conditions (**II**), as proved by Estonian case studies in articles **II**, **III** and **IV**. Above firm level activities were described, but the leadership issue is also crucial in national policy formulation. The innovative vision and emergence of strong leaders, which can only come from within the forest sector, have been vital in forest policy reforms in countries in transition (Nilsson, 2005; Brukas, 2015; Estonian example is given by Kallas, 2000).

Porter (1979) named five forces that govern the competition in industry and despite the criticism (Rugman and Verbeke, 2000) he stated (2008) that government is not a sixth force. Estonian experience shows that legislation or governmental institutions have set up entry barriers. According to the first Forest Act in 1993, the forest management planning activities were licenced, but the licencing procedure was not regulated. Until the entry into force of the next Forest Act (1998) the single state owned FMP institution (since 1997 state-owned company) Eesti Metsakorralduskeskus acted without the required licence and new companies could not enter the market. The licencing of FMP activities as well as

its implementation procedures were restored by the Forest Act of 2004, in the next year after the liquidation of the state-owned forest management planning company (RMK konsultatsioonid and Keskkonnaministeerium, 2008). Also the wood based electricity production by privately owned companies needed active political lobbying until state monopoly was terminated by legislative changes in 2007 and first privately owned CHP plant started to operate in 2009 (**III**).

Estonian sawmilling capacity for the years 2001–2004 was set according to the domestic felling volumes (**I**) in 1999–2004 (Figure 5). It is a question of interpretation whether or not the governmental activities and legislation changes in 2004, which led to a decrease of felling volumes in 2004–2006, is governmental intervention or 'sixth force'. However, the competitive sawmilling industry reacted with a significant increase of sawlogs import, which for one year, 2006, transferred Estonia from roundwood net exporter to net importer (**I**).

Several changes in forestry legislation were targeted at controlling forest owners' activities (**I**, **IV**, **V**). Therefore product and process innovation tools were used, which can be considered as institutional innovations. Some of the innovative tools became later publicly available, e.g. partial data and mapping solutions of the state register for the accounting of forest resource. However, over-regulating or over-controlling of forest owners' activities is contradictory to the aims of innovation policy (**I**). Findings of paper **I**, Sootla (2004), Lazdinis et al. (2005), Teder and Kaimre (XXXX), witnessing that the forest administration is under political influence, in some policy changes the ambitions of the sitting Minister of the Environment and his/her political party or their popularity are more important than the forestry content. The above-said is confirmed by the fact that several legislative changes were overruled by following amendments in forest acts, implemented by another political coalition in the government. This confirms the findings by Buttoud et al. (2011) that some of the institutional changes in forest policy are demanded by stronger stakeholders' desires to retain their power, usually in favour of conventional policies and market rules. Although the policy-makers have been much critisised, the Estonian forestry reforms have been more radical and therefore more successful compared with Lithuania, a similar country in transition (Brukas, 2015).

The current study proves the theory by Buttoud et al. (2011) that multifunctional use of forest, non-timber forest products and services is not

much supported by forestry sectoral innovation systems. The majority of innovations in Estonian forestry are related to the timber based forest production or controlling the timber flows. Nevertheless, the case studies used for the current analysis provided an indirect example of promoting multifunctional use of forests. Namely, the state register for the accounting of forest resource and information sharing with IT solutions enhance multifunctional use of forestry e.g. by enabling to locate the best places for picking berries or mushrooms.

One of the greatest institutional innovations, which influenced the whole Estonian forest sector, was carried out in 2004, when the licencing of forest management planning activities and establishment of FMPs were enforced. The establishment of FMPs and validated forest inventory data were needed for filling in the forest notification to get a felling permit. According to the Forest Act and the Procedure for the Establishment of Forest Management Plans (2004), the establishment procedure had to be carried out within one month, but at first the real establishment time was longer. The lack of forest management planning licence holders and long establishment time directly influenced the getting of the felling permits and thus the quantity of fellings decreased (Figure 5). The forest management planning regulation set up considerable restrictions to usual forest management practices as nearly 2/3 of the private forests were out of use; the state bureaucracy and administrative burden also increased (RMK konsultatsioonid and Keskkonnaministeerium, 2008). Thus the 2004 FMP related legislative changes direcly influenced timber flows on the Estonian timber markets. On the Central and Eastern European level the restrictions in forest management planning are not seen as regulating the timber flows, but as an instrument for strengthening sustainable management of forest resources (**V**).

Compared with several other Central and Eastern European countries, the Estonian FMP is not fully restrictive, as the forest owner can without a forest notification, and thus without a FMP, harvest up to 20 m^3 of timber per property (**V**), which generally equals the annual firewood need of a household.

Earlier the governance or legislation driven innovations were described; however, the Estonian National Forest Inventory (NFI) process has partly been a contrary development. Estonian NFI is based on Swedish Riksskogstaxering methodolody. The first contacts with Swedes were in 1988, the first tentative regional forest inventory attempts were made

in 1992, 1996 and 1997. The innovators were a few active persons who worked for the state-owned forest survey company Eesti Metsakorralduskeskus. The first attempts were made without any special financing scheme (Adermann, 2010; Pärt, 2016 (e-mail interview)). The use of the statistical selection method in forest inventory was enforced in legislation from 1999 (Forest Act, 1998), and in the same year the first country level NFI was carried out with a special governmental financing scheme. Since 2003 NFIs have been carried out by state institutions and its data are used in various domestic and international environmental reports (Adermann, 2010).

The governmental or policy-makers' influence on the competitiveness of Estonian forestry and woodworking companies is testified by comparing felling volumes with indices related to export and import values of the forest related sector and Estonian worldwide ranks. For felling volumes the strongest linear correlation is with the RCA index — 0.823 ($p = 0.003$, $n = 10$). Of different index based worldwide ranks the decrease in felling volumes in 2004 had the strongest influence on the Estonian import based RMA index. The industry producing prefabricated buildings can be considered to be the most innovative Estonian woodworking sub-sector, as in the RC it holds the first place in worldwide ranking.

The Estonian Forestry Development Programme until 2020 concluded the sector's situation as valid for 2009—2010. The technical level of the forest sector is comparable with competitors from Scandinavia. Investments in recent years have been predominantly made into product development and increasing the efficiency. The installed production capacity is in correspondence to the EFDP 2010 optimum felling volume. The decrease in felling volumes during the previous period was not in accordance with the increased need of raw material by forest sector companies. The forest industry's development is hindered by change in demand, the unstable availability of raw material and insufficient flexibility of its use (EFDP, 2011).

Thus, the Estonian institutional innovation and changes in legislation have influenced not only forest owners and forest management practices but the whole national forest related sector.

7. CONCLUSIONS

The following conclusions can be drawn about the role of institutional innovation in the development of the Estonian forest sector:

- In Estonian forest policy documents innovation is not directly mentioned; however, instead of innovativeness, the importance of the improvement of international competitiveness of Estonian wood products is described. Estonian innovation policy and forest policy are not linked to each other.
- Since 1991 Estonia has enforced a national forest policy; two national forestry programmes have been adopted and 37 amendments to forest acts have been made. During the legislative changes, various institutional innovations related to forestry governance have been introduced. From the perspective of the current thesis the most important of them are those that regulate forest management planning activities, with further implications to the forest management practices.
- Some of the Estonian forestry related activities are among the most controlled in Europe. For forest management planning (as well as forestry advisory services) a special activity licence or permit is required in addition to the compulsory forestry education. At the beginning, the implementation of control mechanisms and felling restrictions had a negative influence on the timber flows in the domestic market.
- Estonian forest management planning is overregulated; however in commercial forests the private forest owner can harvest a certain amount of timber without permit from state authorities.
- Some of the innovations, e.g. state register for the accounting of forest resource, were created for forestry authorities, but later various applications have become available to the general public.
- The national forestry programme focuses on innovation in forestry governance and no attention is paid to the differences between private and public sectors for innovative activities.
- Illegal logging has been one of the fostering factors for forestry legislation changes. Forestry related institutional innovations are mainly targeted at controlling the forest owners' and forest managers' activities. As a result, the number of illegal logging offences has decreased.

- Political lobbying or politicians' activities have had both a positive and a negative influence on the forest sector innovativeness. Lobbying was needed for legislative changes, which led to the wood based electricity production by CHPs. Examples of negative political influence are innovative ideas in forestry legislation that were not fully enforced, the implementation rules or procedures were not developed and they were later repealed.
- Since 1990, several former socialist countries have carried out similar reforms in state forest management; however, the reform processes and organisation tasks are different and country specific. Estonia, like many other countries, has chosen the option where one state-owned organisation is responsible for the management of all state-owned forest resources. The Estonian state forest management organisation does not control the activities of private forest owners and generally it doest not offer services to other forest owners.
- The institutional innovations in state forest management have led to the situation where the majority of operations are outsourced. State, as a powerful and the biggest forest owner, is setting higher standards for its contractors than those valid for private forest management.
- Incremental innovations are mainly used by forestry contractors. For supporting contractors, one of the policy goals should be the further development of human resources and entrepreneurial capacities.
- Various legislative restrictions, which led to the decrease in felling volumes, had a direct influence on the forest sector companies. After the enforcement of felling restrictions, the importance of wood products import increased and foreign trade based revealed competitiveness decreased.
- In worldwide comparison based on foreign trade statistics the prefabricated buildings industry is the most competitive forest based industry subsector in Estonia.
- The generally used theoretical frameworks are applicable also in the forest sector. Forestry is not something very special, but it is rather traditional for innovative activities. However, as the forest sector is a rather complex field of activity, from the innovation point of view its analyses should be carried out by subsectors. In different subsectors, the innovation patterns are different.

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SUMMARY IN ESTONIAN

INSTITUTSIONAALSE INNOVATSIOONI ROLL EESTI METSASEKTORI ARENGUS

Sissejuhatus

Kuna metsaga on kaetud ligikaudu pool Eesti pindalast, siis on metsa kui majandusressursi kasutamine rahvuslikule majandusele väga oluline. 2010. aastal oli Eesti metsasektoris hõivatud 29 000 töötajat ehk 5,1% kogu tööga hõivatute arvust. Metsaga seotud sektorite väliskaubanduse bilanss on positiivne, aastatel 1995–2010 oli metsaga seotud sektorite ekspordi osakaal Eesti kogueksportdis 17,9–27,2% ja vastav impordi osakaal oli 6,3–7,5%.

Nagu teada, on viimase 25 aasta jooksul toimunud Eestis olulised sotsiaalmajanduslikud reformid. Pärast taasiseseisvumist 1991. aastal on toimunud üleminek plaanimajanduselt turumajandusele, tekkinud on erinevad omandivormid. Need muutused on mõjutanud ka metsasektori arengut ning seepärast on väitekirjas käsitletud Eesti metsasektoriga seotud arenguid aastatel 1990–2010.

Tavapäraselt mõeldakse metsasektori all metsandust koos puidu- ja paberitoodete tootmisega ning puitmööbli tootmist ei loeta metsasektorisse kuuluvaks. 2001. aasta Eesti metsanduse arengukavas on mööblitööstust siiski käsitletud koos puidu- ja paberitööstusega kui peamisi rahvusliku metsaressursi kasutajaid ning ka metsanduse aastaraamatutes käsitletakse mööblitööstust ühe osana metsasektorist. Seepärast on ka selles väitekirjas mööblitööstust loetud metsaga seotud sektoriks.

Hoolimata metsaga seotud sektorite olulisusest kogu Eesti majandusele, on metsasektori innovatsiooni seni vähe uuritud. Seoses metsasektoriga on tähelepanu pälvinud peamiselt vaid innovatsioon mööblitööstuses ja puitu töötlevas tööstuses. Käesolev väitekiri keskendub institutsionaalsele innovatsioonile Eesti metsapoliitikas. Väitekirjas tuuakse välja need metsaseaduse muudatused, mida saab käsitleda kas innovatsioonina või metsasektori innovatsiooni soodustavate või takistavate teguritena, ning analüüstakse, kuidas metsapoliitika muutused on mõjutanud kogu metsasektorit Eestis.

Töö teoreetiline taust ja põhimõisted

Innovatsiooni mõistet kasutas esmakordselt Joseph Schupmeter 1911. aastal, hiljem on erinevad teadlased ja organisatsioonid seda mõistet edasi arendanud ning täpsustanud.

Neli peamist ettevõtte tasemel rakendatavat innovatsiooni tüüpi on järgmised (joonis 1):

- Tooteinnovatsioon on sellise toote või teenuse kasutuselevõtmine, mis on uus või oluliselt muudetud oma näitajate või kasutusvõimaluse poolest.
- Protsessiinnovatsioon on oluliselt täiendatud tootmis- või tarnemeetodi rakendamine.
- Turundusinnovatsioon on uue turundusmeetodi rakendamine, mis hõlmab olulisi muutusi toote disainis, pakendamises, paigutamises, edendamises või hinnakujunduses.
- Organisatsiooniline innovatsioon on uue äripraktika, töökoha struktuuri või organisatsioonivälise suhtlemise meetodi rakendamine.

Institutsioonide ja poliitikate analüüsiks on võetud kasutusele täiendav innovatsiooni tüüp – institutsionaalne innovatsioon, mis hõlmab uute või olemasolevate organisatsioonide kohandamist, uusi või oluliselt muudetud regulatsioone, mille on sätestanud seadused, eeskirjad või poliitika; samuti uusi või oluliselt muudetud protseduure poliitika kujundamiseks ja rakendamiseks. Just institutsionaalsele innovatsioonile on suunatud käesoleva väitekirja põhitähelepanu.

Innovatsioon erineb leiutamisest selle poolest, et leiutamine on millegi uue loomine, samas kui innovatsioon on mingi uudsuse tutvustamine. Uudsuse erinevaid astmeid saab kirjeldada järgnevalt:

- Tootetäienduslik innovatsioon on mingi olemasoleva lahenduse edasiarendamine olemasoleva raamistiku sees, tavaliselt hõlmab see ettevõtte või ettevõtja poolt läbi viidud väiksemaid lahendusi.
- Radikaalne innovatsioon on olemasoleva raamistiku muutmine, eelnevaga võrreldes uue ja teistsuguse lahenduse pakkumine.

Innovatsioonisüsteeme on erinevaid, sõltuvalt taustsüsteemist ja kasutusotstarbest. Metsandusega seotud uuringutes kasutatakse peamiselt kahte innovatsioonisüsteemi:

- Regionaalsed innovatsioonisüsteemid on regionaalsed klastrid ümbritsetuna kohalikest toetavatest organisatsioonidest, näiteks puhkemajandus või keskkonnateenused.
- Valdkondlik innovatsioonisüsteem on kogum toodetest ja agentidest, kes turul ja turuvälistelt tegutsevad nende toodete loomisel, tootmisel ja müügil. Valdkondlikku lähenemisviisi kasutatakse puidu väärtusahela innovatsiooni uurimisel.

Valdkondlike innovatsioonisüsteemide võrdluses peetakse metsandust traditsiooniliseks valdkonnaks. See tähendab, et valdkonnas on palju innovaatoreid ja puuduvad selged geograafilised piirid. Peamised innovatsioonid on seotud seadmete ja materjalidega, innovatsiooni esmane eesmärk on tootmiskulude vähendamine. Seepärast on arvatud, et metsanduse valdkondlik innovatsioonisüsteem ei toeta mittepuidulisi metsasaadusi ja teenuseid.

Omandiõigusega seotud analüüsis kasutatakse töös Schlageri ja Ostromi (1992) raamistikku, mis defineerib viis peamist loodusressurssidega seotud õigust:

- Juurdepääs (*access*) – õigus siseneda kindlale maa-alale.
- Kasutamine (*withdrawal*) – õigus omandada ressursi saadusi (näiteks metsamaterjali raie või seente korjamine).
- Majandamine (*management*) – õigus läbi viia muutusi, et reguleerida ressursi kasutamist ja ümberkujundamist (näiteks metsa istutamine, harvendusraiete tegemine).
- Piirangute seadmine (*exclusion*) – õigus määrata, kellel on juurdepääsuõigus ja kuidas seda õigust üle kanda.
- Võõrandamine (*alienation*) – õigus müüa ja/või rentida eelnevalt nimetatud õigusi.

Metsaomaniku sissetuleku määravad reeglid selle kohta, millal, kus, kuidas ja kui palju saab raiuda. Kasutamise ja majandamise õigused on otseselt seotud metsamajandusega, need on reguleeritud poliitika ja spetsiaalse, piiranguid sisaldava seadusandlusega, ülejäänud õigused omavad kaudset mõju metsaomaniku sissetulekule.

Valdkondliku konkurentsivõime määramiseks on töös kasutatud **ilmutatud suhtelise eelise (Revealed Comparative Advantage – RCA) meetodit**, mis põhineb erinevatel suhtarvudel, kus olulisteks sisendkomponentideks on riigi kogu ekspordi või impordi väärtus, sama riigi uuritava kaubagrupi ja ekspordi või impordi väärtus, lisaks veel kogu

uuritava geograafilise grupi, milleks antud töös on kõik maailma riigid, ekspordi ja impordi koguväärtused ning uuritava kaubagrupi ja ekspordi või impordi koguväärtus maailmas. Lisaks otsesele suhtarvude leidmisele reastati kõik maailma riigid uuritud kaubagruppide lõikes üldisesse pingeritta, et uurida Eesti kohta selles pingereas.

Mingi tegevusvaldkonna konkurentsiolukorra uurimiseks kasutatakse **Porteri viie konkurentsijõu mudelit**, mille Michael Porter pani algselt kirja 1979. aastal ning mida 2008. aastal täiendas mõnede oluliste konkurentsijõudude kirjeldusega. Konkurentsijõududeks on ka käesolevas töös peetud:

- turule uute sisenejate ohtu,
- ostjate läbirääkimisjõudu,
- asenduskaupade või teenuste ohtu,
- tarnijate läbirääkimisjõudu,
- olemasolevate konkurentide omavahelist rivaalitsemist.

Erinevad autorid on kritiseerinud Porteri konkurentsijõudude mudelit ja pakkunud välja täiendavaid jõude, millest üks on valitsuse sekkumine. 2008. aasta täienduses lisas Porter, et strateegid peavad jälgima kõiki viit jõudu, mitte aga kalduma neist ainult ühe suunas. Lisaks on olemas ka muid tegureid, mis ei ole „jõud". Valitsuse tegevus ei ole kuues jõud, sest see ei ole loomupäraselt ei hea ega halb tööstuse kasumlikkusele. Valitsuse mõju konkurentsile tuleks analüüsida nii, et leitakse, kuidas mingi spetsiifiline poliitika mõjutab viit konkurentsijõudu. Valitsus tegutseb mitmel tasandil ja paljude erinevate poliitikatega, neist igaühel on erinev mõju.

Väitekirja eesmärk

Metsasektoris tegutsevate ettevõtete innovaatilised tegevused on mõjutatud ja tulenevad erinevatest poliitikatest, näiteks metsapoliitika, innovatsioonipoliitika, maaelu arengu poliitika ja energiapoliitika. Euroopa tasemel metsasektori innovatsiooni ja seda mõjutanud erinevaid rahvuslikke poliitikaid on uurinud mitmed koostöövõrgustikud, näiteks COST E51 „Integrating innovation and development policies for the forest sector" („Innovatsiooni ja arengupoliitikate integreerimine metsasektoris"). Tänu erinevale taustale on igal riigil oma arengutee, seega on olnud poliitikad ja nende rakendamine samuti erinev. Käesolevas töös

on analüüsitud Eesti metsandusega seotud poliitikadokumente ajavahemikul 1990–2010, et teha kindlaks metsandusega seotud poliitika muutused ja nende mõju metsasektoriga seotud innovatiivsetele tegevustele.

Eesmärk on:

- Analüüsida, kuidas on innovatsiooni mõistetud ja kirjeldatud metsapoliitika dokumentides.
- Analüüsida, kuidas metsasektor on arenenud poliitika muutuste kontekstis.
- Analüüsida, kuidas soodustavad või takistavad metsasektori arengut metsandusega seotud poliitika ja seadusandluse muutused.
- Selgitada välja, millised on olnud peamised innovatsioonid Eesti metsade valitsemises, riigi- ja erametsade majandamises ja metsatööstuses, mis on lähtunud poliitikast.
- Analüüsida Eesti peamiste puidutööstusvaldkondade väliskaubanduslikku konkurentsivõimet, kasutades väliskaubanduse statistikat ja ilmutatud suhtelise eelisega seotud indekseid.

Erinevatest omandiõigustest vaadeldakse töös väljavõtuõigust ja puiduga seotud majandamisõigust, sest need on otseselt metsa majandamisega seotud õigused, mis mõjutavad kõige rohkem metsaomaniku sissetulekut.

Porteri viie konkurentsijõu mudelit kasutatakse ainult metsasektori konkurentsi mõjutava poliitika analüüsimisel.

Ülevaade väitekirja artiklitest, materjalist ja meetodeist

Väitekirjas kasutatakse uurimisküsimustele vastamiseks erinevaid meetodeid.

Kõikides artiklites (**I–V**) on kasutatud seadusandluse, poliitika ja strateegia dokumentide kvalitatiivset analüüsi.

Artikkel **I** analüüsib erinevaid Eesti innovatsioonipoliitika, metsapoliitika ja maaelu arengu poliitika dokumente, millest käesolevas väitekirjas keskendutakse metsapoliitikaga seotud valdkondadele.

Artiklid **II–IV** kasutavad juhtumianalüüsi ja poolstruktureeritud intervjuusid, et kirjeldada ettevõtte tasemel innovatsioonide elluviimist.

Artiklid **I–III** valmisid rahvusvahelise koostöövõrgustiku COST E51 raames. Artikli **I** algandmed koguti Baueri ja Rametsteineri poolt koostatud juhiste alusel, kuid edasise analüüsi viisid läbi artikli autorid.

Artiklite **II** ja **III** andmekogumise juhised valmistati ette 2008. aastal COST E51 vastavate töögruppide liikmete poolt, kes ühtlasi on ka artiklite autorid. Lisaks erinevate poliitikadokumentide analüüsile viidi aastatel 2008 ja 2009 läbi poolstruktureeritud suulised intervjuud juhtumianalüüsis kasutatud Eesti ettevõtete omanike või tippjuhtidega. Artikli **II** juhtumianalüüsi firmad valiti sellised, mis oleksid innovatiivsed, aga võrreldes konkurentidega ebatüüpilised. Artiklis **III** intervjueeriti puidul põhineva elektri ja soojuse koostootmise innovaatoreid Eestis – Priit Maranit ja Tiit Veeberit – ning kasutati nende firmade andmeid. Artikli **III** jutumianalüüsil kasutatud pelletitootmise firma valiti selline, mis oleks innovatiivne ja analüüsi läbiviimise ajal ebatüüpiline.

Artiklid **IV** ja **V** valmisid Euroopa Metsainstituudi Kesk ja Ida-Euroopa regionaalkontori rahvusvahelise projekti „Innovation and Sustainability of forestry in Central-Eastern Europe: challenges and perspectives" („Kesk- ja Ida-Euroopa metsanduse innovatsioon ja jätkusuutlikkus: väljakutsed ja väljavaated") raames. Riikidevahelised võrdlused tehti 2010. aasta seisuga, lisaks analüüsiti ka poliitilisi muutusi eelneva kahekümne aasta jooksul. Mõlemad artiklid baseeruvad kirjanduse ja poliitikadokumentide analüüsil, kasutades standardiseeritud andmekogumise protokolli. Täiendavaid suulisi (personaalne kohtumine või telefonivestlus) või kirjalikke (e-kiri) kommentaare küsiti erinevatelt anonüümsetelt metsanduse spetsialistidelt.

Ilmutatud suhtelise eelise analüüsil arvutati ja analüüsiti peamiselt järgmisi indekseid:

- RCA (*Revealed Comparative Advantage index*) – ilmutatud suhtelise eelise indeks. Antud väitekirjas tähistati sellega ekspordi andmete alusel leitud indeksit.
- RMA (*Relative iMport Advantage*) – ilmutatud suhtelise eelise indeks impordi andmete analüüsimiseks.
- RC (*Revealed Competitiveness*) – ilmutatud konkurentsivõime indeks.

Ilmutatud suhtelise eelise ja ilmutatud konkurentsivõime indeksite arvutamiseks kasutati väliskaubanduse andmeid järgnevalt:

- FAOSTAT (Ühendatud Rahvaste Organisatsiooni Toidu- ja Põllumajandusorganisatsiooni ja Toitlustuskomitee statistika divis-

joni) ja WTO (Maailma Kaubandusorganisatsiooni) andmeid ajavahemikul 2001–2010.
- UN COMTRADE (Ühendatud Rahvaste Organisatsiooni rahvusvahelise kaubavahetuse) andmebaasi päringud peamiste puidutoodete gruppide (tabel 3) osas vastavalt standardse väliskaubanduse klassifikaatori versioonile 4 (SITC 2006) ajavahemikul 2007–2010.

Lisaks ilmutatud suhtelise eelisega seotud suhtarvude leidmisele reastati kõik maailma riigid uuritud kaubagruppide lõikes üldisesse pingeritta ning leiti Eesti koht selles pingereas.

Tulemused

Metsasektori innovatsiooni kirjeldamine Eesti innovatsiooni-, metsa- ja maaelu arengu poliitika dokumentides

Töö üheks esmaseks ülesandeks oli välja selgitada, kui palju ja kuidas käsitletakse innovatsiooni metsandussektoriga seotud valdkondade dokumentides. Võib öelda, et Eesti innovatsioonipoliitikas metsaga seotud sektoreid ning ka maaelu arengut ei ole kirjeldatud. Samuti ei leia innovatsiooni terminit uuritud Eesti metsapoliitika dokumentidest.

Eesti metsanduse arengukava aastateks 2001–2010 kasutab innovatsiooni mõistele kõige lähema terminina konkurentsivõimet; oluliseks peetakse metsa- ja puidutööstuse rahvusvahelise konkurentsivõime tõstmist, et tagada metsade majandamise käigus tekkiva puidu maksimaalne ärakasutamine. Kaudselt innovatsiooniga seonduvat võib leida järgmiste strateegia elluviimiseks planeeritud tegevuste alt: valdkonna arendustegevust toetavate uuringute läbiviimine ning selleks vajalike andmete kogumine, erametsanduse nõuandesüsteemi väljaarendamine, metsahariduse koostöökoja moodustamine, metsandusliku teadustöö arendamise koostöökoja moodustamine. Metsanduse arengukava keskendub riiklike institutsioonide innovatsioonile, aga piisavalt tähelepanu ei ole pööratud riigi ja erasektori vahelistele innovatiivsetele tegevustele.

Innovatsiooni soodustavad metsapoliitika muutused

Alates Eesti taasiseseisvumisest 1991. aastal on Eesti metsapoliitikat arendatud ning metsanduslikku seadusandlust seejuures pidevalt ja oluliselt muudetud. Eestis on vastu võetud oma metsapoliitika (1997) ja

kaks erinevat metsanduse arengukava (2001 ja 2011). Alates 1991. aastast on Eesti metsaseadust muudetud kokku 37 korda (muutuste arv on üks suuremaid Euroopas). Töös vaadeldi neid metsapoliitika muutusi, mida saab pidada kas otseseks innovatsiooniks või innovatsiooni soodustavateks või takistavateks teguriteks metsasektori arengus. Mõned näited töös selgunud olulisematest innovatsiooni soodustavatest muudatustest (sulgudes on esitatud vastava seaduse punkti jõustumise aasta):

- Metsateatise kasutuselevõtmine. Erametsaomanik peab riigi esindajaid informeerima kavandatavast metsaraiest, metsauuendamisest või metsakahjustustest (1995).
- Erametsaomaniku võimalus oma metsast raiuda puid rinnasdiameetriga alla 20 cm kuni üks tihumeeter hektari kohta aastas (1995). Hilisematel aastatel on sõnastust muudetud. 2010. aastal kehtinud metsaseadus lubas metsaomanikul „raiuda kolm tihumeetrit puitu metsamaa ühe hektari kohta raie korras, mis on selles metsaosas õigusaktiga lubatud, kuid mitte enam kui 20 tihumeetrit kinnisasja kohta aastas“[5].
- Ühe ja keskse riigimetsa majandamise organisatsiooni, Riigimetsa Majandamise Keskuse (RMK), loomine alates 01. jaanuar 1999.
- Metsaressursi arvestuse riikliku registri rajamine (1999).
- Metsakorraldustööde litsentseerimine (2004).
    - Metsakorralduse välitöid võib teha ainult metsandusalase eriharidusega töötaja, kes on sooritanud teoreetilise eksami ja praktilise katsetöö. Metsakorraldustööde tegevusluba võib taotleda isik, kellel on piisavalt tehnilisi vahendeid ja kes välitöödeks kasutab eelkirjeldatud töötajaid.
    - Metsamajandamiskavade kvaliteedi kontroll ja kehtestamine vastava riikliku institutsiooni poolt.
- Raiemahtude piiramine. Tühistati varasem metsaseaduses olnud punkt, mis lubas teha lageraiet keskkonnaministri määrusega kehtestatud tingimusel, keskmise rinnasdiameetri saavutamisel (2004).
- Metsa uuendamise tagatisraha sisseviimine erametsades (kui kavatsetakse teha üle kahe hektari suuruse pindalaga lageraiet) kolme metsatüübi kuusikutes (2007).
- Leevendused metsakorralduses, näiteks ei puuduta metsamajandamiskava koostamise kohustus kinnisasju, mille metsa pindala on väiksem kui kaks hektarit (2007).

5 https://www.riigiteataja.ee/akt/13318447

Metsapoliitika ja metsandusliku seadusandluse muutuste seos metsamajanduse innovatsiooniga

Metsandusliku seadusandluse karmistamise, metsaomanike ja metsandustöötajate tegevusele piirangute seadmise ning riiklike institutsioonide metsanduse kontrollimehhanismide arendamise põhjuseks on olnud soov vähendada erinevaid metsaõigusrikkumisi. Selles osas on erinevatel seadusemuutustel olnud selgelt positiivne mõju, ebaseaduslike raiete arv on vähenenud 1010-lt juhtumilt 2001. aastal 22-le juhtumile 2010. aastal, oluliselt on vähenenud ka õigusrikkumistega seotud puidu kogus.

Töös selgus, et riiklikele institutsioonidele suunatud innovatsioon on toonud kaasa nii toote- kui ka protsessiinnovatsioone, näiteks hakati metsaressursi arvestamise riiklikku registrit kõigepealt rakendama kui metsa inventeerimisandmete hoidmise andmebaasi, seejärel integreeriti erinevad kaardirakendused ning metsandusametnikud said tulemit kasutada nii kontoris kui ka kontrollkäikudel looduses. Eelneva baasil on välja kasvanud laiale üldsusele mõeldud metsaregistri avalik veebiteenus.

Töös on näidatud, kuidas reformidega (1992–2008) saavutatud innovatsioon on puudutanud riigimetsa majandamise organisatoorset ülesehitust ja funktsioone. 1992. aastal erastati endiste metsamajandite tootmisbaasid ja moodustati 186 iseseisva juriidilise üksusena tegutsevat metskonda, 1999. aastal moodustati üks juriidiline organisatsioon Riigimetsa Majandamise Keskus (RMK), mis Keskkonnaministeeriumi haldusalas tegeleb riigimetsa majandamisega (erandiks on haridusasutuste, näiteks Eesti Maaülikool, kasutuses olevad metsad). Reformide tulemusena on muutunud riigimetsade maa-ala-põhine majandamine funktsionaalseks majandamiseks, vähenenud on riigimetsa majandamise organisatsioonis töötavate inimeste arv (sest metsade majandamisega seotud teenuseid ostab RMK sisse erinevatelt erasektori firmadelt), lisaks riigimetsade majandamisele pakub RMK erinevaid loodushariduse ja muid teenuseid ning haldab rahvusparke.

Poliitika mõju erametsade majandamisele on töös vaadeldud metsakorralduse kontekstis, mis võrreldes teiste Euroopa riikidega on Eestis üks rohkem reguleeritud tegevusvaldkondi. Metsamajandamiskava on Eesti erametsaomanikule kohustuslik ainult siis, kui omanik soovib metsa aktiivselt majandada. Paljudes Euroopa riikides on metsamajandamiskava omanikule kohustuslik, kuigi, nii nagu Eestiski, võib esineda erandeid lävendina kasutatava minimaalse pindala osas. Metsamajandamiskava

koostamisel saab arvestada omaniku soove kehtiva seadusandluse piires. Võrreldes mitmete Kesk- ja Ida-Euroopa riikidega eristub Eesti ka selle poolest, et metsaomanik võib ilma metsandusametnikke informeerimata oma metsast raiuda teatud koguse puitu. Eesti seadusandlus ei nõua raiutavate puude ettemärkimist, samas kui mitmes Euroopa riigis peavad seda tegema volitatud metsandustöötajad või riiklike institutsioonide esindajad.

Poliitika ja seadusandluse muudatuste mõju puidutöötlemise sektorile on kõige paremini jälgitav ajavahemikul 2004–2007. Eesti puidutöötlemise sektorisse, eriti aga saetööstustesse oli 2004. aastaks tehtud suuri investeeringuid, tööstused olid kaasaegsed ja toormevajadus oli suur. 2004. aasta metsaseaduse muudatuste tagajärjel vähenes oluliselt Eesti raiemaht ning suurenes ümarpuidu import lähiriikidest. Tänu paberipuidu ekspordile oli Eesti tuntud kui ümarpuidu eksportija, kuid oluliselt suurenenud saepalgi impordi arvelt muutus Eesti kaheks aastaks (2005 ja 2006) ümarpuidu importijaks.

Töös selgus ka, kuidas seadusandluse muudatused on avaldanud mõju metsavarumise sektoris allhankijatena tegutsenud raiefirmade innovaatilisusele. 2004. a seadusemuudatustele järgnenud raiemahtude vähenemist aitas raiefirmadel mingiks ajaks leevendada 2005. a tormikahjustuste likvideerimine välismaal (Rootsi, Prantsusmaa). Kuid arvestades metsatööde hooajalisust ja RMK poolt allhankijate tehnika vanusele seatud kõrgeid nõudeid, otsisid mõned ettevõtjad oma vanematele metsamasinatele muid tegevusvaldkondi. Näiteks leiti peamiselt kokkuveotraktoritele (*forwarder*), kuid ka langetustraktoritele (*harvester*) kasutust teedeehituses, haljastuses, prügilamajanduses või vanade kuivenduskraavide puhastamisel, sedagi võib pidada innovaatiliseks lähenemiseks.

Puidupõhisest bio-energeetikast saab seevastu tuua näite, kus innovatsiooni soodustava seadusmuudatuse taga oli ettevõtjate aktiivsus, kes soovisid arendada puidul baseeruva elektri ja soojuse koostootmist tõhusa koostootmise režiimil. Elektrituruseaduse muudatuste tulemusel tõusis oluliselt taastuvast energiaallikast toodetud elektrienergia toetus ja 2009. a alustas ka riigile kuuluv põlevkivielektrijaam puidu põletamist oma kateldes. Puiduturul toimunud muutustest lähtuvalt toimusid muutused ka RMK töös – loodi puiduenergeetikatalitus, mis varustab suurtarbijaid hakkpuiduga (protsessi- ja organisatsiooniline innovatsioon).

Eesti peamiste puidutööstusvaldkondade väliskaubanduslik konkurentsivõime

Töös selgus, et Eesti metsasektori toodete väliskaubanduses on Eestil suhteline eelis (RCA > 1) nii puidutoodete ekspordi kui ka puidutoodete impordi osas. Puidutoodete ekspordi suhtelise eelise indeks RCA oli aastatel 2001–2010 vahemikus 3,93–5,19, analoogse impordi indeksi RMA väärtused olid 1,12–2,57. Aastal 2004 muudetud raiepiirangute mõju on jälgitav nii indeksite väärtuste muutustes kui ka indeksi väärtuste alusel koostatud riikidevahelises pingereas. Eriliselt tähelepandav on impordi indeksi RMA pingerea muutus: kui aastatel 2001–2003 oli Eesti maailma riikide pingereas 36–50. kohal, siis 2004. aastal tõusti 7. kohale ning ligikaudu samale kohale (3.–7.) jäädi kuni aastani 2010.

Erinevate peamiste puidutoodete väliskaubanduse ilmutatud konkurentsivõime (RC) indeksid olid kõikide vaadeldud kaupade osas positiivsed, seega on eksport olulisem kui import. Ajavahemikul 2007–2010 oli ilmutatud konkurentsivõime indeks kõige suurem kokkupandavate puidust ehitiste grupis (RC=2,25–3,50). 2010 oli kokkupandavate puidust ehitiste grupis andmeid 116 riigi kohta ning ilmutatud konkurentsivõime indeksi väärtuse põhjal moodustatud pingereas oli Eesti maailmas esimesel kohal. Vaadeldud kaubagruppide osas oli nii indeksi väärtuse (0,56–0,73) kui ka pingerea (47. koht 125st) alusel kõige madalamal kohal saematerjalid, millest võiks järeldada, et maailma mastaabis Eesti saetööstus ei ole konkurentsivõimeline. Tegelikult väärindatakse suur osa Eesti saetööstuste toodangust järeltöötlemisel Eestis teiste puitu töötlevate tööstuste (näiteks mööbli või kokkupandavate puidust ehitiste tootjad) poolt ja seega võib öelda, et Eesti saetööstus on konkurentsivõimeline.

Arutelu ja järeldused

Kui innovatsioonipoliitika eesmärgid on enamasti otseselt majandusega seotud, näiteks majanduskasv, tööviljakuse kasv, tööhõive või konkurentsivõime suurenemine, siis metsasektorit on innovatsioonile suunatud uuringutes peetud sageli "mahajäänud tehnoloogiaga" valdkonnaks ja seda on nimetatud ka traditsiooniliseks või küpseks tööstusharuks. Nii ei käsitleta ka Eesti innovatsioonipoliitkas metsasektori innovatsiooni.

Üldiselt arvatakse, et innovatsioon toimub ettevõtetes, kus ettevõtjate tegevus efektiivsuse või konkurentsivõime saavutamiseks ning täiendava

kasumi saamiseks on peamiseks tõukejõuks. Erinevate ettevõtte taseme innovatsioonide (toote-, protsessi-, turundus- ja organisatsiooniline innovatsioon või nende kombinatsioonid) läbiviimine ei ole võimalik ainult turuosaliste poolt, vaid see vajab välist tõuget või toetust. Selliseks tõukeks võib olla institutsionaalne innovatsioon, mis muudab vaadeldava valdkonna poliitilis-institutsionaalset raamistikku, sisaldades muutusi poliitikas, seadusandluses, institutsioonides jne. Lähtuvalt Schumpeteri teooriast ei ole kõik seadusandluse ja poliitika muutused innovatsioonid, näiteks mitmed looduskaitsega seotud poliitika muutused takistavad ettevõtja või kliendi poolset kasumi taotlemist.

Töös tuli välja ka see, kuidas institutsionaalne innovatsioon suhestub väga mitmete muude innovatsiooni allikatega, milleks võivad olla nii ootamatud loodusnähtused kui ka ettevõtjate isikuomadused. Arutelu väärib küsimus, kui palju valitsus oma tegevusega tohib mõjutada turul tegutsevate ettevõtete konkurentsi. Töös on toodud näiteid, kus riiklikud institutsioonid on seadnud ettevõtjatele turule sisenemise piiranguid. Näiteks 1993. aasta metsaseaduses oli nõue, et metsakorraldustööd kuuluvad litsentseeritavate tegevuste hulka. Kuna litsentsi taotlemise korda välja ei töötatud, siis uued ettevõtted metsakorralduse turule ei saanud siseneda, samal ajal kui riigi omanduses olnud monopolistlik Eesti Metsakorralduskeskus tegutses ilma litsentsita.

Uurimus näitas, et metsaõigusrikkumiste ja illegaalsete raiete vähendamisega seotud tegevused on olnud üheks metsamajandusega seotud innovatsiooni tõukejõuks Eestis. Mitmed seadusandlikud muudatused olid suunatud metsaomanike tegevuse kontrollimiseks; seda võib pidada institutsionaalseks innovatsiooniks, mille käigus kasutati toote- ja protsessiinnovatsiooni vahendeid. Mõned nendest innovatiivsetest vahenditest pole jäänud mitte ainult metsandusametnike kasutada olevateks kontrollivahenditeks, vaid on tehtud kättesaadavaks kogu üldsusele (näiteks metsaregistri avalik veebiteenus).

Siiski näitas analüüs ka seda, kuidas metsaomanike tegevuse ülereguleerimine või liigne kontrollimine on vastuolus innovatsioonipoliitika eesmärkidega. Eesti metsandusadministratsioon on olnud poliitilise surve all, kus mõnede seadusemuudatuste eesmärgiks on olnud võimul oleva keskkonnaministri või tema poliitilise partei populaarsuse kasv, mitte aga metsanduslik sisu. Taolised juhtumid on hiljem tühistatud seadusmuudatustega, mis on ellu viidud uue valitsuskoalitsiooni ajal.

Samuti näitas analüüs, et Eesti metsanduse valdkondlik innovatsioonisüsteem ei toeta olulisel määral mitmekülgset metsakasutust, mittepuidulisi metsasaaduseid ja teenuseid, sest olulisemad innovatsioonid on seotud metsakasvatuse ja puiduvoogude kontrollimisega.

Üheks olulisemaks kogu Eesti metsasektorit mõjutanud institutsionaalseks uuenduseks, mille mõju pole olnud positiivne, võib analüüsi tulemusel pidada 2004. aastal metsaseadusse uuesti sisse viidud metsakorralduse litsentseerimise ja metsamajanduskavade kehtestamise nõuet. Metsaomanikud, kelle kehtivad metsamajandamiskavad või -soovitused olid kuni 10 aastat vanad, pidid ise alustama kavade kehtestamise protseduuri. Tegevusluba omavate metsakorraldajate vähesus ja riigiametnike esialgne tegevus kavade kehtestamisel muutsid tegevuse vägagi aeglaseks ning reaalne kavade kehtestamise aeg oli esialgu pikem kui seaduses ette nähtud. Kehtiv metsakorralduse regulatsioon seadis olulisi piiranguid tavapäraseks metsade majandamiseks (hinnanguliselt 2/3 erametsadest oli kasutusest väljas ja raiemahud vähenesid oluliselt), suurendas oluliselt bürokraatiat ning riigi administratiivkoormust.

Erinevalt teistest Kesk- ja Ida-Euroopa riikidest ei ole kehtiva metsakorralduskava olemasolu nõue Eesti metsaomaniku tegevust siiski täielikult piirav, sest metsateatist esitamata võib metsaomanik metsaseaduses sätestatud tingimustel oma kinnistu kohta raiuda kuni 20 tihumeetrit puitu, mis üldiselt vastab majapidamise aastasele küttepuidu varule.

Veidi teistsugune kui eelnevalt kirjeldatud protsessid on olnud statistilise metsade inventeerimise (SMI) areng. Kõigepealt kohandasid mõned innovaatilised Eesti Metsakorralduskeskuse töötajad Rootsis kasutusel olnud SMI metoodikat Eesti oludele ja seejärel testiti seda aastatel 1992, 1996 ja 1997. Lähtuvalt esialgsetest SMI tulemustest defineeriti 1998. aastal metsaseaduses metsa inventeerimine statistilise valikmeetodiga ning esimene üleriigiline SMI viidi läbi 1999. aastal. SMI analüüside tulemusi kasutatakse nii kodumaiste kui ka rahvusvaheliste metsapoliitiliste ja keskkonnapoliitiliste protsesside kujundamisel.

Vaadeldes Eesti metsandussektori innovaatilisust Euroopa kontekstis, tuleb tähele panna, et viimase 25 aasta jooksul on nii Eestis kui ka mitmetes teistes Euroopa riikides toimunud olulisi reforme riigimetsade majandamisel, kuid reformi protsess ja riigimetsa majandamise organisatsiooni ülesanded on riigiti erinevad. Eestis toimunud institutsionaalsed uuendused riigimetsade majandamisel on viinud olukorrani, kus

enamik metsamajandamise teenuseid ostetakse sisse allhankijatelt. Riik kui suurim metsaomanik seab allhankijatele kõrgemaid standardeid kui erametsaomanikud.

Eesti konkurentsivõimet metsandusega seotud sektorites on mõjutanud mitmed asjaolud. Näiteks 2004. aasta metsaseaduse muudatustest tuleneva raiemahtude vähenemise tagajärjel tekkis saetööstustel toormepõud ning oluliselt suurenes saepalkide eksport. Lühiajaliselt, aastatel 2005 ja 2006, muutus Eesti ümarpuitu eksportivast riigist importivaks riigiks. Eesti raiemahtude ja metsasektori väliskaubanduse ilmutatud suhtelise eelise indeksi RCA vahel on tugev lineaarne korrelatsioon 0,823 ($p = 0{,}003$, $n = 10$), seega raiemahtude piiramine on oluliselt mõjutanud Eesti metsasektori rahvusvahelist konkurentsivõimet. Samal ajal Eesti puitu töötlevate tööstuste väliskaubanduslik konkurentsivõime on kõrge. Võrreldes 2010. a andmetel erinevate peamiste puidu ja mööblitööstuste valdkondade väliskaubanduslikku konkurentsivõimet, oli Eestis kõige konkurentsivõimelisem kokkupandavate puitehitiste tööstus, mis omas grupis oli maailma riikide pingereas esimesel kohal.

Käesolev töö näitas, et üldiselt kasutatavaid innovatsiooniteooriaid saab rakendada ka metsanduses. Kuid kuna metsasektor on äärmiselt kompleksne valdkond, tuleks innovatiivsust analüüsida lähemalt allsektorite kaupa. Igale metsanduse allsektorile on iseloomulikud eri tüüpi uuendused.

Kokkuvõtteks võib öelda, et metsandusega seotud institutsionaalsed innovatsioonid ja seadusandluse muutused ei ole mõjutanud mitte ainult kitsalt metsaomanikke ja metsa majandamise tavasid, vaid kõiki metsaga seotud rahvuslikult olulisi sektoreid Eestis.

ACKNOWLEDGEMENTS

First of all I am grateful to Professor Emeritus Artur Nilson, who was the supervisor of my diploma thesis, my MSc thesis and the first supervisor of my PhD studies a long time ago. Artur was the person who at the end of 1992 made me to begin teaching forestry students and later motivated me to start scientific research.

I am grateful to all the respondents of the interviews, phone calls, etc. and to representatives of case study organisations as case studies cannot be conducted without respondents. I would like to thank the co-authors of the published papers. The writing of the forest policy related papers has been challenging, sometimes heated discussions and reaching an agreement seemed to be more complicated than policymaking itself.

I would like to thank my supervisors Paavo Kaimre and Peeter Muiste for their valuable support and comments during the preparation of the PhD thesis. The work of language editors Tiia Kaare and Ann Veismann is highly appreciated. Special thanks go to Vaike Reisner for dealing with the bureaucratic issues related to PhD studies

I am grateful to my colleagues from the Department of Forest Industry as well as to other colleagues who have supported my recent activities in one way or another.

My special thanks go to Edda, Lelde and Diana, Linnar, Madis, Marika, Merle and Allan, Peep, Veiko, who have mentally supported me in difficult times.

I owe a lot to Karina and our children Triina, Martin, Karmel and Daniel.

Siiramad tänusõnad ka vanematele – Helgile ja Antsule, aga samuti ka ämmale ja äiale – Veerale ja Ilmarile. Pühendan selle töö oma vanaisa, Viljandimaa Kõpu valla Halliste (hetkel Tipu) küla Kuusemetsa talu peremehe Jüri Tederi mälestuseks.

I

ORIGINAL PUBLICATIONS

Teder, M., Ukrainski, K., Prede, M., Kaimre, P. 2007. Assessing the alignment and integration of innovation and development policies for the forest sector in Estonia. Metsanduslikud Uurimused | Forestry Studies, 46: 102─117.

Assessing the alignment and integration of innovation and development policies for the forest sector in Estonia

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Teder, M., Ukrainski, K., Prede, M., Kaimre, P. 2007. Assessing the alignment and integration of innovation and development policies for the forest sector in Estonia. – Forestry Studies | Metsanduslikud Uurimused 46, 102–117. ISSN 1406-9954.

Abstract. This article analyses the extent to which Estonian innovation policy, forest policy and rural development policy are aligned and integrated for supporting innovative activities in the forest sector of Estonia. The forest sector is understood in a broad sense as comprising forestry, industries using timber (wood processing, pulp and paper and furniture industries) as well as industries using non-wood products (recreational services, *etc*.). The strategic documents related to the forest sector, innovation policy and rural development are analysed to clarify the links between different policies. Most innovations directly emerging from the forest sector policy are related to the organisation and development of the public dimension of forestry; the private sector has received much less attention. The main conclusions are that 1) in all strategies the measures for supporting innovation in forest sectors exist, although they are not considered in the context of innovation, and 2) the coordination between different policies is not sufficient.

Key words: forest sector, innovation policy, forest policy, rural development policy, Estonia

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Introduction

In a world of increasing globalization, each country is faced with the challenge of how to ensure sustainable development of society and the prosperity of its citizens. In recent decades, the traditional understanding of the concepts of prosperity and well-being as strictly economic phenomena has been expanded, embracing economic, socio-cultural and environmental values of the society. Classical natural resources-based economy (Pearce & Turner, 1990) has turned towards human resources-based economic development. This new (globalized, faster paced, knowledge- and network-based) economy means that products are replaced and/or changed more quickly than ever, and industry can move at any time to the lowest-cost provider without space and time limitations (Blakely & Bradshaw, 2002). Being innovative and proactive is the key to success, for all sectoral and horizontal development policies.

Research in many countries has indicated the increasing importance of integrative and holistic approaches to state economic policy strategies. Development of human capital, social infrastructure and an institutional system in the public sector capable of supporting economic initiatives in local communities – these are preconditions for the growth of economic competitiveness and crucial for successful implementation of related national and regional policies (Rametsteiner, 2005)

In recent decades, local and regional development strategies in developed countries have increasingly focused on the sustainable use of natural resources (The Pan-European…1996; Drucker,1998). Key elements of this approach are innovation, new technologies and co-operation between all stakeholders, including local communities, commerce and business sectors (Koobs & Beckers, 1999; Skoberne, 1999; Stigson, 1999).

Innovation is not a recently conceptualised phenomenon; the concept was originally formulated by Schumpeter in 1911 (and in a somewhat revised English version published in 1934). This concept, generally accepted today, considers innovation as the introduction of a new or upgraded product, a new production method adding to possibilities for commercialization, the opening of an additional market or markets, the discovery and/or development of an additional source for raw materials or partially-manufactured goods, or the implementation of a revised organizational structure within the industry (Schumpeter, 1934). In contemporary literature, it is common to classify innovations into two broader categories: product (or service) and process. In addition, several sub-categories can be attributed to the latter depending on the processes developed (see also Oslo Manual (OECD, 2005) for more detailed classification and measurement issues).

The understanding of the innovation processes has advanced from linear innovation models (science-push or market-pull models) to more systemic ones (chain-link or interactive models), which has transformed the respective policy approaches from science and technology policies to innovation policies (see e.g. Lundvall & Borrás, 2007) that aim to remedy specific failures between various actors in the respective national, regional or sectoral setting. Rametsteiner and Weiss (2006) find, in exploring respective policies in countries of Central Europe, that explicit policies and strategies that would provide systematic innovation support for forest sectors are rare and those innovation support measures that do exist are fractioned and not coordinated.

The present study is based on the Estonian forest sector. Timber, an abundant forest resource, occupies a paramount role in the overall Estonian economy, especially in rural development. Despite the economic relevance of forest-related sectors in the Estonian economy, there has been little attention to innovation in those industries, especially forestry and industries related to non-wood forest products. The available studies (e.g. Ukrainski & Varblane, 2006; Tiits 2007) and empirical reviews typically address the manufacturing industries (wood processing, pulp and paper, and furniture) and originate from the two subsequent innovation surveys: "Innovation in Estonian Enterprises 1998–2000" and "Innovation in Estonian Enterprises 2002–2004". The surveys are generally based on the methodology of the Community Innovation Survey developed by the European Commission and Eurostat.

The empirical analyses show that, in terms of innovative activities, the forest-related sectors under discussion perform quite well in comparison with the overall economy, with more rapid growth in the number of innovative firms. At the same time, the role of public funding of innovative activities also increased for forest sector firms (12.2% of firms have received public support in 2002–2004 compared to the 1.5% in years 1998–2000), mainly for funding of training expenses. In contrast to

other sectors forest sector firms have received no state support for acquiring external knowledge resources (consultants, universities, *etc.*) for innovation; however they have relied upon those resources just as intensely as those receiving support. In the study of Tiits (2007) it appears that in the years 2004–2005, only furniture firms received public support for R&D (Research and Development) projects through innovation policy measures. However, wood, paper and furniture firms received significantly more public funding for export, training, counselling, infrastructure, and start-up projects. The above-described analysis does not cover a specific part of innovative activities related to the forest sector concerning the diversification of rural economies with service innovations.

The article analyses the extent to which Estonian innovation policy, forest policy and rural development policy are aligned and integrated for supporting innovative activities in Estonian forestry sectors. "Forestry sector" is here understood in a very broad sense comprising forestry, industries using timber as input (wood processing, pulp and paper industries and furniture industry) as well as supply of non-wood products (like recreational services *etc.*). The primary relevant policy and strategy documents are reviewed as they can have substantial influence, either supporting or hindering innovative business activities. The most apparent problems are identified and suggestions for further research will be given.

Short overview of the Estonian Forest Sector

Following political changes in the former USSR, Estonia regained political and economic independence in August 1991 and joined the European Union in May 2004. Those changes implied a rapidly changing economic legislative base for forestry. The privatization and restitution processes are not yet fully complete. According to the Land Cadastre (as in 01.01.2006) 1.863 million hectares (82.3%) of forest land has been registered: 879.6 thousand hectares (38.9%) are in private ownership, 2.5 thousand (0.1%) are owned by municipalities and 981 thousand (43.3%) are state-owned: 816 thousand ha (36.0%) are managed by the State Forest Management Centre and 165 thousand ha (7.3%) by other institutions (Yearbook Forest, 2006). Approximately 0.4 million ha (17.7%) of forest land have not yet been registered in the Land Cadastre.

The forest-related sectors have played a significant role in the Estonian economy, comprising 3.1–5.8% of the GDP (see Figure 1). However, in recent years, they have grown slowly, resulting in a decreased share of the GDP despite rapid increase in other areas.

Until recent years, there were more than 45 000 employees in the combined forestry and forest-related industries (Figure 2). Structural reforms in state forest management have resulted in a major decrease in employment.

The wood processing industry has constantly been expanding. The first modern sawmills were built in 1995. Since then, there have been substantial investments into efficient new technologies in the sawmilling industries, increasing both productivity and employment, thereby securing a competitive position in both domestic and export markets. The sawmilling capacity was set up according to the domestic felling volumes in 1999 and 2000. As domestic fellings have drastically decreased since 2000, the processing capacity of Estonian wood sectors has exceeded the supply of domestic roundwood and Estonia has become a net importer in recent years (Figure 3). The main trade partner in roundwood import has been Russia, but sawlogs are currently being imported from Sweden, Germany, *etc.* (Rozental, 2007).

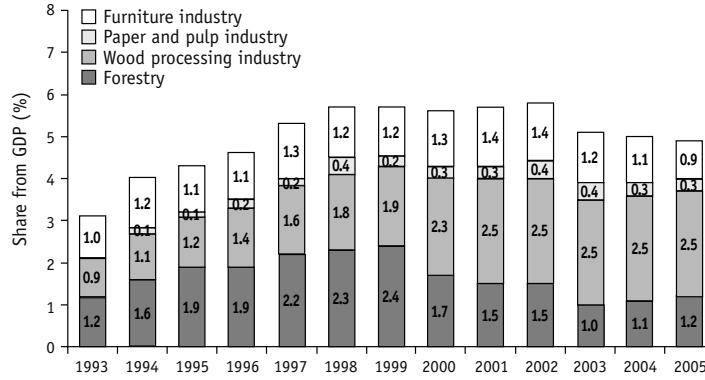

Figure 1. Share of forest industry from gross domestic product (by current prices) in 1993–2005 (*Sources: Yearbook Forest 2006, Centre of Forest Protection and Silviculture*).

Joonis 1. Metsasektori ettevõtete osakaal sisemajanduse kogutoodangust (jooksevhindades) aastail 1993–2005 (Allikad: Aastaraamat Mets 2006, Metsakaitse- ja Metsauuenduskeskus).

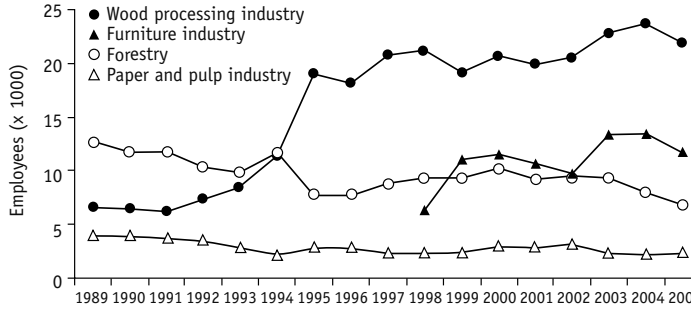

Figure 2. Employment in forest related industries in Estonia (*Source: Centre of Forest Protection and Silviculture*).

Joonis 2. Tööhõive Eesti metsasektori ettevõtetes (Allikas: Metsakaitse-ja Metsauuenduskeskus).

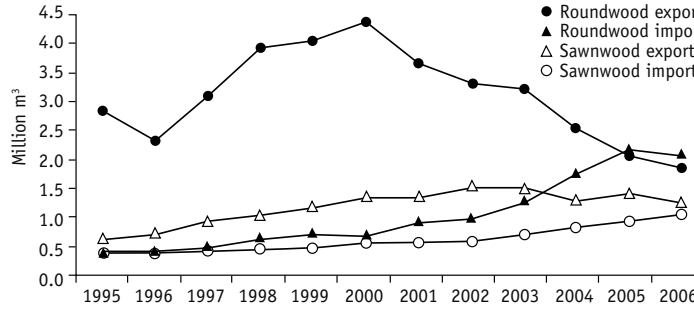

Figure 3. Estonian foreign trade of roundwood and sawnwood (*Source: Centre of Forest Protection and Silviculture*).

Joonis 3. Eesti ümarpuidu ja saematerjalide väliskaubandus (Allikas: Metsakaitse- ja Metsauuenduskeskus).

To overcome the shortage of raw material, investments were made in different value-adding technologies thereby enhancing the product and process innovation of the Estonian wood processing industry. Changes in the use of roundwood (mainly pulpwood) were also a factor. In addition to sawmills, other innovative wood processing facilities were created, using small dimensional roundwood (e.g. gardening and fencing products). Estonia does not have capacities for pulp production from pine, spruce and birch timber; pulpwood of those species is exported.

The shortage of sawlogs has resulted in the closing or bankruptcy of several small sawmills. Stora Enso, an international forest industry group, announced the closing of Sauga Sawmill, one of its four in Estonia, in June 2007. The continuing shortage of raw material resulted in higher costs and unprofitable operations (Stora Enso, 2007). Within the 5 first months of 2007, 27% of employment contract terminations occurred in the woodworking or furniture industries; the Estonian Unemployment Insurance Fund is expecting another increase in the second half of the year (Lühiste, 2007).

It can be concluded that the future of Estonian woodworking industries depends in large part on the ability to react adequately to conditions in the roundwood and labour markets.

Material and Methods

Innovative activities of forest sector firms are shaped by policies of different areas, however, innovation policy, forest sector policy and rural development policy can be considered as the most immediate. As in many other transition countries, the impact assessments of different policy measures have not yet been carried out, one reason being the short time period of policy implementation and learning. Therefore, the analysis here is focused on the inter-textual analysis of policy and strategy documents aiming at identifying the innovation orientation of the documents, from one perspective, and forest sector orientation from the other. The following process was undertaken, following the COST guidelines (Bauer & Rametsteiner, 2006):

1) The inclusion of the forest sector in innovation policy documents and rural development policy documents;

2) The inclusion of innovation in forest sector policy and rural development policy documents;

3) The integration of policy documents of related areas, in general terms, but also in the forest sector, specifically.

In addition to the aforementioned analysis, the policy and strategy documents are assessed from their general approach to innovation (linear vs. systemic). This is based on assessing the relative importance of respective policy measures – whether the measures foreseen in the documents support private and/or public sector R&D or the collaboration between them, or if they have incorporated wider measures of networking, clustering, institution-building, *etc.*

For the analysis, the key documents from each field are selected and summarized in Table 1. Several parallel and overlapping strategic documents can be considered with regard to the R&D and innovation policy of Estonia. The broadest in coverage and most general is the Action Plan, but the earliest, more specifically targeted to R&D and innovation, is the strategy "Knowledge-Based Estonia: The Estonian Research and Development Strategy 2002–2006" (KBE) and its successor document KBE for 2007–2013. The Action Plan is formed in its innovation-related sub-section in accordance with the strategy of KBE; however it is broader, encompassing in addition the measures (e.g. export promotion, entrepreneurship and finance) more indirectly

supporting innovation. For analysing the background information (main institutions, their functions and financing schemes of current research policy), The Organization of Research and Development Act was used (see Table 1). Practical forestry in Estonia is regulated by Forest Acts. Forestry policy formulation is mostly found in National Forest Policy (1997) and The Estonian Forestry Development Programme until 2010 (EFDP): the first is a strategic document only and the second consists of both strategies and action plans.

In studying the innovation and forestry sector integration in rural development policies, Estonian Rural Development Strategy 2007–2013 (RDS) is analysed as the basic document, and is compared with the other regulations relevant to the implementation of RDS, forestry, innovation and rural development (Rural Development Plan and Action Plan 2004–2006). RDS is in line with the European Community's objectives in the framework of the Community Strategic Guidelines 2007–2013, CAP reform, Lisbon Strategy and other strategic documents addressing the competitiveness of agriculture, forestry, land management, environment, quality of life, and diversification of rural economy.

Table 1. Analysed Policy and Strategy Documents.
Tabel 1. Analüüsiks kasutatud poliitikate ja strateegiate alusdokumendid.

Document Name	Description
Innovation Policy and Strategy Documents	
"Knowledge-Based Estonia: The Estonian Research and Development Strategy 2002–2006"	The earliest R&D strategy of Estonia. The evaluation of the implementation of this strategy document has not been carried out implicitly (the strategy didn't include specific implementation plan).
"Knowledge-Based Estonia: The Estonian Research and Development and Innovation Strategy 2007–2013"	Successor of the previous KBE was approved in February 2007 by Parliament. The strategy includes an implementation program which specifies the tasks and financing details in 4 years (1+3) period.
"Action Plan for Growth and Jobs 2005–2007"	The broadest in coverage and most general, regulating the general development strategy of the country.
The Organization of Research and Development Act	The main document regulating the functioning of Estonian R&D system (first agreed in 1997, but significantly changed in 2001).
Forest Sector Policy and Strategy Documents	
Forest Acts	Have been changed three times since 1991: in 1993 (4 amendments), in 1998 (12 amendments) (Etverk 2005) and in 2006 (valid from 01.01. 2007).
National Forest Policy	Approved by Parliament in July 1997. One major result was the restructuring of the public forestry administration: forestry supervision (inspection) and state forest management was assigned to different organizations. Some historical overview is given by Kallas (2002).
The Estonian Forestry Development Programme until 2010 (EFDP)	Adopted by the Parliament in November 2002; the main strategic document currently valid in forest sectoral policy.
Rural Development Policy and Strategy Documents	
Estonian Rural Development Strategy 2007–2013 (RDS)	Adopted by Estonian Government in July 2006.
Estonian Rural Development Plan 2007–2013 (RDP).	RDS policy implementation document, approved by Estonian Government in February 2007.

Results

Forest Related Industries and Estonian Innovation Policy

The R&D and innovation strategy documents determine the general financing strategy of R&D expenditures, whereby not only the prognosis of public funds, but also expected private funding is specified (see general trends in Table 2). The measures of KBE 2002–2006 are concentrated on supporting the R&D projects in firms and universities, strengthening the knowledge base in universities and encouraging the cooperation between industry and academia. The second KBE encompasses a wider variety of measures by adding support for cluster initiatives, funding for the diffusion of innovations, but also increased funding for improving innovation awareness of the general public. The second KBE is certainly a step towards a more systemic approach to innovation, but it still omits some crucial activities related to entrepreneurship and networking generally held relevant for systems employing an innovation approach (Edquist, 2005).

Both documents bring out specific sectors/fields that are targeted; however, the forest-related sectors are not mentioned. It is evident from textual analysis that both documents of KBE are well integrated concerning the strategies of higher education and entrepreneurship (as is also evident from the division of funding volumes by the ministries) at the same time containing no links to rural development or forestry (including the respective development strategies). Therefore the conclusion that KBS is not aligned with and integrated specifically towards forest sector seems eminent.

As in other catching-up economies, Estonian innovation strategy is targeted towards user- friendly information and communication technologies and the development of an information society; biotechnology (in Estonia, biomedicine) and materials' technology. The problem here is that the strategy imitates similar strategies in other countries without aligning it with the structure of the national economy and without seeing the importance of traditional industries as customers of high tech industries. (The first problem is more deeply discussed in Edquist, 2001 and the second in Von Tunzelmann & Acha, 2005 and Hirsch-Kreinsen *et al.*, 2005.)

Table 2. R&D expenditures in 2002–2010 (million EUR)*.
Tabel 2. Kulutused teadus- ja arendustegevusele aastatel 2002–2010 (miljon EUR).

R&D Expenditures	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total expenditure	52.1	64.2	85.8	110.9	139.7	*175.8*	*230.8*	*315.6*	*351.8*
Total expenditure, % of GDP	0.8	0.9	1.1	1.3	1.5	na	1.5	na	1.9
Public sector expenditure	41.7	51.4	64.4	83.2	97.8	83.0	118.4	192.2	213.5
Share of public sector, %	80.0	80.0	75.0	75.0	70.0	*47*	*51*	*61*	*61*
State budget allocations	31.8	39.2	45.6	56.5	64.8	83.0	118.4	192.2	213.5
– of which Ministry of Education and Research	26.4	27.5	29.4	35.2	38.3	49.6	72.3	139.6	155.4
– of which Ministry of Economic Affairs and Communications	4.5	10.9	15.3	20.5	25.6	26.3	39.9	46.3	51.9
– of which other ministries	0.9	0.9	0.9	0.9	0.9	7.0	6.1	6.2	6.2

Source: Knowledge-based Estonia 2002–2006 p. 32; Knowledge-based Estonia 2007–2013, p.35.
*Authors' calculations based on presented data are shown in italics. The years 2011–2013 are not added because they do not include details respective strategies.

Although indirectly, the KBE 2007–2013 can be considered to be targeted more directly to the forest sector as it recognizes the need for supporting innovative attempts of both new and traditional industries (to which forest-related sectors certainly belong). For example, to respond to the needs of traditional industries, starting in 2007, support is being extended for testing and certification procedures, design and productivity management projects, etc. The strategy also aims at strengthening the competences and knowledge base of firms for strategic innovation management and development activities by supporting the engagement, training and counselling of specialists, including development specialists from Estonia, but also from abroad. By developing industry clusters, priority is established for active use of key technologies which lead to growth in productivity (Knowledge-based Estonia, 2007). The funding for the above-listed measures comprises 22% of the total funding for KBE 2007–2010.

Innovation in the Sectoral Development Policy of Forestry

With the restitution of private properties launched in the beginning of the 1990's, forestry rather than agriculture became the major source of income for many rural residents. A large number of people who bought forests had no forestry skills; some new owners undertook illegal activities, e.g. over-cutting in their forests. Direct timber theft also became a problem. The forest regulations valid at the time created the motivation for such activities: income taxes were levied on sales turnover of timber and there were insufficient control measures. Beginning in 1998, the Forest Act and its amendments in the following eight years limited various fellings, and also improved and strengthened controls. Felling volumes decreased: according to the national forest inventory, fellings in 2004 were almost 2 times less than in 1999 (respectively 7.0 million m^3 and 12.7 million m^3 (Yearbook Forest, 2006). Even more restrictions for forest owners were established in the Forest Act in 2006.

The control measures have created innovative solutions in public organisation; for example, a Forest Register was implemented to account for forest resources. This GIS (Geographic Information System)-based information system includes different mapping solutions (Land cadastral data, aerial photos, basic map, maps of protected natural objects, woodland key habitats), stand-wise forest inventory data and different IT based solutions, e.g. internet-based E-notification, through which a private forest owner can submit the required notifications of planned activities in his forests. In the public sector it is used by various forestry administrative and monitoring authorities, allowing specialists with GPS (Global Positioning System)-equipped field computers and mobile telephone-based internet connections to verify the reported and actual situations in forests. In addition, other innovative ideas have been used in implementation of forest regulations, e.g., analyzing illegal fellings by use of satellite photos. The State Forest Management Centre has several innovative solutions for local use: its own forestry information system; the planned installation of a digital forest fire monitoring system; methodology for evaluating informal forestry and forests as biological assets; an inventory of forestry cultural heritage in combination with nature tourism (Hepner, 2007a).

One of the major organisational innovations in national forest policy was the creation of the State Forest Management Centre, a new, single state forest management organization, in 1997. Before the reforms at the end of the soviet era, 22 state forest enterprises (including more than 200 state forest districts) handled state forest management. By 2007, that has been reduced to 64 districts. In the mid-1990's, the number of employees in the state forestry system was rapidly cut back; lower position staff were dismissed. Some later started their own businesses, selling services to forest owners.

The Estonian Forestry Development Plan until 2010 (EFDP) defines the development priorities for forestry in Estonia until 2010 and lists the activities planned to achieve the objectives, including a timetable and budget. The EFDP is not only a general strategic document, but also contains the action plan for 9 different categories of detailed measures with respective budgets. The total budget from 2002 until 2010 was planned to be 23 million EUR, 19 million from Estonia and the balance from EU structural funds and various international co-operation programmes (EFDP, 2003). According to an EFDP intermediate evaluation report, the budget has been exceeded (Hepner, 2007b) in some categories.

Innovation-related issues are not directly mentioned in forestry policy documents. Most changes (which can be considered as innovations) directly emerging from the policy are related to the organisation and development of the public dimension of forestry. A few measures can be considered to be more or less oriented towards innovation in the private sector. For example, in order to increase the competitiveness of Estonian wood products in the international markets, measures supporting the research of the potential of forest products, programs encouraging the local use of timber and measures prospectively elaborating standards facilitating the use and international competitiveness of timber, funds (in EFDP, the budget of 831 thousand EUR) were foreseen for period of 2002–2004.

In addition, the following allocations were made for 2002–2004:

- 192 000 EUR for the development of a private forestry counselling system (utilizing the environmental authorities of countries and the Private Forestry Centre)
- 64 000 EUR for the formation of a Forestry Education Co-operation Chamber, intended for the development of an integrated forestry education system intended to meet the needs of society, and for the formation of a similar cooperative chamber for the development of forestry research, including the definition of priorities.

In EFDP, the measures enhancing innovation activities can be found in the fields of R&D, diffusion of innovation and strengthening of the knowledge base. However, the strategy concentrates on innovation in the public sector of forestry and lacks sufficient attention to cooperation between the private and public sectors for innovative activities. Since the policy has not included the consideration of innovation processes, it cannot be verified as being linked to either the linear or the systemic model, because elements of both models are not systemically considered in the strategy.

Innovation and Forest Sector in Rural Development Policies.

Estonian Rural Development Strategy 2007–2013 (RDS) is the strategic document for the sustainable socio-economic development of Estonian rural areas. RDS is in line with the main strategy of Estonian development – Sustainable Estonia 21 (Sustainable…, 2005) and other strategic documents. RDS is the follow-up document to the Estonian Rural Development Plan and National Development Plan 2004–2006 (Estonian…, 2004), using experience gained in 2001–2004 from SAPARD programs. During the new EU programming period, 2007–2013, Estonia can use approximately 925.2 million EUR of public sector funds for agriculture, fishery, forestry and rural development. RDS specifies strategic priorities, quantified objectives and complementarities with National Strategic Reference Framework 2007–2013 (National…, 2007). where the more detailed budget for development priorities is specified.

In the context of sustainable rural development and innovation, the main aim of the RDS is to improve the competitiveness of the agricultural and forestry sector, the countryside environment and quality of life in rural areas, supporting local initiatives and co-operation for economic diversification.

The main goals for improving the competitiveness in the rural economy are indicated as follows:

- increase the potential of the enterprises, ensuring direct investments in quality, product development and new technologies; promote co-operation between science and private business;
- develop research and innovation – increase state and private investments;
- create an energy-efficient market focusing on biofuels, renewable energy sources and growth of labour productivity;
- ensure a positive environment for sound development of micro-enterprises as the main job-creators in the countryside;
- promote sustainable use of land and forests, preserve biodiversity and valuable landscapes in the context of diversification of rural economic activities based on local cultural traditions and natural heritage (e.g. tourism & recreation).

Beginning in the early 90's, employment in the agriculture, fishery and forestry sector has decreased more than 67%, and its share in total employment has dropped from 18% to below 6%. To remedy that, the diversification of the agricultural and forestry sector economy has the crucial role in RDS and RDP. In recent years, rural economic diversification has successfully developed and expanded with respect to the rural tourism and recreation sector. In Estonia, ca 65% of accommodations are located in countryside – over 500 tourism accommodations with various tourism products and services were registered, in 2003 (Rural…, 2004).

According to statistics, the income of accommodation establishments in Estonia amounted to 135 million EUR in 2006. The main contributor to the fast growth was domestic tourism: the accommodation sector's income from foreign tourists increased by 5% in 2006, while the income from domestic tourists increased by 47%, 103 million EUR (Tourism…, 2007). Thus, one of the main priorities of the state is assigned to the development of the local tourism infrastructure, in 2007–2013 (National…, 2007). In the state forestry sector, similar trends have already led to positive growth in recreation and related economic activity – during the last four years, the number of the visitors to state forest recreation areas has doubled, reaching 600 000, in summer season (Development…, 2007). While ca 40% of forest belongs to private owners, this segment is lacking such active recreation infrastructure; moreover, private forestry owners remain passive concerning the development of tourism. This is indicated to the weak or non-existent links between the local/forest sector development and tourism/forest sector development policies (National…, 2006).

Taking into account that, of ca 70 000 private forest land owners, 80% own less than 10 ha and less than 1% owns 100 ha or more, innovation (especially R&D) in the private forestry sector is not at the frontier (Estonian…, 2006). The main reasons are low awareness, lack of skills in forest management and lack of financial means for investments by small forest holding owners. Moreover, in recent years, storms in private forests have caused considerable damage resulting in significant economic losses. Therefore in RDP, attention is paid on improvement the economic value of forests – in years 2007–2013, 3000 private forest holdings (30 000 ha) will be supported with 20,4 million EUR.

State support in RDS and RDP is mainly targeted at afforestation activity, training, compensations for NATURA forests management and advisors. The overarching aim of the RDS is to overcome these broader problems, supporting local initiatives and raising the general quality of life in the countryside. To improve competitiveness, in 2007–2013, an even stronger emphasis has been placed on systemic innovation policy.

The support measures are mainly targeted at the diffusion of innovations, improvement of the knowledge base and framework conditions, creation of public demand and the interaction of actors.

The important preconditions for higher competitiveness are seen in improvement of vocational education, life-long learning systems, promotion of R&D spin-offs, creation of the competence centres' network, increasing public investment in new technologies, demand-creation, improving legislation and regulation, *etc*. Special (increased) attention is given to innovation, higher value-added production, training, the advisory system and co-operation with universities. Bio- and renewable energy system development are areas of forestry and agriculture receiving growing support. Within the framework of improvement of the environment and countryside, special attention is paid to the agri-environment, NATURA areas and support for afforestation for private forest owners. However, in the case of private forestry, the latter has only a minor share in the overall text of the RDS 2007–2013, and no specific development programs are identified in this document. Though in RDP, the measures for support of restructuring and modernization are more clearly specified, it is hard to estimate the total share of funds allocated to the forestry sector. The budget breakdowns of forestry-related measures are separately indicated only in some specific cases like afforestation.

Moreover, while there are 11 departments with 28 bureaus in the administrative structure of the Ministry of Agriculture, there are no single executive body or officer positions responsible for the private forestry sector within the ministry's structure. That suggests the institutional weakness of private forestry management at the ministry level, compared to the agricultural and fishery sectors. Since 2001, planning and development are mainly based on the Private Forestry Union's activity, with limited state financial support.

In the context of innovation, the RDS and RDP 2007–2013 reflect a new, higher quality strategic rural development planning compared to the former basic document, RDP 2004–2006. However, in the context of classical R&D support (science-based new technologies, products etc.), innovation remains an issue, among others, that is quite general, without detailed programs in RDS. In RDP, some measures for the forest sector are specified in detail. Concerning the systemic innovation policy approach, i.e. the integration of innovation into different development areas and policies, it holds a more prominent position. Traditional innovation (R&D) is seen as the tool for modernizing food and wood processing and for new technologies in the forestry and agriculture industries.

In analysing the integration of innovation, rural development and forestry-related strategic documents, it appears that the forestry sector is weakly or not at all linked to the development of horizontal rural and tourism policy documents. While approximately 81% of the EU structural funds allocated to Estonia for years 2007–2013 are targeted to support economic growth and competitiveness, forestry is barely mentioned in the context of nature protection and construction in the relevant success report (Action Plan…, 2007).

Overall, innovation orientation is much stronger in the case of rural development than in strategic documents relating to the forest sector. However, innovation is still mainly seen as an issue of human capital (education, training, knowledge diffusion, networking, cooperation) and the development of infrastructure (Internet, transport, construction) in the countryside. A supportive political and economic framework for small business development is seen as the goal. In RDS, the innovation support measures are constructed rather on the basis of a linear approach to innovation.

Concerning the forest sector, RDS is seen as the supportive measure for ensuring the competitiveness of private forestry and the sustainable multifunctional use of forest resources.

Discussion and Conclusion

The inter-textual analysis of policy and strategy documents regarding innovation, the forest sector and rural development fields leads to the following conclusions: First, the innovation strategies of Estonia are not targeted to forest sectors. When seen in the broader context of traditional sectors, some programmes exist but are not integrated into the broader network of sectoral or rural development policies. Second, innovation is not mentioned directly in forestry policy documents. Third, rural development strategies do include the forestry sector, but innovation is not targeted specifically, nor is the terminology in use relevant to forestry.

The synthesis of different policy measures and their orientation towards the forest sector is summarized in Table 3. This conclusion coincides with the results of Rametsteiner and Weiss (2006) pointing to the fact that systematic innovation support does not exist in other countries as well, and that individual measures are rather "*piecemeal, fractioned and often not coordinated*".

With regard to innovation policy, a clear shift towards traditional economic sectors (including forest industries) and additional elements of a systemic approach can be seen. In forest sectoral policy, the strategy concentrates mainly on public forestry, less on the private segment and interaction between those two. (It has to be noted that the contribution of the academic sector has been most weakly represented.)

It is evident from the results that not all the strategies are integrated with each other; even more significantly, they are not aligned to support innovation in the forest sector. As recognised by other authors, the problem is largely generic, reflecting the lack a truly forward-looking long-term development strategy for Estonia (Tiits *et al.,* 2006). Other studies indicate that national innovation policy in Estonia has been targeted towards high-tech enterprises: there are few services that most forest sector firms can use. As a result, many enterprises do not perceive that innovation policy concerns them. Innovation awareness among Estonian entrepreneurs is rather low; innovation is perceived as something high-tech, centred on R&D: distant, and connected with IT, banking and telecommunications rather than with the traditional industries of the economy (Kalvet *et al.*, 2005). This study shows that the orientation of R&D strategy has changed and could alter the situation in the future.

Several aspects not considered in this article are relevant. First, cross-sectoral coordination of different innovation-related policies is almost non-existent in Estonia. Therefore, policy analysis of sectoral impacts would be necessary. Further research is needed regarding interaction between the forestry and tourism sectors and regional and local development. The second partially related to the first concerns the political aspects of strategy formulation. As the policies are coordinated under different ministries (rural development issues are under the Ministry of Agriculture, forestry is controlled by the Ministry of the Environment and innovation is regulated by the Ministry of Economic Affairs and Communications), cooperation between ministries for policy formulation and implementation is necessary, but often influenced by the party membership of the sitting minister. For example, the Ministry of the Environment has had little change in governing party or among top-officials. Most changes in the Forest Acts concern control measures for forest owners' activities, and are contradictory to the aims of innovation policy. According to several anonymous

Table 3. Orientation of Innovation Support Measures across Policies towards Forest Sector Innovation.
Tabel 3. Metsasektori innovaatilisele tegevusele suunatud toetusmeetmed erinevate poliitikate lõikes.

Policy orientation/ aspect according to Bauer & Rametsteiner (2007)	Innovation Policy	Sectoral Forest Policy	Rural Development Policy
Research and Development	Measures existing and from 2007 onward targeted to some extent towards traditional industries	Measures existing, but funding is limited	Measures existing, but not specified for forestry
Diffusion of Innovation	Measures existing and from 2007 onward targeted to some extent towards traditional industries	Measures existing, but oriented towards public sector	Measures existing, for forestry, in RDP: for improving value of forests and adding value to forestry products
Strengthening the knowledge base	Measures existing and from 2007 onward also oriented to traditional firms	Measures existing, but funding limited	Measures existing, but not specified separately for forestry
Strengthening the interaction	Measures existing also oriented from 2007 onward to traditional firms (clusters). However, in some sectors respective academia partners are weakly developed	Measures existing, but oriented towards public actors	Measures existing, but not specified for forestry, in RDS. In RDP, some measures are indicated for the forestry
Demand creation for innovations	No measures	No measures	The need for sustainable use of forest and quantitative goals of increasing labour productivity of forestry are indicated
Improving framework conditions	Measures existing, but not relevant for forest sector.	Measures exist for improving the innovations in public sector.	Measures existing, but not specified for forestry

experts, in recent years the development of the forestry sector in Estonia has stagnated. However, this remains an issue for future studies.

Acknowledgements. Authors acknowledge valuable comments of three anonymous referees, also the COST E51 community for encouraging this analysis and supplying the ideas for methodology used. The financial support from EU 6th framework project CIT5-CT-028519"U-Know", Estonian Science Foundation grants 6493, 6853, Estonian Centre of Environmental Investments forestry project no 17 (2006) "Innovation in Forest Cluster" is also appreciated.

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Innovatsiooni käsitlemine Eesti metsandust mõjutavates strateegiates

Meelis Teder, Kadri Ukrainski, Monika Prede ja Paavo Kaimre

Kokkuvõte

Artiklis antakse ülevaade sellest, kuidas on Eesti innovatsiooni-, metsa- ja maaelu arendamise poliitika omavahel seotud ja kuidas need toetavad innovatsiooni metsasektoris. Metsasektor hõlmab siinkohal nii metsamajanduse, puidutöötlemise, tselluloosi- ja paberitööstuse ning mööblitööstuse, aga ka valdkonnad, mis tegelevad metsa mittepuiduliste toodetega nagu näiteks puhkemajandus. Autorite eesmärk on selgitada, kas majanduspoliitilised programmid ja arengukavad toetavad või hoopiski pidurdavad innovatsiooni.

Vaatamata metsasektori olulisele kohale Eesti majanduses, on selles majandusharus, eriti aga metsamajanduses ja mittepuiduliste väärtuste kasutamisel, pööratud innovatsioonile üldiselt vähe tähelepanu. Empiirilistest uuringutest selgub aga, et metsanduses on innovatiivsete ettevõtete kasv kogu majandust silmas pidades siiski suhteliselt kiire. Samal ajal on sektoris väga vähe kasutatud teadus- ja arendustegevuseks mõeldud riiklikke vahendeid, aastatel 2004–2005 olid erandiks mööblitööstusettevõtted (Tiits, 2007).

Puitu töötlev tööstus kasvas pidevalt alates 1995. aastast, saetööstuse tootmisvõimsused saavutasid maksimumi 1999. ja 2000. aasta raiemahu toel. Kuna pärast seda on raiemaht oluliselt vähenenud, ületab tootmisvõimsus kodumaise ümarpuidu pakkumise ning Eesti on muutunud ümarpuidu netoimportijaks. Tooraineprobleemi lahendamiseks otsivad puidutöötlemisettevõtted innovatiivseid lahendusi nii tehnoloogia kui tooraine kasutamise osas.

Sarnaselt mitmete teiste siirdemajandustega, ei ole ka Eestis erinevate poliitikavahendite mõju nende lühikese rakendamisaja tõttu hinnatud. Seepärast on käesolevas uurimuses kesksel kohal strateegiliste dokumentide tekstide omavaheline võrdlemine, selgitamaks nende seotust innovatsiooni ja metsandusega. Hinnatakse, kas strateegilised dokumendid käsitlevad innovatsiooni lineaarselt, s.t. on suunatud majandussektorite ja teadusasutuste ning nendevaheliste seoste toetamisele või süsteemselt, s.t. sektoriteüleselt toetades võrgustikke ettevõtete vahel, institutsioonide loomist jne. Analüüsitud dokumendid saab jagada kolme suuremasse valdkonda: innovatsioon, metsandus ja maaelu.

Eesti innovatsioonistrateegia jäljendab teiste riikide strateegiaid, keskendudes info- ja kommunikatsiooni-, bio- ja materjalitehnoloogiale ning pöörates vähe tähelepanu majanduse olemasolevale struktuurile. Enamik metsapoliitika dokumentides käsitletuid innovatsioonidest keskendub organisatsiooni arendamisele avalikus sektoris, erasektor pälvib tunduvalt vähem tähelepanu. Uurimusest selgus, et kõigis strateegiates on meetmed, mis toetavad innovatsiooni metsasektoris, kuigi neid sageli ei käsitleta otseselt innovatsioonina. Senine kõrgtehnoloogiale orienteeritud teadus- ja arendustegevuse strateegia on muutunud sisaldades meetmeid innovatsiooni toetamiseks traditsioonilistes tööstusharudes. Samas ei ole innovatsiooni käsitlemine erinevate majandussektorite (metsandus, turism, maaelu) arengustrateegiates piisavalt koordineeritud.

Received July 5, 2007, revised August 21, 2007, accepted October 25, 2007

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Bouriaud, L., Kastenholz, E., Fodrek, L., Karaszewski, Z., Mederski, P., Rimmler, T., Rummukainen, A., Sadauskiene, L., Salka, J., **Teder, M.** 2011. Policy and market-related factors for innovation in forest operation enterprises, in: Weiss, G., Pettenella, D., Ollonqvist, P., Slee, B. (Eds.). Innovation in Forestry: Territorial and Value Chain Relationships. CAB International, pp. 276–293.

16 Policy and Market-related Factors for Innovation in Forest Operation Enterprises

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Abstract

Micro-, small and medium-sized enterprises (SMEs) carry out most of the forest harvesting activities all over Europe. They often act as service providers only and do not own land or wood-processing capacities. They are under pressure from the bargaining power of the wood suppliers (the forest owners, regulating the access to the resource) and the bargaining power of the customers (timber-based industries, regulating the access to the global markets). Innovation in technological development or in business practices is required to improve the situation of forest service enterprises in a difficult market. This chapter studies eight cases of innovation, which have been identified in micro-, small and medium-sized firms in the forest harvesting sector in central and eastern Europe. The aim is to identify the market and policy-related conditions of innovation. It was asked whether there is a relationship between the innovation-related policies and the market in which the firms operate and innovate. It was also of interest to explore if any market-based mechanisms have helped the firms to implement innovation, and if any policies created enabling conditions for innovation. The results suggest that most innovation policies have not yet led to a considerable uptake of innovation among forestry contractors. The innovations that could be identified are mainly incremental applications of already existing technical solutions, and in some cases departing from and/or embarking on additional tasks and new product markets. These innovative activities can be characterized as reactions to market developments and customer demands. There is, moreover, a need for supporting investment in technical innovation in forest operations; for reacting to the increasing demand for harvesting and transport capacities; and for curbing the forecasted lack of workers in many countries. At this stage, a higher degree of mechanization cannot be achieved without public support of investments. An even more important political goal should be to build up or maintain the capacities for support, training and commercial advice of SMEs to develop further the human resources and entrepreneurial capacities needed.

16.1 Introduction

Most forest operations in Europe are carried out by micro-, small and medium-sized enterprises (SMEs), which are firms with up to ten workers or, respectively, 25–250 workers according to EU Recommendation (2003). They typically offer services in harvesting or in other forest operations such as silviculture, forest improvement, biomass harvesting, road

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transportation and ancillary forestry-related services. Statistical information or scientific studies about this sector are rare. A rough estimation shows that some 50,000 mainly small enterprises employ a workforce of about 250,000 people, which today forms the bulk of the professional forest workers in European forestry (ENFE, 2008). A huge difference can be observed in the degree of mechanization of forest harvesting. It greatly varies from 97.5% in northern Europe, to 72% in western central Europe, down to 3% in eastern central Europe. In areas where mechanization is used, the average age of the machines rises from the north to the east: from an approximate average of 4 years of age in Finland to some 15 years of age in eastern Europe, where even timber lorries that are older than 40 years can be found (COMFOR, 2008).

However, SMEs in forest operations all over Europe have a number of issues in common. Contrary to the ambitious goals for the development of rural areas and the sustainable use of forest resources, policy makers do not seem to pay much attention to the precarious situation of most of the forest operation enterprises in Europe. These businesses struggle, their margins being very low. Because of their size, their low capacities for investing in technologies, and so their limited or weak participation in technology transfer, SMEs are the weakest and most vulnerable link in the global and internationalized forest-based value chains. Furthermore, they are more and more under economical constraints with the increasing requirements to undertake environmentally friendly forestry work (Brogt *et al.*, 2007). In addition, small sole traders may raise a serious problem in terms of competition to larger enterprises because they can dramatically lower the price level of services (Austroprojekt, 2008).

The regulatory framework of forest management and of forest harvesting activities entails high transaction costs (e.g. the fragmentation of forest operations hinders the economies of scale, yearly contracts increase uncertainties, natural hazards, including weather conditions, increase the risks, etc.). Neither forest owners nor industrial processing companies are willing to deal with such costs and they convey them down the chain towards the forest contractors. The sector is usually subject to high competition and to pressure on service costs. Timber procurement markets are often based on yearly contracts and the policies for timber procurement may change from one season to another, hampering investment prospects.

Moreover, looking at the forest-based value chain, contractors are tied in between the forest owners, the timber trade and wood processing industries (Westermayer, 2006). They are continuously under pressure from the bargaining power of the suppliers of the raw material (the forest owners, regulating the access to the resource) and the bargaining power of the customers (timber-based industries, regulating the access to the global markets). With increased business competition, innovating in technological systems or in business practices could help SMEs to improve their situation and the forest-based value chain as a whole. While the business of micro-, small or medium-sized forest contractors is precariously balanced, gaining competitive advantages through new technologies or services is not only a matter of profit or gaining markets; it is a matter of survival.

Innovation, in general, has a particular importance because it represents a major response to intensifying competition by enhancing the learning abilities of firms and workers (Lundvall and Borrás, 1997). Innovation is more challenging in SMEs than in larger firms. SMEs generally have fewer resources at hand and spend less on research and development (R&D), they are also faced with more uncertainties and barriers to attain innovation. At the same time, relations to science and technology transfer are rare and SMEs make only a limited use of the full potential of their respective regional innovation systems (Tödtling and Kaufmann, 2001). SMEs rarely interact with universities, contracting research organizations or technology centres and training institutions (Kaufmann and Tödtling, 2002). To innovate, SMEs rather use tacit knowledge, get support from local networks and common learning, local institutions and resources (Malmberg

and Maskell, 1999; Lewark *et al.*, 2010), or they rely on customers in directing their innovations (Tödtling and Kaufmann, 2001). Some studies also reveal the importance of learning by doing while innovating among service performing firms, which differs from innovating in manufacturing firms (Pires *et al.*, 2008). Thus, SMEs can be innovative without having a specialized R&D department, and, more generally, without strong connection with R&D infrastructures.

This chapter focuses on the development of innovation in forest-related SMEs. The factors, or mechanisms, that facilitate innovation within the firm are market-related and policy-related, according to a classification inspired from the Porter's five-force model (1979). A change in any of these forces (threat of substitute products, threat of established rivals, threat of new entrants, bargaining power of suppliers and bargaining power of customers) normally requires a business unit to re-assess the marketplace. This represents a key moment for seizing innovation opportunities. Two main questions guide the study of innovations in the sector:

- Is there a relationship between the market in which the firm operates and the innovation? Which market-based mechanisms have helped or pushed the firm to implement the innovation?
- Is there a relationship between the policies fostering innovation and the innovation in the firm? To what extent have policies helped or created enabling conditions for innovation?

In the attempt to explain how and why innovation appears, this chapter presents eight cases of innovation in micro-, small and medium-sized firms performing forest operation services in Germany, Lithuania, Poland, Slovakia and Estonia.

16.2 Analytical Frame

According to Tödtling and Kaufmann (2001), innovation implies 'modifications and improvements of products or services, changes in a firm's range of products or services, as well as adopting or developing new technologies'. Innovation is also identified as the implementation of a new or significantly improved physical or service product, a technological process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations (OECD, 2005). Because of the particularities of the SMEs in forest contractors' work, innovations in this sector are seldom new to the market as a whole. In this study, innovation is defined as any change in the firm's range of products or services or any technological development that will have a positive impact on the firm's daily business. Such a wider interpretation of the concept of innovation, which still stands in the frame of Tödtling and Kaufmann (2001) and OECD (2005) definitions, draws the attention to examples of innovation that may be considered as well as merely strategic changes when firms are affected by market conditions. But in the strong competition and regulatory frame of the sector, strategic orientation may ensure competitive advantage and market survival.

Innovative activities of SMEs can be related to products, processes, research activities and resources, especially human resources (Tödtling and Kaufmann, 2001). To ensure the successful implementation of a new innovative idea, the concept should, first of all, be feasible, operational and possible to implement in practice. Secondly, the concept should be viable from an economic point of view. Finally, a successful innovation requires personal involvement, effort and trust in its successful outcome (Drucker, 1998).

The driving forces behind innovation can be the rent-seeking behaviour of the owners, who invest in innovation with the aim of making a profit, but also the policies that create innovative opportunities and that foster the capability of firms to exploit new business opportunities and enhance competitive advantages. Very often, developments depend on the financial contributions of the owners, but also on policy (Kaufmann and Tödtling, 2002; Lundvall and Borrás, 1997). As Drucker (1985) states, sources to innovate arise from different challenges and opportunities both within and outside the firm. What

should be retained is that high-impact innovations are the result of a 'discipline' to innovate – a continuous effort inside the firm to look for innovation, yet sometimes the innovation requires years to yield results (Drucker, 1998).

An explanation of how innovation occurs in an SME is offered by the interactive model of innovation. Innovation is conceived as a process of *interactive learning* in which a wide array of institutional mechanisms can play a role (Lundvall, 1992). Learning occurs in the relationships between the firms and the basic science infrastructure, between different functions within the firm, between producers and users at an inter-firm level and between firms and the wider institutional environment. In this context, the market position of a firm, new technology, new entrants and industry competition, learning and adapting inside the firm all lead to innovations (Porter, 1979). Tödtling and Kaufmann (2001) describe four main characteristics of the interactive model of innovation:

- Innovation is considered an interactive process: inside firms and with other firms and organizations.
- Knowledge is the most important resource for innovation, brought forward by R&D, marketing, distribution, production and other activities.
- There are various kinds of actors involved in the innovation process that interact in innovation systems, mainly: customers, suppliers, competitors, service firms, universities and research organizations, technology centres and transfer organizations, finance and training organizations.
- The exchange of tacit knowledge is particularly favoured by face-to-face contacts and by spatial proximity.

Porter's five-force model (1979) has been used to figure out the relation between the firm, policies and markets. Among the many potential factors for innovation, the market position of the firm, the business and cooperation network and industrial relationship, on the one hand, and policies, on the other hand, have been analysed.

The market position of the firm is defined by customers, competition and the position in negotiations for prices, participation in decisions and participation in the wood supply chain.

Policies are considered under the aspect of general existing policies relevant for enterprise development, and policies that have specifically helped or hindered the implementation of the innovation in the firm.

16.3 Methods

To identify the driving forces of innovation, this chapter uses a case study approach. The description of the innovation itself and the process of the innovation are put in the context of the characteristics of the firm in terms of market position, human resources, technical equipment, social relations in the enterprise and policies affecting the development of the firm. Timber procurement services for industrial users are the most important single markets for forestry contractors, whose activities are led by a business-to-business logic frame. Therefore, enterprise characteristics, technology development, market position, barriers to market entry and the role of institutions have been examined especially from the point of view of timber procurement markets.

An exploratory case study approach (Yin, 1994) was considered suitable to understand how innovation is implemented and how it appears in the firm. Different geographical and policy contexts are described in the case studies. The data collection protocol was established in 2008 and implemented during 2009. The protocol contains procedures and general rules such as:

1. Overview of the case study investigation (objectives, issues, topics being investigated).
2. Field procedures (rules of the interviews, sources of information).
3. Case study questions (specific questions to be asked).
4. A guide for case study report (Yin, 1994).

The unity of the analysis is centred upon innovation in the firm. The innovation needs to be new to the firm and to comply

with the definitions provided by Tödtling and Kaufmann (2001) and OECD (2005). The guidelines for the case studies take into account the selection of the firms (and, if possible, the innovations) that should be as typical as possible for the forest sector in the country. The data collection has been structured into four main parts:

1. Description of the enterprises, their business environment, changes ongoing therein and the resulting pressure for the firms to innovate.
2. Information about the situation of typical forest operation enterprises. The description covers the role and position of typical enterprises in terms of activities, resources, social relations and sources of competitive advantage, their position in the market and their role in the wood supply chain.
3. Policies fostering innovation, as mentioned by the representatives of the firms in the data collected.
4. Description and evaluation of an innovation process in terms of fostering and impeding factors and policy support.

The information about the innovation case was collected by semi-structured interviews with owners of the firms or other representative and, in one case (Germany), as an expert assessment based on a number of interviews and enterprise observations. The interview addressed standard questions related to the given protocol and data collection. All information provided during the course of the interviews was, however, recorded. Thus, as the study of the innovation among forest contractors is only in an incipient phase, it was essential to collect as much information as possible about past or ongoing innovation processes, keeping in mind that the case studies should offer the opportunity to maximize what could be learned in a limited time period (Stake, 1995).

16.4 Results

16.4.1 Overview of the case studies

The firms that were analysed are different in size, yet all except one are still within the range of micro- and small-sized enterprises (Table 16.1).

Apart from two exceptions, the firms operate on local or regional markets. Access to the market is mostly tender based, with 1-year-maximum contracts.

Policies fostering innovation in the case studies were based on the entrepreneur's

Table 16.1. Key aspects of the studied innovation cases.

Case study	Size of the enterprise	Access to the market	Type of market
Entering bio-fuel harvesting (GE)	4–5 employees, and the owner (family)	More and more tender based	Local, but expand because competition
Purchasing a forwarder (PL)	5 workers	Tender, state forests	Local
Purchasing a harvester (LT)	24 and the owner	Tender, state forests	Local, around 50 km
Custom-made logging tractor (SK1)	Division of bigger firm, 20 employees	Tender, negotiations, salvage timber market	Regional, all forests, and abroad
Packing timber for conservation (SK2)	Division of bigger firm, 36 employees	No tender for packing timber	National, military forests, abroad
Purchasing a logging tractor using subvention system (SK3)	22 employees, plus 15 sole traders	Tender, negotiations	Local and regional, occasionally abroad
New uses of the harvester (EE1)	10–12 employees plus 10–12 sole traders	Tenders in state forest, negotiation	Local, 30–50 km
Use of forwarders out of season (EE2)	4–5 permanent and sole traders as needed	Tenders, negotiations	Regional (Estonia mainland)

perception of the issue. In general, the firms' representatives were not aware of policies fostering innovation except when they applied for financial support in the frame of specific policies. However, at the EU level and then at the national level, some policies may stimulate innovation in the forestry contractors sector, e.g. the European Regional Development Fund – Regional Operational Programme, or EU Rural Development Policy 2007–2013, energy efficiency policy for increasing the supply of energy from bio-energy sources by 20% until 2020, or forest/nature conservation-specific policies to enhance biodiversity protection.

16.4.2 Description of the case studies

Case study 1 – Germany: Entering bio-fuel harvesting (GE)

The German case describes a typical forest harvesting enterprise for the region. A number of interviews were carried out in previous studies by researchers at the University of Freiburg. The main activity is timber harvesting and transport (skidding) to the roadside. Mechanized systems have become the leading system. Silvicultural works (planting, clearing, pre-commercial felling) are carried out but represent a small share of the overall turnover. The enterprise employs four or five workers. Occasional higher workload is handled by using sub-contractors or partner enterprises. All members of the enterprise are able to work both on machines and motor-manually. However, the harvester operators and forwarder operators do not rotate. Management is the task of the owner. Office work is mainly carried out by the owner's spouse. The main equipment is a harvester–forwarder system. The enterprise has two harvesters (one new, one used) and one forwarder. When one of the machines is written off and when it is replaced, the most recent technical generation will be bought. If in the past machinery was mainly one's own capital, more and more machines are financed by bank loans. New investments will be facilitated by increasing offers for leasing machines. There exists a traditional relationship (both private and public) with forest owners in the region where the enterprise is based. Competition in the region, but also from outside the region, encourages the contractor to take on contracts outside the region to maintain a decent utilization rate of men and machines.

INNOVATION. An important innovation for the firm was the entry into bio-fuel harvesting. The market for forest harvesting services is becoming saturated, prices are falling and competition is increasing. This has resulted in enterprises searching for additional sources of revenue. Bio-fuel is seen as profitable. Innovation is implemented by purchasing a chipper and by making efforts to find and sign contracts with larger customers, such as pellet producers and/or local heating plants. Also, contacts with local forest owners and communities are made in order to negotiate the demand and supply. The owner considers shifting more capacities into this sector in the future.

MARKET. In the wood supply chain, the general procedure is that the contractor gets a contract for harvesting the timber, which is marked by forest owners or foresters. The timber is forwarded to the roadside. A different enterprise carries out the haulage to the customer. There is generally no direct business relationship between the harvesting enterprise and the hauler. The enterprise is paid by the forest owner and the hauler by the timber buyer. The main customers are the forest owners in the region, approximately within a radius of 100 km around the base of the enterprise. Occasionally some contracts are signed beyond the region. Buying and harvesting standing timber is a rare business. It can be done but it is considered occasional. The market in this case is local or consists of suppliers of large industries with a local base. Competition has been increasing particularly after the recent storms. Now the timber demand has dropped. Contractors offer services all over Germany. New entrants, who dramatically underbid cost-covering price levels, have penetrated local market relationships. More

and more contracts are based on tenders. Yet, some contracts are still negotiated directly by the contractor with the forest owners. In these cases, the negotiation power is weak or non-existent. This is further enforced by an increasing pressure from competitors. The participation in the decision regarding timber procurement policies does not exist. The enterprise is hired to do the harvesting operations and its job is limited to that.

POLICIES. Within the institutional framework, there are no evident factors to foster development but also no real barriers. The hindering factors are related mainly to market situations. Industrial relations are poor, because there is no direct supportive structure in the customer relations (e.g. contractor empowerment by industries). In the case studied, the policies did not support the innovation.

Case study 2 – Poland: Purchasing a forwarder (PL)

This enterprise is a typical enterprise for Poland, undertaking harvesting, forwarding, silviculture and forest protection operations. It is a micro-enterprise with five employees, specialized in forest and transport operations, engaged as machine operators (of chainsaw, forwarder and tractors). The equipment consists of five chainsaws, two used agricultural tractors, one used forwarder and one plough. The company intends to and has even started to embark on new technologies by exploring available products, such as harvesters. In general, forest operation companies work rather separately, with little business partnership. Since 1992, an Association of Forest Entrepreneurs (SPL) has provided mutual assistance to contractors in the country.

INNOVATION. For years, harvesting and logging were performed using chainsaws and agricultural tractors. Recently, the problem of finding new forest workers has arisen because of difficult working conditions. Thus, the owner of the Polish enterprise made the decision to invest in a forwarder. After getting an interesting offer from a machinery supplier, a used forwarder (3 years old) was rented for 1 year, and a leasing contract has been signed for the next 4 years. The seller of the machinery also provided information, technical support and training of the staff. The cooperation with the machine supplier has been a fostering factor of innovation. In fact, the entrepreneur built up a good releationship with the machine supplier. The owner of the firm expected more support from the state forests to implement the necessary organizational changes in harvesting and forwarding.

MARKET. The biggest customer is the state forests, with early-based tenders. The local market is usually in the area of one or two forest districts. Usually, the contractors who work in one forest district do not compete with each other, keeping a local *status quo*. When one firm wants to develop, it must compete fiercely with small companies. The winner often hires the losing tenders as subcontractors. Business cooperation and participation in decision making regarding the timber supply/timber procurement market is rather weak. Meetings with the contractors are organized only by forest districts. These are mostly carried out to exchange information, but they do not to give a real opportunity to participate in decision making processes concerning further harvesting operations.

POLICIES. Occasionally, a company can get support for the training of new employees, e.g. for chainsaw operator courses. After that, the contractor has to guarantee a workplace to the qualified entrants for some period. However, there was general support from the main partner, the state forests national company, for introducing new methods of harvesting, e.g. switching to cut-to-length systems. For example, in the period 1994–2003, the state forests national company helped enterprises financially to purchase special machinery for forest operations, though they no longer

do so at present. Nevertheless, owning new machinery offers tenders advantages in the tenders in forest harvesting services. The impacts from policies regulating timber harvesting and yearly based tenders were further mentioned as negative factors.

Case study 3 – Lithuania: Purchasing a harvester (LT)

In the case of Lithuania, the activities of the firm cover the whole wood procurement chain, mechanized and manual (with chainsaws) wood harvesting, mechanized forwarding, timber trade and road transport. The income from wood production amounts to about 55% of the total turnover. The firm has one (new) harvester–excavator, two self-loading trailers for wood harvesting, and one truck. The owner of this enterprise and his wife (as bookkeeper) do the main part of management work. Harvester and forwarder operators have a tractor driving licence but did not attend any special courses for harvester or forwarder operators.

INNOVATION. Three years ago a lack of forestry workers (especially chainsaw operators) encouraged the owner to buy a harvester as he had a harvesting contract with the state forest enterprise. At that time, there were only a few harvesters in Lithuania. The use of harvesters was an innovation to the firm and a new development in Lithuania. The enterprise doubled the harvesting volume after purchasing the harvester. To implement the innovation, the owner of the enterprise consulted with the supplier of machinery. The investment was completely private.

MARKET. The enterprise participates in tenders for timber harvesting services mostly in state forests. The winner of the competitions is the enterprise that offers the lowest price for timber harvesting. Additionally, this enterprise buys timber from the state forest enterprises as well as from private forest owners and sells it to customers. The enterprise has a long-standing relationship with one state forest enterprise, but the enterprise must participate in the bidding for tenders each year. The enterprise works on the local market, about 50 km around the base of operations. Having enough volume of work in a very compact area provides some advantages in relation to competitors. The owner states that there is a high level of competition in the field of timber harvesting because of an oversupply of forest operation services. The enterprise does not participate in the decision-making processes related to forest harvesting services. In some cases, the enterprise participated in seminars where the requirements of legal acts were discussed. The owner of the enterprise has a negative opinion of cooperation with or participation in any business network.

POLICIES. There are some political programmes dealing with innovation but they do not have any impact on forest enterprises. The answer of the interviewee was 'we would like politicians not to disturb us'. No state policy or support measures for cooperation of contractors were reported.

Case study 4 – Slovakia: Custom-made logging tractor (SK1)

The Slovakian enterprise was established in 2001 (and the forest-timber division was founded in 2005). It is one of three enterprises in the country that processes more than 100,000 m^3 of timber annually. The enterprise is divided into three departments: (i) forest-timber; (ii) transport; and (iii) pellet production. The forest-timber division has its own technician and production manager. The forest-timber division represents 14% of the total turnover of the enterprise. The division performs various forest services: timber felling by an assortment of methods using harvesters and a processor cableway; picking, transport and processing of biomass for energy use; and public services on water courses. Timber is mostly sold at the skid way. One of the main trends in this business area is the merging of firms that provide forest services with timber-processing firms. In its cooperation and business network, the enterprise concentrates on processing salvage timber felling. In buying

and improving the forest machinery, there is a close cooperation with a machinery producer. Long-time businesses are established with some wood processing firms. The firm also cooperates well with municipal forest associations of the Slovak Republic.

INNOVATION. The enterprise bought an innovative, custom-tailored tractor with a 50% subsidy of the tractor's price based on an assessment measure from National Strategic Plan for Rural Development 2004–2006 (axis 2.1 – improvement of the economic value of forests). The idea of innovation appeared when the owner was faced with the lack of qualified workers for animal skidding. The tractor was ordered on the basis of the enterprise's concrete requirements resulting from practical experience. The innovation is based on foreign R&D done by the machine supplier. This tractor is new, not only for the enterprise, but also for the entire Slovak market. The first orders of this tractor indicate its potential for a wider application in Slovak forests. It could provide advantages against competitors as it can be perceived as an environmentally friendly skidding tractor as far as it gets close to horse skidding. The main actor of this innovation was the director of the forest-timber division. After consultation with the workers, he concluded that small tractors with a long cable can effectively skid timber in Slovakian terrain conditions. The director addressed the machine supplier with the question whether it would be possible to conceive a tractor with a 200-m cable. Practical demand and experience were the sources of this innovation, rather than research. The fostering factor of the innovation was at first the subsidy provided via the Agriculture Paying Agency, covering 50% of the price of the tractor. The next positive factor was the long-term and good cooperation between the firm and the machine supplier, e.g. at exhibitions the firm presented the machine supplier products for free. One of the impeding factors was a lobbying action of the environmental NGOs, who favoured animal skidding against machines. The other impending factor for further investment is that the subsidy from structural funds is limited to SK 200,000 and can be provided only once in 3 years.

MARKET. Generally, the activities of the firm are located in forest districts with occurrence of calamities in recent years. Competition among over-regional tenders is relatively high, thus the forest division has built its competitive advantages by investing in equipment, qualified operators, experience in working abroad and quality of services – clean, undamaged, correctly measured assortments delivered to the skid way. The biggest customers are state forests.

The competitors are a branch of one forest machinery supplier and foreign competitors coming from the Czech Republic, Austria and Germany. The supply of forest services is sufficient, but most firms or sole traders use old, ineffective and not very ecological machines. In fact, the quality of forestry work is not very high, and herein lies the competitive advantage of the firm. The firm plays no part in making decisions, because decision-making processes about procurement policies can be significantly influenced by state forests only, and the situation is not likely to change.

POLICIES. Some policies could help the enterprise if the firm was able to apply for financial support, although the firm representatives consider the whole process as requiring too complicated procedures. Thus, the firm has directly benefited from provisions of the Council Regulation (EC) No. 1698/2005 (National strategic plan for rural development SR 2004–2006, axis 2.1) and from the provision of the Act of the National Council of the Slovak Republic No. 239/2001 regarding 'red diesel' that is subject to lower taxation (11.5% cheaper than normal diesel). Red diesel can be used by a registered subject only and only for machines working in agriculture and forestry. Procurement policies are perceived as barriers because they are inflexible and slowly implemented.

Case study 5 – Slovakia: Packing timber for conservation (SK2)

The firm was founded in 2003 as a branch of a bigger firm. It provides various services: soil preparation; afforestation; slash cleaning;

plant protection against game, insects, weeds, rodents; fungi control; forest tending; harvesting operations; advisory service, including forest management expertise; biomass collection, including the purchase of standing timber, etc. The technical equipment is modern and relatively new. The firm faced problems with finding qualified staff for operating a cableway. As much as possible, the firm is trying to integrate the whole timber value chain, from stump to mill, even if sometimes the firm has to contact other sawmills in order to process all the timber bought or cut. The enterprise further wants to expand timber transport and timber trading. Besides, the firm has rented some forest land. Although the enterprise is cooperating with few sole traders, it does not force its own employees to turn into sole traders, like many other enterprises in Slovakia do.

INNOVATION. The innovation is based on foreign R&D. The idea of innovation comes from the situation of over-supply of unmarketable timber after a calamity. One of the solutions is to conserve the timber following a development by German foresters after the Lothar storm in 1999. The logs are packed airtight in a customary silage film and can be conserved up to 5 years. The method is brand new in Slovakia, and implementation seems to be difficult. The innovation was achieved with private investment sources.

MARKET. The enterprise is already relatively well known on the market and active in the whole of Slovakia on both local and regional markets. The biggest advantage against its competitors is the fact that the firm holds several sawmills and contracts with some other sawmills, which enables them to guarantee the customer that the harvested timber will be bought.

POLICIES. The innovation case does not depend on any direct influence from policies.

Case study 6 – Slovakia: Purchasing a logging tractor through a subsidy system (SK3)

The firm was founded in 2005. The forest services provided are: timber felling and skidding; planting new forest stands; and services connected with treatment of forest stands. The firm has some experience of working in Poland, but not on a large scale. Long cooperation exists with one timber processing firm. The technical equipment is relatively new, but no innovative technologies are implemented. The main trends in this business area are the lack of effective personnel able to work with forest cableways and the rising demand of fuel-wood in the future. The enterprise plans to enlarge its machinery endowment with a new logging tractor.

INNOVATION. The enterprise is waiting for its application for a subsidy to be granted in order to buy a new logging tractor. The main innovative ideas were about light forest cableways. The director tried to obtain more information about them but he did not find what he was looking for. Therefore, the enterprise started with applying for a subsidy to buy a new tractor, also with the idea of further increasing the production capacities of the firm. It was the first time that the firm tried to obtain a subsidy; all the other machines had been bought with their own resources. What was new for the firm was not the fact of buying one tractor, but the fact that they were granted external financial support and the fact that they outsourced the application work. The application had been elaborated by a consultancy firm and sent to the Agricultural Paying Agency. The owner of the firm appreciated as a fostering factor the professional approach of the consultancy firm and its troubleshooting ability to write the application. The main impeding factor was the lack of properly provided information at the level of Agricultural Paying Agency.

MARKET. The firm works on local and regional markets. In the region, the firm is one of the biggest in its business area. Competitive advantages come from the good level of mechanization on the local scale, and a high productivity of skilled employees. The main competitors are small sole traders, who own old, un-ecological machines. They are able to push the prices for their services dramatically

down. Actual market trends are indicating that customers will be looking for more effective (e.g. smaller damage on standing forest stands) and more ecologically sound services (smaller contamination of forest soil by oil products). The enterprise has no opportunity to participate in decision-making processes about procurement policies.

POLICIES. Some policies, which are generally relevant for the firm's development, are mentioned in the case study. In the present case the enterprise attempted to get relevant financial support within the frame of Council Regulation (EC) No. 1698/2005 (National strategic plan for rural development SR 2004–2006, axis 2). The main institutional barrier was the fact that the APA (Agricultural Paying Agency) was not able to provide the relevant information properly or in a timely manner. One other barrier was the fact that the enterprise had to own, or had to rent, at least 10 ha of forest to get the subsidy.

Case study 7 – Estonia: New uses of the harvester (EE1)

The firm established in 2003 is situated in the south-west of Estonia. Until 2003, they dealt with forest operations only, mostly felling and skidding trees to the roadside in state forests (State Forest Management Centre – RMK). In 2003, they diversified their activities to include maintenance services and infrastructure work using their bulldozer equipment, as well as dump truck services since 2005. At present, forest services represent 40% of the turnover. The firm offers mainly felling and skidding services to the roadside, with occasional roundwood transportation by subcontractors, afforestation services or digging forest ditches. Cooperation and business networks are not strongly developed. In forest harvesting operations, the firm has only two main partners: RMK and StoraEnso. Because of strict requirements in RMK tenders, the firm has no direct access to the RMK forests, except via subcontracts with other companies, who have won RMK tenders for forest harvesting operations.

INNOVATION. In 2006–2007, the firm found new uses for the forwarder in the low season, e.g. recovering a former wasteland/garbage area, destroying beaver dams on forest ditches, and forest ditch soil/earth digging for reconstruction or cleaning old ditches. Everything was done at their own initiative, based on intensive exploration of opportunities – researching on the Internet, reading different procurements of tenders, making projects and trying to implement them.

MARKET. In forest harvesting operations, the firm operates only in Estonian markets, within a radius of 30–50 km from its home location. High competition exists, especially after 2005, when annual Estonian allowable cut decreased by nearly half. Also, the tax system for forest owners makes them harvest smaller volumes of timber now. In the state forest tenders, the prices for forest operations have sometimes been extremely low, to the point where outsourcing was carried out to avoid too high costs linked to the use of their own machines. In this way, the firms have been working in the state forests as subcontractors for other companies. Generally, the owners cannot participate in decision making about timber procurement, which implies that the situation is 'take the job or leave it'. At the same time, one of the company owners is very active in different lobbying activities; he is a member of the board of various organizations, like local forest owners' association, so that he can influence some decisions.

POLICIES. Specific policies directly related to the firm innovation have not been recorded in this case study. Indirectly, the firm is influenced by transportation restrictions. Another limit is related to the use of specially marked (blue colour) agricultural diesel fuel that is cheaper, but its use is not allowed in forests and forest machinery, e.g. harvesters in forests and fork-lifts in sawmills.

Case study 8 – Estonia: Use of forwarders out of season (EE2)

The firm is situated in the south-east of Estonia. Until 2002, all the turnover came

from forestry operations (felling and skidding), but the firm has evolved, and in recent years (2008–2009) only 20% of the turnover has come from forestry operations, the remainder resulting from participation in landscaping and infrastructure works. In the forest market, the entrepreneur works with the Estonian private forests only. Lately, the forest market has developed towards the use of the felling residues (mostly from mixed forest) to supply combined heat and power production units. If the use of wood for electricity production is an innovation in Estonia, it is the same for the collection of branches and felling residues. In forestry-related areas, the firm is not a member of any network, but it is a commercial partner working for larger forestry companies (such as StoraEnso) and small private forest owners. In landscaping and infrastructure activities, the firm is a member of some business networks. The owner is also a member of the local private forest owners' association.

INNOVATION. Innovation appeared accidentally, when once in the low season the firm was asked to do roadside fortification. In the beginning they used a lorry and manual work and they soon realized that the efficiency was not very high. Within 1 week, they solved the problem of low efficiency by starting to use forest forwarders. Later, harvesters were also used for different types of work. Since then, in low season the forestry machinery (forwarders and harvesters) is used for roadside slope fortification and other landscaping activities, which might take place during road reconstruction or the building of new roads.

The regulation on the use of blue, cheaper diesel fuel now appears as an impeding factor. This fuel can be used in agriculture on the condition the machines stay on properties and are not used on public roads. In forestry (especially concerning forwarders), the use of cheaper, agricultural-intended diesel has always been a problem. On top of that, the recent changes in labour-related legislation do not allow working in 24-h shifts. Working contracts with employees have to be changed to adapt to this regulation, yet the practice up to now was that in wintertime employees worked long shifts, compensated by longer summer vacations.

MARKET. The firm is operating mostly locally. In the forest sector, there is a very high competition. In road construction and landscaping-related activities, competition exists, but it is not as high as in forestry. In infrastructure works, the partners of the firm are big road construction companies, winners of public procurements competitions in the area. The firm has worked with them all over Estonia.

POLICIES. There are no specific policies for innovation in this case. Generally, the forestry contractors and machine owners are faced with financial difficulties when they must stop work because they have to pay their loans for leased machinery. Surviving in summertime pushes for inventive solutions as the firm developed in entering the infrastructure market activities.

16.5 Discussion

16.5.1 Categories of forest service enterprises

The central element of analysis in this chapter relates to innovation among enterprises performing forest operations. Each enterprise was selected to ensure that it was representative of the sector in its region. No attempts were, however, made to determine the representativeness of the firm for the whole domestic sector. The results of this suggest that there is a further demand for a typology of forestry contractors. It may be suggested that further analysis should consider the following strategic categories of forest contractors in Europe:

1. Large highly mechanized firms operating nationally. Tender-based contracting, eventually subcontracting in the case of high work volume.
2. Medium-sized firms with niche market focus. Direct contact with customers and

tender-based contracting, subcontracting if needed.
3. Small firms with high specialization. Local market contract, local tenders, participate as subcontractors for larger firms.
4. Medium or small-sized firms with a diversified market focus.

16.5.2 Type of innovation

Most of the innovations described in the cases are mainly linked to the investment in and the utilization of new machines or techniques. This can be interpreted as symptomatic for the sector, where the day-to-day challenges are characterized by practical operational tasks, and where the search for an optimized technical solution is a priority in decision making processes. This shows, among other things, where the focus and main interest of forestry contractors lies. In general, these innovations are incremental rather than representing new ideas. It may be considered that they represent a business development diversifying the normal service into a new field according to the market opportunities or changes, or a way of improving the competitive advantage and gaining economies of scale rather than an innovation. However, for the individual firm the named technological or product innovations bring a radical change in their management. In the cases of bio-fuel harvesting, purchasing a forwarder or purchasing a harvester, and using subsidy systems to buy a logging tractor, the innovations are radical and new to the firm. In the case of the custom-made tractor, and packaging timber for conservation, the innovations are new to the market as well. Estonian cases with innovative use of forest machines are new to the firm and incremental in the sense that the existing machines are improved to make a better use of them.

In all the cases where new machines were bought, mechanization was an innovation because it meant a new way of working for the firm. Usually, purchasing machines represents a normal upgrading of the enterprise technical equipment that cannot be considered innovation because of its permanence. However, the first purchase of a forwarder or harvester completely changes the production system of the firm and should thus be considered an innovation new to the firm only. Purchasing a forwarder or harvester for the first time often means an innovative approach to acquiring funding (e.g. because of lacking private financing or the difficulties associated with obtaining a loan). It additionally means having to contact machine suppliers and learn about performance and using and maintaining the machinery, which in eastern countries may be challenging considering the lack of qualified agents to maintain the machinery or the recruitment of qualified workers, given that few professional schools in eastern Europe can train workers for these types of machines.

16.5.3 The driving forces of innovation

The driving forces of innovation are the profit-seeking opportunities offered by the implementation of the innovation, market-related opportunities in most cases, and policy-related opportunities in the two cases dealing with the use of the subsidy scheme for purchasing new harvesting equipments. In both cases, the innovations were triggered by the need to find a solution to the lack of manpower (forest workers). According to Drucker (1998), the opportunities for innovation are limited: unexpected events, discrepancies, specific needs of some activities and changes in the sector and in the market. External to the company, there are demographic changes, perception changes and new knowledge.

Unexpected events came in the Estonian case from the policy side when it was decided that for a sustainable management of forest resources, the annual allowable cut should be reduced. The sharp drop of the timber supply tightened

the competition, and therefore the firms have been looking for new ways of using the expensive machines they bought. Also, an unexpected event was the storms in 2001 and 2004 that favoured firms with pro-active management to forecast the scarcity of timber, and to adapt by using machines in alternative ways, or by developing parallel activities such as infrastructure works or machinery repair. Changes in the sector and in the market inspired the innovation described in case one – entering the bio-fuel market. Changes in the policies of the timber provider enhanced adaptation and some innovation in the forest contractors firms, but mostly they are perceived by the firms as having a higher potential risk. The demographic changes (lack of labour because of immigration or to the changes in the profile of the young generation) are bases of innovation in the purchase of a harvester in the Lithuanian case, and the purchase of a forwarder in the Polish case.

New knowledge-based innovations are the most spectacular innovations, yet they require long-term development, finalization and the synthesis of different kinds of knowledge, called the discipline of innovation (Drucker, 1998). This is the case with the conservation of timber and with the custom-made tractor; both innovations require time, and they are not really implemented in the market yet. Drucker (1998) argued that innovations are not just some events, but the result of a systematic search for innovation. It may be seen in the second Estonian case that the innovation comes from a firm actively searching for market opportunities in the domestic market or abroad; it may be seen as well in the custom-made tractor that the product came under the frame of a long and stable cooperation between the machine supplier and the firm. It should, however, be stressed that cooperation requires good personal relationships (e.g. between the owner of the firm and the manager of the machine supplier) and not merely an institutional, de-personalized cooperation between the firm and the machine supplier.

As stressed in many case studies, competition in forest contractor works is high. The intensity of competitive rivalry leads the firm to find sustainable competitive advantage through innovation (Porter, 1979). Competitive advantages were found in:

- The integration of the wood value chain through the diversification of services, such as timber transportation or saw milling. Innovation is related to the change in the market segment.
- Providing quality services, e.g. via modern technologies, as in the Slovakian and Polish cases, and increasing the labour productivity – innovation is related to investing in new machinery as a choice criterion to access the timber procurement market.
- Specializing in niche markets, such as salvage (SK1) or storm cuttings.
- Finding new markets for services by using machinery for other purposes than forest-related activities in the low harvesting season – innovation here related with entering a new market (the infrastructure market) changed the usual business environment of the firm.

The firms' capacities in negotiating prices and the influence on public timber procurement policies and decisions are very weak compared with the bargaining power of suppliers. Through the regulation of timber procurement, through spot transactions, short-term delivery contracts, relatively small values/quantities and few if any substitutes, the suppliers of forest services tend to have a significant power over the firm. Therefore, when the supplier requires machinery to be less than 10 years old, it compels the firm to innovate. The requirement for quality services is a driving force of innovation in several cases.

On a more general level, the policy-related milieu of the forest sector can facilitate the horizontal and vertical integration of forest activities. The strong regulatory climate, as in the Polish case, would not allow the same horizontal development of activities as in Lithuania, Estonia or

Slovakia. In these three latter cases, the portfolio of activities is very large, from harvesting, forest protection to forest management services, which allows the firm to be flexible and to face the uncertainties of the timber markets. When diversification of activities is allowed, there is a better climate for product or services innovation. When the firm undertakes only forest harvesting services, as in Poland or Romania (Austroprojekt, 2008), not only is the innovation in new products hindered, but the firm is also affected by the drop of the production flow in the low seasons. Some forest contractors considered the integration of the wood chain as a solution. They bought the timber they have been contracted for harvesting, they process it in their own mill (or in a partner's mill), and they provide transportation and trading services.

16.6 Conclusion

16.6.1 The role of markets and cooperation

Innovation was financed by subsidies in the case of SK1 and SK2; all other innovative activities were financed by private investment. Yet, the cases show a trend towards loan-based investment. In all cases, business cooperation and networks between contractors are rarely mentioned or they are regarded as having little importance. This is in fact not typical of the contracting sector, since there are frequently contractor/subcontractor business relationships already in place. Furthermore, most interviewees did not regard the market-related commercial partnership as a business network. They have a negative perception of professional associating bodies and related lobbying activities. Therefore, one should classify cooperation (as recorded in the case studies) as being market-relationship-based and professional-associations-based.

The existing market-relationship-based cooperation shows that the firms have their own strategic or operational relationship, such as:

- *Long-term relationship with clients*. Certain forest districts or private owners are the 'usual' customers of forest services and this partnership with the customers is a smooth solution to the uncertainties of a yearly based market and/or tender-based systems (in public forests). However, the case studies show a trend aiming at replacing the long-term relationships by tendered contracts for services, which fairly often do not respect or favour trustful past cooperation, but just the actual price offer. This is a huge threat for locally existing business networks.
- *Stable partnership with suppliers*. The cooperation with the suppliers of machinery leads in one case to the development of innovation (custom-tailored tractor; SK1).
- *Subcontracting as an operational cooperation strategy to face extra workload*. When work volume or need for specialized equipment is required, the contractor resorts to partner enterprises which work as subcontractors, or he gets subcontracted by them if required.

Subcontracting is used either to share advantages when faced with larger demand (GE), or to push some costs to smaller firms or sole traders, as mentioned in general in the Slovakian case (the studied firm cooperates with sole traders, but it does not force its employees to turn into sole traders, contrary to the trend). None the less, small sole traders might be a problem since they are able to push down the price level for services (SK3, PL). In none of the studied cases was subcontracting used as a vector to implement the innovation; the possibility should, however, not be excluded. A second form of cooperation is the membership in professional bodies and organizations, such as Associations of Forest Entrepreneurs, whose aim it is to lobby for the members or for the sector. The cooperation in professional organizations and bodies represents a 'power sharing' approach of the firm development, based on non-binding membership

and loose commitments. In the cases studied there were, however, negative perceptions of the benefits of membership in professional bodies and of the real impact of lobbying activities. One explanation can be that most of the cases were observed in eastern European countries where, after the shift to market economy, a strong resistance to social and economic control in associations persists.

16.6.2 The role of policy milieu characteristics

Results from the case studies suggest that policies do not have an effect, or (if any) the impact on the activities of the firm is negative. However, the financial support that the firms received from public policies helped them to invest in new machinery via the rural development programme (SK1, SK3), to employ young or long-time-unemployed people (SK3) or to pay for training qualified people (PL). Even though the employment and education policies were not directly aimed at innovation, they helped the firm to develop, particularly in the context of increasing demand from the timber supplier (state forests in Poland, Estonia and Slovakia) for high skill and modern environmentally sound machines. These policies can consequently play an important role in fostering innovation, as training and qualifications are amongst the crucial prerequisites for innovation.

The negative effects of policies were identified within the regulatory barriers for forest harvesting operations in legislation or within the internal regulation of timber providers. Examples in the case studies were: shortening the harvesting period; requirements for the quality of the services; age of the forestry machinery to be used (e.g. Estonian RMK requires less than 10 years old forest machinery); the regulatory provisions concerning transportation limits (truckload length and gross weight); and the rules regarding the use of cheaper agricultural diesel fuel (Slovakia, Estonia). These regulatory provisions have had an impact on the general performance of the firms, or can be regarded as general frame conditions or technical specifications of the contracted operations. Therefore, they may be considered only as indirectly hindering factors of innovation. It is none the less worth noting that the contractors themselves see these requirements as 'politically' imposed restrictions to their daily business. They furthermore blame 'policies' for the higher cost and lower profit, which result from environmental or procurement regulations.

The policies of the main timber providers, such as state forests in Poland aiming to change from tree length to cut-to-length systems or RMK in Estonia requiring high standards of mechanized work and quality services, have a high direct impact on the harvesting technologies used. The policies of the main timber suppliers can provide strong incentives for innovation in some firms, *provided* they are able to adapt in a short time. This conclusion fits with the recorded case studies, where the state forests still have an important role to play on the market. Technological innovations are stimulated, but also organizational ones, when the state forest radically changes the timber procurement procedures.

16.6.3 Lessons learned and recommendations for policies

It can be assumed that a majority of innovation policies have not yet led to a considerable uptake of innovation among forestry contractors. The innovations that could be identified are mainly incremental applications of already existing technical solutions, and in some cases departure from/embarkation on additional tasks and new product markets. These innovative activities can be characterized as reactions to market developments and customer demands. The question remains whether the urgently needed development of contractors could be considerably fostered by national or European policies. Advice and support by public or semi-public bodies, which are based on public enterprise development policies, can

be found in most countries. However, it seems that forestry contractors are addressed by such organizations in rare cases only, or the offers are rather directed to craft or trade businesses. Herein lies a considerable potential for identifying the needs for development and innovation among forestry contractors, and for identifying supportive measures, which would reach those enterprises that often work in remote rural settings.

At this stage, one of the major requests is quite obvious, particularly in eastern and central European countries: there is a crucial need to support investment in technical innovation in forest operations, to react to the increasing demand for harvesting and transport capacities, and to curb the forecasted lack of workers in many countries. Reaching a higher mechanization level cannot at this stage be achieved without public support investments. It is worth discussing whether a direct subsidizing system would be politically desirable, since direct subsidies are not in any case the best means to encourage entrepreneurship and innovation. There are still challenges and opportunities to be found in the EU rural development funds to direct the grant systems in such a way that supported forestry measures can be connected to the use of innovative technique. To develop market-opportune measures aiming at a desired impact on innovation in forest operations is a huge challenge for political decision makers in the near future.

An even more important political goal should be to build up or maintain the capacities for support, training and commercial advice of SMEs to develop further the human resources and entrepreneurial capacities that will be crucially needed in the future in order to enable contractors to fulfil their important role in the forest-based value chains.

Acknowledgements

The work was partly supported by the Slovak Research and Development Agency under the contract No. APVV-0692-07 (2007), by Estonian Environmental Investment Centre project 'Innovation in Forest Sector' (2008) and by COST Action E51: Integrating Innovation and Development Policies via the Short time scientific mission (2009). Edgar Kastenholz and Piotr S. Mederski would like to thank Prof. Siegfried Lewark for his valuable help and comments necessary to make the analysis of the German and Polish cases.

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III

Nybakk, E., Niskanen, A., Bajric, F., Duduman, G., Feliciano, D., Jablonski, K., Lunnan, A., Sadauskiene, L., Slee, B., **Teder, M.** 2011. Innovation in the wood bio-energy sector in Europe, in: Weiss, G., Pettenella, D., Ollonqvist, P., Slee, B. (Eds.). Innovation in Forestry: Territorial and Value Chain Relationships. CAB International, pp. 254–275.

15 Innovation in the Wood Bio-energy Sector in Europe

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Abstract
This chapter aims to analyse sources of innovations for bio-energy at the firm level and to assess which policies have supported or impeded company innovations and business development. Our analyses are based on 14 firm-level cases from eight European countries. The case study data were collected in 2008 and 2009 using common interview guidelines. The cases represent companies engaged in activities that range from wood pellet and chip production to district heating, large-scale electricity production at a pulp mill site and other bio-energy business applications in Europe. As one might expect, the contents of the cases were diverse. Although the innovations analysed had different sources, in the majority of the cases the innovations were prompted either by emerging new market situations (e.g. rising fossil fuel prices) or new available woody biomass sources, or were driven by changes in company strategies or introduced and led by visionary managers. The case studies often stress the important roles of innovation champions, with their innovative charisma and excellent interpersonal skills. Also, policy and policy measures played an important role in many of the analysed cases. Based on the analysed results, we found that determined national policies and programmes supporting and providing favourable financial conditions for investments in the area of renewables boosted innovative activities in the use of woody biomass for energy purposes.

15.1 Introduction

There is often a gap between political ambitions regarding bio-energy use and actual bio-energy use in many European countries. The most obvious explanation is that bio-energy is not price-competitive because the costs of production are too high. Thus, the use of bio-energy has not grown as expected. There are two other potential explanations: first, the capital costs of wood-fuel boilers are high compared with those of alternative forms of heating or electricity generation; and second, the full environmental costs of use are not factored into the cost models for alternative heat and energy sources. Environmental factors, such as reducing greenhouse gas emissions, provide a justification for cost-share measures in bio-energy policy or carbon taxes. Some environmental benefits of bio-energy are internalized in energy prices, but policy support varies greatly from country to country.

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Many factors aside from price and environment also influence actual bio-energy use. In the popular literature, these other factors are referred to as *barriers* and *drivers* (W. White, 2007, 'Assessing drivers for bioenergy and biomass supply. The perspective of economics', unpublished manuscript). It is important to obtain more knowledge about these barriers and drivers because such knowledge can be used to design more efficient bio-energy policies. Many of the barriers and drivers are of the kind that economists call transaction costs. In mature, well-functioning markets, transaction costs are low. In relatively new and weakly developed markets, the transaction costs may be high. Most bio-energy projects involve companies and other actors who do not normally cooperate, and it takes time and effort to establish trust and a cooperative environment between them. The decision-making process used to establish any bio-energy system also takes time and involves several public actors. This process creates transaction costs associated with supply chain development (Roos *et al.*, 1999).

Another important factor influencing long-term bio-energy use is technological development and innovation (Audretsch and Feldman, 1996; Staffan and Bergek, 2004). All customers have alternatives to bio-energy, and the alternatives may become relatively less expensive over time because of innovation. Without innovation, bio-energy systems will not ultimately be competitive. A central concern is what may drive innovations in bio-energy systems faster or more efficiently compared with competing energy systems.

According to the Oxford English Dictionary, an invention involves the creation of something new, and innovation is the act of introducing something new. From an economic perspective, an invention must be advantageous, or it must minimally be thought to be advantageous, to be considered an innovation (Nybakk, 2009). It is important to distinguish between different types of innovation (Nybakk *et al.*, 2008). Jenssen and Nybakk (2009) found that product, process and market innovations are affected by different innovation drivers. Furthermore, it is common to distinguish between radical and incremental innovation (Damanpour, 1991). Radical innovation is innovation that is new and different from previous solutions, whereas incremental innovation implies smaller and more subjective new solutions adopted by a firm. Recent innovation research on the wood industry distinguishes between product, process and business system innovations (Hovgaard and Hansen, 2004; Hansen *et al.*, 2006). One might also add policy innovation to the list of systemic innovations. Product innovation is an act that leads to new products and services. Process innovation is an act that leads to new processes and refers to the process that is intended to produce something. Business system innovation is the act that leads to new business systems. A business system consists of everything in a company that is necessary to manage, structure, operate and administrate the business and its internal and external environment (Hovgaard and Hansen, 2004). Policy innovation is the introduction of new enabling policy measures (Rametsteiner *et al.*, 2010).

Drivers or antecedents of innovation are frequently debated in innovation literature. Largely, research concerning innovation and innovativeness can be classified in accordance with the level of the independent variable. Four levels can be distinguished: the individual, organizational, interorganizational and societal levels. At the individual level, the importance of individuals or 'innovation champions' is emphasized (Schön, 1963). Jenssen and Jørgensen (2004) define an innovation champion as a person willing to take risks by enthusiastically promoting the development and/or implementation of an innovation inside a corporation through a resource acquisition process without regard to the resources currently controlled.

The second level is organizational, which focuses on organizational culture and structure (Mintzberg, 1979). Factors at the organizational level that are assumed to influence innovation might be categorized as organizational structure and communication, organizational culture, strategy, incentives, finances and slack (e.g. Duduman and Bouriaud, 2007; Tidd and Bessant, 2009).

At the third level, the focus is on relationships between organizations, and it is

assumed that relationships between individuals in different companies and networks of individuals at different organizations stimulate innovation within organizations (e.g. Burt, 1992, 1997; Granovetter, 1973). At the societal level, studies on the effect of regional clusters are an important example (Porter, 1990). Porter (1990) argues that the development of clusters is essential for national competiveness.

The innovation system approach is another perspective from which to study innovation. It was introduced by Freeman (1987) and is considered an approach rather than a theory. However, an institutional view of innovation is reflected in the literature on systems of innovation. Institutions shape and are shaped by the actions of organizations and the relationships among them (Edquist, 1997). The main components of a system of innovation are actors, institutions and their interactions. Actors are considered organizations, which are seen as formal structures with an explicit purpose that have been consciously created (Edquist and Johnson, 1997). Interaction among actors and institutional settings is important for innovation activities. The basic idea is that companies do not normally innovate in isolation. Instead, in the innovation system approach, innovations are seen as based on interactive learning between organizations or actors (Edquist, 1997). Several scholars have also applied an innovation system approach on the wood and forest sector (Rametsteiner *et al.*, 2005; Hansen *et al.*, 2006; Rametsteiner and Weiss, 2006a,b).

15.2 Research Question, Method and Introduction of Cases

Factors influencing the diffusion of certain energy technologies are the topic of several studies (Dieperink *et al.*, 2004; Madlener, 2007; Mahapatra, 2007). Unlike other studies, which focus on a particular country and on micro-data, we used case studies in different countries and compared the results from an international perspective. The aim of this study was to understand different types of innovations and their drivers in European bio-energy companies. Furthermore, we wanted to determine how external relations and institutional and policy factors affect the innovations and the innovation process. During the work of the European Science Foundation-funded COST Action E51, it became evident that innovations in the bio-energy sector are very different in various European countries. This chapter attempts to analyse sources of innovations for bio-energy at the firm level in different parts of Europe. Based on the similarities and differences found, the policy implications of the findings are discussed regarding how to support bio-energy business development.

This study was based on qualitative case studies that were built around the examination of different innovation activities in companies in various European countries. The case studies were used to investigate drivers of innovation, the degree and importance of networks, and policies that impede and foster development.

In the following chapter, we describe 14 firm-level cases from eight European countries: Finland, Norway, Lithuania, Estonia, Poland, Romania, France and Scotland. The research design, sampling, data and analyses are outlined. The results are then presented and discussed. Finally, some implications are considered, and suggestions are made for further research.

The case study data were collected in 2008 and 2009 using the same interview guidelines (originally developed by Thomas Rimmler) in all countries to increase reliability. Also, a similar semi-structured interview method was applied. The cases represented companies that engaged in wood pellet and chip production, district heating, large-scale electricity production at a pulp mill site and other bio-energy business applications in Europe. An intensity sampling strategy was used to select the cases. Themes touched upon in the interviews fell into the following four main categories:

1. What is the main innovation undertaken by the company?
2. What were the origins of the innovation?

Table 15.1. Case company descriptions.

Case no., country and firm name	Case description
C1: Norway: pellets case company	The company produces pellets from round logs; a garbage disposal company's surplus heat is used for the drying process
C2: Lithuania: pellets case company	The company produces pellets and briquettes
C3: Lithuania: wood chips case company	The company produces and delivers energy wood chips from logging residues
C4: France: electricity case company	Electricity production in pulp mills
C5: Poland: pellets case company	The company buys pallets, repairs them or chips them; the chips are used for the production of briquettes and pellets and sold to small industry and private users
C6: Poland: district heating case company	Town district heating, supplying heat to the town, installing biomass-fired boilers (to replace coal-fired ones) and partial use of own willow plantations for raw materials
C7: Estonia: wood chips and fuel wood case company	Company that sells different wood-made materials, recently has also expanded into combined heat and power (CHP) production from forest residues and fuel wood
C8: Estonia: district heating case company	Large-scale heat producer that began electricity production in 2009 (CHP)
C9: Estonia: pellets case company	Pellet producer that partly uses round wood with debarking (and sawdust from sawmills)
C10: Finland: pellets case company	Large-scale producer of pellets from sawdust
C11: Finland: district heating case company	District heating cooperative
C12: Scotland: wood chips case company	The enterprise produces wood chips both to be consumed by the estate mansion and to be sold in regional markets
C13: Scotland: pellets case company	The company produces wood pellets for fuel/energy and for horse bedding
C14: Romania: district heating case company	The company sells thermal energy for heating a town in north-eastern Romania; the thermal energy is produced from sawdust and small wood residue

3. What actors were involved, and how important were networks?
4. How did the respondent assess the potential for this innovation in the country (including the market and policy)?

A detailed overview of the studied companies is given in Table 15.1.

The data were collected by different researchers from the case study countries. The first portion of the data analysis was undertaken by the researcher in each country. This analysis resulted in one document from each case with 2–14 pages of text. In the second step of the analysis, these documents were compared, and the text was grouped into themes and subthemes. The results of the second step of the analysis are presented in the following sections and discussed in the last section.

15.3 Types of Innovations and their Drivers

15.3.1 Case studies descriptions

The innovations found in the 14 case studies are presented in Table 15.2. Even if we had selected more innovative companies for the case studies, the innovations found would probably have been predominantly incremental. The object of investigation was bio-energy companies (mostly pellet producers and district heating companies), and

Table 15.2. Innovations in the cases and their drivers.

Case company	The innovation	Source/drivers for innovation
C1: Norwegian pellets case company	Pioneers producing pellets from forest raw materials that were dried by surplus heat from a garbage disposal company	The CEO developed the idea behind the innovation and was the main driver during the start-up process; he was the internal/innovation champion. Synergy with a waste disposal partner company was key
C2: Lithuanian pellets case company	Briquettes and pellets from sawdust produced from round wood	Unstable sawdust deliveries from sawmills prompted the CEO to develop an independent sawdust production chain. Innovation was driven by good demand prospects in pellet importing countries
C3: Lithuanian wood chips case company	Fuel chips produced from logging residues	The idea born at seminars on bio-energy and exhibitions accompanying international projects on bio-energy. Environmental scanning: local supply of logging residues and local demand for fuel chips. Low transportation cost for fuel chips
C4: France electricity case company	Generation of electricity from wood biomass (pulping by-products, by-products of wood industries)	Governmental initiative (instrument: calls for tender, with 15–20-year fixed prices). Competitive pressure on production costs and on markets. Technical skills and characteristics of internal process of the mill
C5: Polish pellets case company	Pellets and briquettes are made from recycled pallets and sawmill waste wood. Pallets are either chipped or repaired. Chips are made into briquettes or pellets for heating purposes or sold to an OSB plant	There was an oversupply of wood pallets and wood waste, highly priced gas and coal, a market for pellets, CO_2 issues and rising eco-awareness
C6: Polish district heating case company	Heat energy supply from biomass-fuelled boilers that replaced old coal-fired boilers, a willow plantation project and a straw briquette line	Coal was replaced by wood because of rising coal prices and the need to replace coal boilers. Cheap land offered the option of establishing their own biomass plantations, and the chairman acted as an internal visionary
C7: Estonian wood chips and fuel wood case company	Started combined heat and power (CHP), both heat and the electricity production in Tallinn area from wood. Initiated the use of forest-felling residues and stumps	A visit to Nordic countries resulted in secured demand for heat from the district heating network 'Tallinna Küte', secured raw materials from Woodex, pre-negotiated sales of electricity
C8: Estonian district heating case company	Production of both heat and electricity (CHP) from wood and peat. First time the CHP was built on such a small territory. The total available area was 2.2ha (site of the old boiler house); normally, the territory for CHP is *c.*4–5 times larger in size	Vertical monopoly: they owned the resource (peatland), production of heat, pipelines for delivery to customers and sales organization. Forest areas are nearby, but harbours where pulpwood is exported are distant, so occasionally pulpwood is sold for heat production. Increasing price of Russian gas. All of these factors led to the decision to build a CHP

C9: Estonian pellets case company	Chipping and grinding from round wood; stationary chipper; debarking of round wood; and flex heat brand	Lack of raw material (sawdust) and desired market attributes drove the debarking decision. High demand for premium quality (German standard). Cooperation with equipment manufacturers
C10: Finnish pellets case company	Technological development; investments in the efficiency of pellet production; and service innovations. The company increasingly focused on providing a full-service concept that included the delivery of pellets, heat production and the maintenance of power plants (households not included)	The company strategy shifted: more business from the processing of sawdust from the company's own mills and the dust bought from other sawmills turned into pellets. Market development was focused in Finland and abroad, because the company exports most of its production
C11: Finland district heating case company	The formation of cooperation: the owners of the cooperative increased the demand for otherwise non-marketable small-diameter wood; the community created new local business and jobs as well as a good image in replacing non-renewable oil-based energy production with bio-wood-based energy	The increasing price of oil improved the price competitiveness of wood-based energy. Thus, profitability increased for the energy producer. Income also increased for the landowners from otherwise low-value wood and jobs for the municipality (win–win)
C12: Scotland wood chips case company	Improved supply chain and process (chip boiler for heating), and business model	This activity began as a response to the rising cost of energy for heating a very large mansion house on the estate. The mansion is used for business purposes on a mixed highland estate that supports forestry, farming, quarrying, sport shooting and tourism enterprises. Wood procurement is characterized by opportunistic acquisition of low-grade fuel wood
C13: Scotland pellets case company	Wood pellet production with two markets. The wood fuel market was the intended market, and the horse bedding market was discovered by chance. Establishing a modern pellet production enterprise in high-quality buildings. 'Torrefaction' technique – it removes moisture from the woodchips in a vacuum. The brand name for the product: 'Stovies'. The raw material is sourced locally from the estate's own woods and from a nearby sawmill. The key innovation is to make the right choice of the raw material and to produce the right sort of fibre (without bark or twigs)	The CEO wanted to add value to his timber and picked up ideas for that while working for a landowners' association. He believed that in the future, wood fuel was going to be promoted by the Scottish government. They chose to produce pellets instead of chips, because pellets are more convenient and easier to handle. They started to produce wood pellets for horse bedding after noticing that another distributor was selling pellets to the horse trade. The plant was designed to use sawdust, but because it compromised the quality of the pellets, they stopped using it
C14: Romania district heating case company	Heat and hot water from wood residues	In a national setting, new logistical equipment for sawdust collection, new buffer stores for sawdust; new thermal power plant; new distribution network; the replacement of the old heating equipment in buildings' basements with new conduits; a new system for thermal energy production based on sawdust, chips or bark

this approach limited the possibility of finding significant product innovations.

As seen in Table 15.2, most of the innovations were basically incremental process innovations and often associated with supply chain innovations. Two of the companies, one Norwegian (C1) and one Estonian (C9), were both local pioneers, using round logs in pellet production. In these cases, the innovations were not related to the end-product but were process innovations enabling the utilization of round logs. In Norway, pellet production with roundwood as a raw material was normally seen as unprofitable because of the high energy cost related to drying. However, the Norwegian company was the first in Norway (and one of the first in the world) to produce pellets directly from raw material from the forest, ideally from round logs. The company obtained its lumber from the forest: tree trunks were ground into chips, and afterwards the raw chips were dried with warm air from the refuse disposal plant. After drying, these were manufactured into pellets. The company was also one of few pellet producers in the world to use low-temperature drying in pellet production. Several of the other case companies made larger investments in new equipment and improved processes as their main innovation (e.g. Lithuania and Scotland).

The Lithuanian case (C2) is an example of incremental innovation. The pellet and briquette producer exports 90% of its output. They were strongly dependent on sawdust deliveries from sawmills because the company was exposed to unstable round wood markets, resulting in varying quantities of available sawdust. Confronted with such a situation, the management decided to implement a process innovation by developing a sawdust delivery chain, with the sawdust produced directly from round wood. The company decided to make an investment. They bought a wood chipper and put it into operation, thus decreasing the company's dependence on uncertain sawdust deliveries from sawmills. The innovation was driven by a strongly rising wood pellet demand in Europe. The manager displayed innovative behaviour, if not features of an innovation champion, being able to analyse the present situation, as well as foresee the market developments and create a vision of the company's future.

The two Finnish companies developed a business system innovation. In the energy cooperative (C10), the most important innovation was the establishment of cooperation. The owners of the cooperative increased the demand for otherwise non-marketable small-diameter wood. Similarly, the community created new local business and employment and improved its image in replacing non-renewable oil-based energy production with bio-wood-based energy. This cooperation was possible because all key players (forest owner, community, inhabitants, forest transportation entrepreneurs and heat producers) had something to gain from the system created. The increasing price of oil improved the price competitiveness of wood-based energy (although fluctuating oil prices are able to alter market conditions markedly). In the other Finnish case (C11), the most important innovations were classified as both business system and process innovations. There were both technological developments, including investments in the efficiency of the pellet production, and service innovations: the company increasingly focused on providing a full-service concept that includes the delivery of pellets, heat production and the maintenance of power plants. These services did not emphasize households as main customers, because the company operated on a somewhat larger scale. The company also exported large amounts of pellets.

In one of the Scottish cases (C13), the most important innovation in recent years was a torrefaction technique (process innovation) that removes moisture from the woodchips in a vacuum. A further innovation was the spontaneous market innovation that emerged after the wood pellet producing process was initiated: the discovery of a major new market for the wood pellets in the 'horse bedding' market.

The Romanian case (C14) was also a combination of process and business system incremental (local) innovation. When it was initiated in 2004, the innovations introduced

were of national significance because the technologies that were used, even if they were not the latest in this field, were the most modern in Romania. Examples of the innovations are as follows: (i) new logistical equipment for sawdust collection; (ii) new buffer stores for sawdust; (iii) a new thermal power plant; (iv) a new distribution network; (v) the replacement of the old heating equipment in the buildings' basements with new conduits; and (vi) a new system for thermal energy production based on sawdust, chips or bark. The main results and outcomes of implementing this innovation were: (i) the capacity to produce cheap energy from wood residue; (ii) a new price for the energy produced in this power plant, which was half the average price of energy in the country; (iii) the self-evident ecological benefits; and (iv) the improvement of the region's image, which became more attractive to tourists.

As stated above, most of the innovations in the Romanian case (C14) were process and business system innovations. In the Polish pellets case (C5), we also discovered product innovations that were new to the firm and a local market. The direct stimulus for establishing the firm was the possibility of utilizing wood waste in the form of pallets and sawdust. The oversupply of wood pallets and other waste wood was the basic reason for initiating the production of pellets. The waste wood was chipped and then pelletized, with a portion of the chips sold to a chipboard manufacturer. The CEO argued that the factors that were conducive to innovative activities in wood pellet production were ecological awareness in society and local demand. Local demand was enhanced because of the presence of areas without the natural gas infrastructure that would make it possible to use natural gas for heating purposes for inhabitants living there. The pellets also proved to be a cheaper fuel than heating oil and coal, and, because of their relatively low ash content, they were regarded as convenient to use.

The French case (C4) was one of product innovation at the organizational level. The case company operates three pulp manufacturing units, producing fluff pulp for absorbent products (nappies, etc.) and kraft pulp. The drivers of innovation are two constraints on the current production: increases in production costs and market pressures on the products. In 2007 and 2008, the company faced tighter fibre supply conditions, with higher costs for raw materials. An additional pressure came from a sharp increase of fossil fuels, leading to higher costs of chemicals and transport. The Law on Water, passed in 2006, raised water costs, which are important in pulp production. Conversely, the company's main market (kraft pulp) is a mature, worldwide market (dominated by multinational companies) that fixes the reference price leading the company to behave as a price-taker. The erosion of prices in 2009 has endangered the business. Moreover, the long-term trends of paper consumption (kg paper/inhabitant) are uncertain and may well decrease. The determinants of demand (the development of the information society, government policies related to the reduction of paper consumption, and competition from other materials) may also decline. These constraints drove the company towards new markets and oriented activities to innovation. In accordance with legal objectives, the public authorities issued three calls for tenders and brought an opportunity to develop the innovation in energy production.

Conversely, the other Polish case (C6) presented a typical process innovation. In the Polish district heating case, the main innovative activities begun in recent years were centred on three topics: new boilers fuelled with biomass that replaced old coal-fuelled ones; a willow plantation established in 2002 (with the initial idea that the firm could cover 60–70% of its heating needs with its own biomass sources); and a straw briquette-manufacturing line, with the straw briquettes sold to a large power station in the western part of the country. Each of the innovations proved successful, except the willow plantation, where major cultivation problems appeared. The replacement of old coal-fuelled boilers with new biomass-fired ones was the most important innovative activity and was directly tied

with the willow biomass produced on land owned by the company. The main drivers behind the innovation were rising coal prices, cheap agricultural land with the potential to produce willow biomass and the need to renew the heat-producing infrastructure (boilers). What must be stressed here is the vital role of the company chairman, who acted as an engine and driving force and was able to stimulate the entire company management structure to formulate a new energy supply programme for the town.

15.3.2 Drivers for innovations

Previous research emphasizes that there are many different innovation drivers at different levels. Some of the literature concerns internal and external factors driving firms' innovative behaviour. Related to the case studies analysed in this work, one can distinguish four levels driving innovations: the individual, organizational, inter-organizational and societal levels. Here, the innovation drivers varied from country to country and among firms in each country. The Norwegian case (C1) clearly illustrated the importance of the 'innovation champion': the innovator and the engineer in a small business were the same person. Many actors were involved, but one person (or, at most, a few) turned the innovations into new business opportunities. Ultimately, it appears that several of the external actors were not very supportive. The champion theory is supported by several research findings (Jenssen and Jørgensen, 2004). Other cases (e.g. the district heating company in Poland) also emphasized the importance of the CEO and/or the owner. In at least one case in Scotland (C13), the existence of an 'innovation champion' was highlighted. This individual participated in as many activities as he could (e.g. shows, seminars and fairs around the country), but he recognized that much more could be done 'if there were six of him'.

Environmental scanning is often seen as an important innovation driver (Jenssen and Nybakk, 2009). It encourages CEOs' and other managers' awareness of emerging trends and can often lead to the recognition of innovation possibilities (Auster and Choo, 1994). First, the manager can learn about customers' preferences, demands and willingness to pay for different products and services. The Estonian pellets case company began by producing pellets from round wood with a new chipping and debarking machine. The innovation was mainly based upon the observation of market needs using scanning.

A similar situation was noticed in one of the Lithuanian cases (C3). A small family company doing forest contracting work in wood harvesting, forwarding and hauling saw a developmental chance in producing fuel chips from logging residues. The enterprise was aware of the local logging residue supply because it was a material that they used to leave behind in the clear cut areas where they performed wood harvesting operations. Also, a local heating plant was located in the area, securing a stable demand for woody fuels. Thus, environmental scanning enabled the enterprise to develop by diversifying the product it offered.

Secondly, CEOs and managers can learn about and be updated on technological changes and competitors. Companies in other regions or countries are more likely to have different information and ways of solving technical problems. In the Estonian wood chip and fuel wood case (C7), the ideas came from a visit to similar plants in Nordic countries. In one of the Scottish cases (C13), the CEO and a forester employee developed contacts with boiler builders, communicated with other people and conducted horizontal networking in a very practical way. In the other Scottish case (C12), the owner visited wood fuel plants in Germany, Northern Ireland and England before building his own plant. In procuring the plant, he made inquiries to several manufacturers. One particular engineering firm was especially useful because it immediately offered sensible advice and suggestions for the machinery that should be purchased.

Thirdly, the social and economic environment is changing, as are public regulations and support programmes (e.g. Auster and Choo, 1994). To gain a competitive advantage, it is therefore important to

to systematically scan a company's surroundings for signs of possible opportunities and threats arising from new policy, which could reduce costs for new entrants or provide funding for new initiatives. Today, with the ongoing debate on how to promote bio-energy to reduce CO_2 emissions, this type of scanning is especially important. For example, in Scotland, the Climate Change (Scotland) Act 2009 created a statutory framework for greenhouse gas emissions reductions in Scotland by setting an interim 42% reduction target for 2020, with the power for this figure to be varied based on expert advice, and an 80% reduction target for 2050 (Part1). Similarly, in Lithuania, state promotion of wood heating plants created demand and local markets for woody fuels, indirectly helping woody fuel production chains to develop.

Organizational-level innovations (emerging trends, updates to technology and scanning the social and economic environment) were not the emphasis in the Finnish cases, though we directly asked about this element. In all likelihood, the managers and developers of the new bio-energy business did pay implicit attention to changes in the business environment (i.e. the managers and developers of the companies were so involved in developing bio-energy that they could not even recognize it).

15.4 External Relations in the Innovation Process

As described earlier, innovation is an interactive process within a company or among companies, organizations and other actors. These ties can be both weak (with occasional interactions, e.g. casual acquaintance) and strong (which implies more regular interactions within networks). The strength of a tie depends on factors such as trust and friendship. Stronger ties often go beyond short-term market transactions and include more long-term and stable partnerships. In Table 15.3, the importance of cooperation between different actors involved in the analysed innovation processes is emphasized.

15.4.1 Strong ties in the innovation process

These network ties, though often informal, are clearly visible in the Polish district heating case. The main actors involved in the principal innovative activity were higher educational institutions (two universities), businesses providing technical advice and sharing their experience, the town authorities, local banks and other partners with whom contact had been established while visiting technology fairs and exhibitions. The variety of organizations involved in the innovative activity resulted not only from the complex nature of the innovation but also from the devotion and charisma of the company chairman. The network that was built was a complex one, with the company's stakeholders and shareholders (the local municipality, the housing cooperative and a few industrial plants) standing at its centre. Vertically, the structure of the network mirrors the material flow. Wood biomass suppliers deliver chips from a number of wood industries to the heating plant where they are converted to heat and delivered to apartment blocks, public buildings and industrial plants. The lateral form of cooperation is much more complex, because it includes higher education institutions providing advice (e.g. on the willow plantation), banks and government organizations providing advice on the possibility of using public funds to pay for the innovation, and other (often small) businesses providing technical assistance, advice and support. As a result of this network, a relatively small district heating company was able to implement successfully a costly innovation and fund it largely using public funding. In the course of achieving innovative activities, a network of formal and informal links was established. The flow of information in the network happened in business and town council meetings, at exhibitions and fairs, and through personal, and often informal, contacts. Books and professional journals were named as important sources of information concerning innovative activities.

In the Norwegian pellet case (C1), the factory was built in connection with the refuse

Table 15.3. Descriptions of networking and the networks' importance for the innovation.

Case company	Network description	Importance for the innovation
C1: Norway: pellets case company	A separate company is buying all of their pellets, does the logistics further down the value chain, and assists with marketing and sales (domestic and exports). Local forest owners provide timber via a forest owners' organization (co-owner). A garbage disposal partner plant provides the heat for drying. Other energy companies are co-owners and, in some cases, customers	Medium/large degree importance: cooperation with the garbage disposal was of special importance
C2: Lithuania: pellets case company	Sawmills provide sawdust. Foreign wholesalers and end-users (90% of production). Association of businesspersons and financial institutions. A specific association for pellet and briquette manufacturers may be beneficial	Relatively low importance
C3: Lithuania: wood chips case company	Harvest residues from state forest company. All sales to local heating plant. Little contact with association. Owner does not believe in networking	Relatively low importance
C4: France: electricity case company	External collaboration with banks (leasing loans) and with the national professional organization of pulp and paper industries	Significant importance with regard to practical feasibility and realization of innovation
C5: Poland: pellets case company	No formal cooperation with any major institutions, authorities or businesses. Vertical chain providing feedback: wood pellet and waste suppliers (the pellet company), pellet buyers (private and small industry). Weak lateral network resulting from contacts with similar businesses (advisory role and exchange of experience). Important role of information flow from sources like wood machinery fairs, journals, the Internet and personal contacts	Low importance. The weak network was not vital for the realization of innovation. Important role of information flows
C6: Poland: district heating case company	Vertical network: local wood industries as biomass suppliers, local heat consumers (private residents, public institutions and businesses). Lateral network: local municipality, housing cooperative and industry, higher education and research institutions – advisory roles. Consultancies and banks provided economic analyses and prepared application documents for public funding. Smaller companies provided technical support. Vital role of personal contacts with science and business representatives. Important role of information sources: visits to fairs and exhibitions, access to trade journals	High importance. The innovation would not have been possible without the network. Numerous problems in the course of the innovative undertaking required cooperation on the part of very different agents
C7: Estonia: wood chips and fuel wood case company	Network for wood procurement: forestry firms, transport and logistics. In cooperation with the Estonian State Forest Management Centre control test regarding potential suitability of forest felling residues for chip production. Buyers of heat and electricity were mentioned as important partners, but not as much as network partners. Suppliers of technology were mentioned, but the contact was not frequent enough for them to be called an actor in a network (this contact was more a normal buyer/seller relationship)	Low importance

C8: Estonia: district heating case company	Network for wood procurement	Low importance
C9: Estonia: pellets case company	Research – University of Technology, equipment manufacturers, other companies, market representatives of end-users in other countries	Clients and marketing channels were important for changing technology
C10: Finland: pellet company	A network of company-owned and other sawmills that provided raw material (mainly sawdust) for pelleting. A network of different companies to increase the size of the plant. A company network to conduct research to improve the quality of pellets and extend its raw material base	Low importance. The main driver has been the company in working to develop its own business
C11: Finland: district heating case company	Network for wood chip procurement and heat service – local forest owners, wood procurement company, municipality and the cooperative, which charged the users of the heating services. The network was originally developed under a special project of the local Forestry Centre (District Government on Forestry), which invited different actors to discuss cooperation and later to agree to the establishment of the cooperative	Significant importance. Without the network, the cooperative would not have been established or been operational
C12: Scotland: wood chips case company	They rely mainly on an informal network of actors. Making contact with as many key players as possible (almost all of whom were private sector operators), visiting existing set-ups and learning from others' mistakes is considered more useful academic research on the subject. They never paid consultants, and their confidence on the expertise of institutions was almost zero	Strong importance at establishment of informal networks built to help scope project
C13: Scotland: pellets case company	The Forestry Commission and the Biomass Development Officer have been very helpful in promoting the enterprise outside and inside the municipal area. They are the core actors in the public sector – Aberdeenshire Council; Chamber of Commerce: Arbuthnott Wood Pellets applied for a business award that has some connections with the Chamber of Commerce	High importance for practical feasibility and realization of innovation
C14: Romania: district heating case company	Scouting and networking: making contact with as many key players as possible. The network is mainly composed of different power plants from the Sawdust 2000 project, environmental agencies, the town municipality, the Romanian government and the Danish Agency for Environment Protection. No collaboration with R&D or universities	Networks are very important. The existence of the analysed Thermal Power Plant is a consequence of network's existence. Networks are used to recruit new active markets

disposal plant. This co-location not only provided a good use for surplus heat but also allowed joint operation with the mutual utilization of the competence and manpower of the two companies (i.e. the waste disposal and pellet businesses). In addition, the forest owners' organization and several energy company co-owners were involved in pellet production.

The CEO in the Scottish pellets case (C13) also emphasized the importance of his network of contacts. The company belongs to the Aberdeen Renewable Energy Group, which has regular meetings. It also belongs to the biomass group that is part of the renewable energy group and is represented in shows, seminars and fairs around the country. The CEO also attempts to participate in as many networking events as he can. Other important actors who help the case company with marketing are the Forestry Commission and the regional Biomass Development Officer (a public sector official). They help to promote the company both outside and inside the municipal area. The raw material for wood pellets is sourced locally from the estate's own forest and a nearby sawmill, from which off-cuts are obtained. Additionally, there are several other important actors from the public sector. Maintaining a large network may be a key to success, but sustaining a large network of contacts can also be costly and very time-consuming. The CEO recognizes that he could do more if he had more time. This lack of time is a major challenge of setting up, running and building networks for an enterprise where one individual is pivotal.

In the French case company (C4), two main network partnerships were created. First, the company established three leases, one for each installation, with banks. The long-term contracts for electricity generation provide guarantees of revenues, reducing the risks associated and facilitating borrowing. The leasing form enables the company then to distribute installation costs over a period at a predetermined interest rate with an option on ownership, rather than a major one-off investment. The second partnership, with the national Paper and Board organization, facilitated resolution of difficulties in collaboration with public authorities, enabling practical implementation.

At the inception of the Norwegian company, different private companies, associations and public organizations had an important role, but the entire process was driven by the inventor and CEO. The Estonian power and electricity production company (C8) generally did not consider suppliers of technology to be network partners, because (for them) it was more a weak, short-term buyer/seller relationship. The forestry companies, suppliers of round wood or chips, were mentioned as network partners, but they were assigned low importance. There was competition in the timber market, and if one supplier was having problems, then the others would be available.

At the inception of the Romanian company (C14), the process was driven more by a system of actors. The project or case company is based upon cooperation between the Romanian government and the Danish Agency for Environment Protection, as well as the Environmental Protection Inspectorates in the different counties involved. The Danish Agency for Environment Protection has been involved in developing and co-financing a large number of projects in Romania, with Neamt County as the specific target area. Sawdust, bark and wood waste had been stockpiled in many places, causing a considerable impact on the natural environment. The new plant reduced local pollution from the wood industry and changed the heating system from a reliance on fossil fuels to the use of bio-energy. In 2000, the project was developed by the Romanian Agency for Energy Conservation, the Danish Agency for Environment Protection and local Romanian agencies for environment protection from different counties, together with a consulting firm with engineers. There were five locations selected. With respect to lateral cooperation, the Danish Agency for Environment Protection and the Romanian government were, collectively, both the initiator and the finance institution on the basis of the Kyoto Protocol. At the same level, other actors were involved: the European Union, which funded 'Sawdust 2000' through a Phare Project; the municipality (as the proprietor and finance

institution); and two companies that offered consultancy and coordinated the activities (because they were permanently in contact with the municipality and the Danish Agency for Environment Protection). Vertical cooperation existed both before and after implementation between the municipality and the staff of the power plant to assure the proper functioning of the plant. The Sawdust 2000 project allowed the establishment of five power plants in Romania. Thus, it created an interesting network for horizontal cooperation: the five plants remain connected through their managerial staff. In addition, as part of horizontal cooperation, the plants communicate with environmental agencies and customers that provide the feedback needed for permanent adaptation to new innovations.

15.4.2 Weak ties in innovation process

In contrast to the networks presented above, both Lithuanian cases showed relatively insignificant or underdeveloped networking. In the case of the smaller family enterprise doing forest contracting work and producing fuel chips, this is understandable. However, in the other case (the pellet manufacturer) the network observed was insufficient, and the company's management was aware of it. Although the pellet manufacturing company (C2) was a member of a local business association and established contacts with banks and leasing companies, no consulting or advisory bodies were present in the network. This absence led to a situation in which the management had to gather almost all the necessary information by itself. The CEO expressed a strong need to establish an association of woody-fuel-producing enterprises.

The Polish case (C5) may be regarded as nearly the opposite of the network in the previous case (C2). The pellet manufacturing company, employing only six people, did not build a strong formal network. However, in the course of the delivery of wood pallets and other waste wood to the company, before the innovation to the pelletizing line was initiated, certain vertical ties with suppliers were established that facilitated the information flow. Ties with pellet buyers, however, appeared later when the pelletizing line began operations. A weak lateral network was also noted; the company management, being active in waste wood processing, had contacts with other similar businesses that served as sources of information and advice. Thus, the information flow proved decisive in the process leading to the innovation. Here, different wood-processing machinery fairs, exhibitions and trade journals played an important role in delivering information on technical solutions. Finally, the company was aware of the potential local market for wood pellets before the idea of the innovation was even developed. This awareness indicates that information on the local market demand must have been available to the management, and it was sourced informally through unofficial contacts. Indeed, external relationships are often not fully perceived because they have the character of relationships based on acquaintance, friendship or accidental meetings.

Also, the low importance of the network was highlighted in both Estonian case studies (C7) and (C8) and in the case of the Finnish pellet company (C10), where the companies developed the business and innovations without the support of other actors. Here, the networks are important only in terms of the companies' efficiency regarding the provision of raw material and the maintenance on the market.

15.5 Institutional and Policy Factors Affecting Innovations in Bio-energy

The supporting and impeding actors related to the different cases are presented in Table 15.4. The institutional settings in the different countries differ. The CEOs' views of the policy instruments also vary between companies in the same country.

In the Estonian electricity production cases (C8), political 'lobbying' was needed to change the local legislation Energy Act, wherein electricity production from local

Table 15.4. Positive and negative impact(s) of policy.

Case no.	Supporting factors	Opposing factors
C1: Norway: pellets case company	Subsidy at inception. The grant was an important factor in the endeavour to undertake the project. Subsidies were provided to private households for the purchase of pellet stoves. Subsidies were also provided to trade and industry for investment in pellet stoves	Support to households was not sufficient. Subsidized electric prices in many municipalities. Subsidized addition to the electric grid but no corresponding goals for bio-energy
C2: Lithuania: pellets case company	Open markets enabled the company to develop by exporting the majority of production. Financial support through EU programmes	No direct subsidies were provided, and the policy has not been the main supporting factor. Underdeveloped local market for pellets. No promotion of woody fuels use in households
C3: Lithuania: wood chips case company	The innovation within the company was not supported directly by any political means. However, indirectly, the state promotion of wood heating plants created demand for wood chips. Additionally, the EU programmes supported the purchase of wood chip production equipment	No direct support of investment into wood chip production from logging residues
C4: France: electricity case company	Calls for tender instruments (not direct subsidies like subsidies as part of the investments) but fixed prices guaranteed for electricity produced	Visibility of investment is reduced because guaranteed prices between calls for tenders are different. Uncertainty of investment in R&D activities in future
C5: Poland: pellets case company	Price relations are favourable for woody fuels; prices are a basic tool for supporting RES. Rising eco-awareness in society	Insufficient support to small companies innovating through eco-friendly projects. Still insufficient advertising of wood as a source of energy
C6: Poland: district heating case company	Government subsidies for investments in eco-friendly projects (95% of the investment was in various ways supported by the government). Plantations with energy plants are financially supported by the government. Obligatory renewable energy quotas for companies dealing in energy	Application procedures for public funding too complicated
C7: Estonia: wood chips and fuel wood case company	EU legislation and energy policy: the use and production of renewable energy should be increased; the opening of the electricity market in Estonia (which occurred more slowly than in the rest of the European Union). Estonian energy policy: by 2010, the share of renewable electricity would be 5.1% (in 2007, it was 1.75%). Support from Tallinn City government (is it a political issue?)	In the planning stage, the legislation did not support the idea; another factor was the proximity of the Iru Power Plant, a subsidiary company of the state-owned monopolistic electricity and power production company Eesti Energia
C8: Estonia: district heating case company	Their own management team made a significant effort and took the initiative to change the Energy Act so that local fuels could be used for electricity production. When the law was changed, the opportunity emerged to start planning the CHP. In the current 'Development Plan of the Estonian Electricity Sector until 2018', more attention is paid to energy production from renewable energy sources (including bio-fuels). The Sustainable Development Act in 2005 set some limits on monopolistic activities by Eesti Energia (at that time an electricity producer using oil shale; since 2009, this company also uses wood for electricity production)	The old version of the energy act, which regulated the principles of energy price and return on investment (investment payback) in electricity production. The Earth's Crust Act (earlier, it was important for peat production, with permits from local communities), not important from a forestry point of view. Waste Act: currently the ash from CHPs cannot be used for further production (e.g. construction, road construction)

C9: Estonia: pellets case company	Availability of different support programmes and grants offered by Enterprise Estonia that are co-financed from the EU structural funds. The company studied different programmes. However, during that time, it did not find one that could meet its needs and, thus, it did not use any of them	In end-user markets (in different countries), CO_2 quotas and support programmes for obtaining kettles/boilers that use pellets will create additional demands for pellets
C10: Finland: pellets case company	Public support for R&D: mainly knowledge on pelleting technology. In the future, the extension of the raw material base for pellets will be emphasized in R&D. Investment support for households if they replace oil boilers with pellet boilers	No impeding policies identified, though the slow growth in the number of households using pellets for heating has caused debates regarding whether the policy measures have been sufficient and efficient
C11: Finland: district heating case company	State subsidies for harvesting young stands (the purpose being to support forest growth) and for chipping. Without these subsidies, the chip-based energy would not be price competitive. Public support for R&D: knowledge of small-scale heating ability and technology. A person at the Forestry Centre (district government Office on Forestry) made the network work. He ran the plan and enabled different partners to cooperate. His salary was partly paid by regional development funding for a special project coordinated by the Centre	During the municipality planning stage, the use of pipelines for hot water heating was not obligatory or even an option to consider. Even now, this use is not obligatory, but since the municipalities learned that district heating using wood chips is an option, they have invested in pipelines
C12: Scotland: wood chips case company	Grant aid for biomass boilers was available	Weak support from the state authorities that comprised the official support system. Regulatory and planning environment limiting the renewable energy options of the estate
C13: Scotland: pellets case company	The funding for the plant was 40% grants from the Scottish Biomass Support Scheme and 60% from the company's own capital. A policy 'window' was open for just a few months, but AWP managed to capitalize on it to provide support for setting up the plant	Needed licence to handle the waste (sawdust) produced
C14: Romania: district heating case company	Danish Agency for Environment Protection, the initiator and finance institution (28% of the total cost). EU support through the Phare Project (36% of the total cost). Romanian state institutions: the necessary legal framework was created for the implementation of the Sawdust 2000 project. The Romanian government, through the Romanian Agency for Energy Conservation and the town Municipality, supported 36% of the total cost of the project	No opposing factors identified

(bio)fuels (including wood and peat) was not allowed. In this way, the state protected its own electricity production monopoly. After changes to the Energy Act, the final planning of combined heat and power plants by private businesses could be initiated. When in the Estonian case enterprises began electricity production from wood, the state-owned company also started to use wood in addition to oil shale (in 2009). After that change in the local timber market, the biggest forest management organization, the State Forest Management Centre, created a new subdepartment: the Wood Energy Division.

In the French case (C4), the public authorities issued three calls for tenders for electricity generation from biomass in respect to the national objectives for increases in renewable energy sources (RESs). The national objectives are reinforced by the latest European and national legislation. The revised directive for the promotion of energy from RESs establishes an objective for France of 23% of energy being produced from RESs in 2020, strengthened by the new national legislation increasing the objective of electricity production from biomass (MEEDDAT, 2009). The calls for tenders created an opportunity for business, ensuring the sale of electricity produced at a predetermined price for a certain period (15–20 years). It provides guarantees on future revenues and increases the security of the investments. In electricity generation, the case company possesses both the technical skills necessary to run the process and opportunities in internal processes with chemical pulping. In this context, the calls for tender brought opportunities to realize the constraints.

The stimulating role of policy in supporting innovative activities that led to the implementation of clean technologies (e.g. heat production from biomass) can be clearly noted in the Polish district heating case. New biomass-fuelled boilers that replaced the old coal-fired ones were funded up to 95% with public money set aside by the government in the form of different eco-funds for eco-investments. Various policies that are often very general and only set directions for future development usually result in more specific documents specifying rules and financial means and measures that support the activities described in those policies. Such a situation enabled the district heating company to make use of financial means of eco-investment, thus contributing to the realization of the eco-policy. Using these methods of funding is often perceived as difficult, because the application procedures are complicated and require experience and knowledge. With this in mind, the importance of building networks, including financial consultancies, cannot be overestimated. Another stimulating instrument that had its origins in the policy and was specified in greater detail in resulting legal documents was the financial support for the willow plantation. Growing willow, which is considered an energy plant, entitles the company or farmer who wants to establish an energy plantation to certain financial assistance from the government. This measure encourages firms and formers to set up energy plantations, thus contributing to innovative activities. Yet another factor that contributed to the successful performance of the district heating company was the obligatory renewable energy quota that has to be met by all firms that deal in energy. This quota results indirectly from the energy policy. On one hand, this obligation requires solutions and innovations related to the use of renewables among firms dealing in energy. However, it also provides them the opportunity to sell their bio-energy production to energy giants, for example, who simply have to meet their obligatory quotas, leading to better financial results for the innovator. This dynamic can also be perceived as indicating the stimulating role of centrally adopted measures and policies.

The Polish pellets company case (C5) was not able to use public funding, because its application was not strong enough to secure such funding. When asked about political factors supporting innovative activities in the bio-energy sector, the CEO mentioned the favourable price relationship between woody and fossil fuels and the rising eco-awareness of the public at large. This eco-awareness could still be increased if proper advertising activities promoting woody fuels were used. Another opposing

factor that was indicated was the insufficient financial support to small firms innovating in the bio-energy area.

15.6 Discussion, Implications and Future Research Needs

A summary overview of the findings from the case examples is presented in Table 15.5. The case companies can be classified into pellet or chip producers and electricity and/or heating companies.

Most bio-energy companies in Europe, and most cases in this study, are SMEs. Several studies show that SMEs, in general, are less innovative than larger companies, but there is considerable variation among them (Kaufmann and Tödtling, 1999; Asheim *et al.*, 2003). However, there are also studies that indicate the opposite (Acs and Audretsch, 1988) and studies that find no differences in innovation related to company size. Some of the differences can be explained by varying definitions of innovation. Indeed, certain scholars have a more radical view of innovation and others a more incremental view.

Another complex relationship is the effect of innovativeness on performance. Many studies indicate a positive effect (e.g. Damanpour *et al.*, 1989; Deshpandé and Farley, 2004). Nybakk *et al.* (2008, 2009) studied forest owners and nature-based companies and found a significant relationship between innovation/innovativeness and performance. Thus, even if there is less innovation among SMEs and one-man firms, the importance of that innovation for economic performance can be just as significant. A last point is that there are considerable differences between industries. This result must

Table 15.5. Summary of the cases and findings.

Aspect	Pellets, chips	Electricity, heating
Innovative activities	Incremental improvements of autonomous processes Widening applications Business model	Systemic technological innovations
Size of firms	Smaller in comparison	Larger in comparison
Dominating drivers	Broader drivers are similar: environmental concerns, relative cost advantage, etc.	
	Internal (personal) initiative and knowledge	Combined initiative: internal (personal), network, government
Supporting networks	Mainly direct business networks: • Supplier involvement (equipment, other inputs) • User involvement (new applications)	Business networks: • Supplier involvement (cooperative procurement channels) • User involvement (local acceptance) Broader cooperation with (municipal) government offices, professional associations, banks and higher education institutions
	More informal networks	More formal networks
	National differences: network failures	National differences: network failures
Public policy	Subsidies for technology and R&D	Support more through regulations of price, quantities, etc.
	Effects of existing policy measures	Effects of both existing and anticipatory measures/ legislation
	National differences	National differences

be taken into consideration in the presentation of the different innovations in Table 15.2. Most of the innovations described in this study can be considered incremental. These innovations are new to the country (or perhaps only new to the firm) but do not mean that that they are of lesser importance for economic performance and growth.

Our study demonstrates that innovation champions are often very important for the realization of projects. The innovation champions may be employed at either private or public organizations or could be self-employed. Most projects are complex and require the power and initiative of a champion. From a policy perspective, an important issue is how the institutional framework for the establishment and operation of bio-energy plants can be made as simple as possible. This framework would create space for champions to operate more effectively. It should be stressed here that champions, often possessing not only innovative charisma but also good interpersonal skills, are usually very effective, even under adverse conditions. A general economic and legal framework can be more or less favourable to innovativeness, but even the best possible conditions can prove unhelpful when there is no personal leader who is keen on driving innovation forward.

Regardless, such an innovation champion does not exist in a vacuum. Several of the case studies indicate a positive relationship between external relationships and innovation. This finding is consistent with different traditions in the management and economics literature (e.g. Granovetter, 1973; Burt, 1992; Jenssen, 1999; Weiss and Rametsteiner, 2005; Nybakk *et al.*, 2008, 2009). Many of the bio-energy companies are small and do not normally innovate alone but rather do so in cooperation with others. Networking can contribute to innovative capacity and innovativeness among small firms by giving companies novel ideas and access to resources, as well as by transferring knowledge (Nybakk *et al.*, 2009). Accordingly, small firms that invest in networking with local actors will obtain an advantage via exposure to new ideas, by concentrating on core expertise and by finding new and better ways to run their businesses. External relationships and a larger social network are also linked to learning. A larger network improves the firm's understanding of its environment, resources, markets, customers and suppliers. This network fosters the implementation of new ideas, new products and new ways of running the business, and is consistent with both organizational management literature (e.g. Calantone *et al.*, 2002) and systems of innovation literature (e.g. Lundvall, 1992; Isaksen, 1999). Inter-organizational factors and networks are also of great importance among small wood bio-energy companies. An interesting research topic would be to examine the role of consultants, industry organizations (e.g. bio-energy associations), environmental organizations and business networks in creating framework conditions. By developing new policy instruments to promote networking and clustering in rural regions in Europe, policy makers can help to develop innovativeness among bio-energy companies.

Consistent with the industry structure of bio-energy companies in Europe, most of the case companies are small-scale. For these small companies, few significant organizational factors influencing innovation were identified. For example, most of the firms would not have their own research and development (R&D) departments or an employee working full-time on R&D. However, the organization of a small family business does present different challenges. Nevertheless, none of the drivers of innovation was linked to the cooperation within the owner's/managers' family in the present study.

Policy and policy measures played an important role in all cases. Energy policy is one of the most important policy fields for all governments, and there are numerous policy measures and public programmes concerning all energy systems. One observation is that policy measures are said to be decisive in many of the cases. To study the role of policy measures in more detail, one would have to consider each case in greater depth, but it seems that countries with an explicit policy regarding alternative energy have had greater success with bio-energy innovations. Furthermore, a tax on CO_2 emissions would make substitutes less competitive and would

be important to increase the use of bio-energy. Environmental policy drivers are obviously important, with policy regarding the reduction of GHG emissions (replacing coal firing or oil prices) especially essential. This policy is part of the rhetoric in many cases, but for there to be a real impact on decision making, the rhetorical arguments must also translate into policies, such as taxes on fossil fuels or capital and ongoing support for bio-energy (e.g. subsidies and calls for tenders). Another important factor is the supply of cheap raw materials. In some cases like Romania (C14), the abundance of raw material constituted an environmental problem and was a very strong driver of bio-energy innovation.

A range of other factors emerged as important in different cases. Price development and expected price development of substitutes obviously play an important role because energy markets are volatile and future price development paths are difficult to foresee. Technological development was important in some cases, but until recently, more research money has been used for conventional energy sources than for bio-energy. Thus, it is difficult to foresee if there will be any major innovations in the near future concerning bio-energy systems. In many of the cases, the bio-energy solutions were quite new to the market, markets were poorly developed and many actors that did not usually cooperate had to cooperate to arrive at a solution. All of this indicates high transaction costs. Another indicator for high transaction costs is relatively long planning times for the projects. Comparing transaction costs for bio-energy investments in different countries would be an interesting future research topic.

Much rhetoric is deployed at the European Union level about a 'level playing field' for European producers, but, in the case of European wood energy production, this does not exist. Some countries have provided substantial policy support for wood energy over a long period. In other cases, positive policy developments have been more recent. This study did not explore the policy means in great detail, but it can be concluded that the conditions for innovation created by policy vary widely.

The wood energy developments explored are predominantly, but not exclusively, small-scale. Some larger-scale operations were examined in Romania and France based on the exploitation of waste or by-products. It seems probable that wood energy production will continue to embrace both small firms operating in predominantly local markets and much larger undertakings. This creates space for different types of innovation, but in most cases, the innovation will be incremental rather than profound and based on process and supply chain development. Innovation in the policy environment can also be an important supporting factor. Indeed, it is the unwillingness of those in the policy community to put a price (or the right price) on carbon emissions that is probably the biggest single obstacle to the development of bio-energy from wood. However, the widespread availability of low-grade wood products, wood waste or waste heat from paper-making creates an opportunity for bio-energy production that has been exploited, more or less successfully, by the operators of our case studies.

In summary, although supply availability was occasionally instrumental in stimulating innovation, the decisive factor in wood heat developments is more often changes in the market or policy environment and a champion who is prepared to make the effort (either as a private or a social entrepreneur) to develop local projects. In general, the innovations observed were incremental rather than fundamental but, in sum, represent a significant development in wood energy systems.

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IV

Teder, M., Mizaraitė, D., Mizaras, S., Nonić, D., Nedeljković, J., Sarvašová, Z., Vilkriste, L., Zalite, Z., Weiss, G. 2015. Structural changes of state forest management organizations in Estonia, Latvia, Lithuania, Serbia and Slovakia since 1990. Baltic Forestry, 21(2): 326─339.

Structural Changes of State Forest Management Organisations in Estonia, Latvia, Lithuania, Serbia and Slovakia since 1990

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Teder, M., Mizaraitė, D., Mizaras, S., Nonić, D., Nedeljković, J., Sarvašová, Z., Vilkriste, L., Zālīte, Z. and Weiss, G. 2015. Structural Changes of State Forest Management Organisations in Estonia, Latvia, Lithuania, Serbia and Slovakia since 1990. *Baltic Forestry* 21(2): 326–339.

Abstract

All former socialist countries in central and eastern Europe have been undergoing a transition from one political system (based on a centrally planned economy and a one-party system) to a radically different political system (based on a market economy and a democratic political system). The formation of a free timber market and new modes of ownership have caused a change in the state forest sector as well.

The primary objective of this article is to demonstrate the changes in state forest enterprises over the last 20 years in five selected countries of central and Eastern Europe: Estonia, Latvia, Lithuania, Serbia and Slovakia. Country case descriptions of the situation are based on literature analysis, statistical data and expert opinions.

The main findings of this study are the following: changes in ownership structure caused a reduction of the area managed by state forest management organisations in most case study countries; in all mentioned countries state forest enterprises have underwent changes in their organisational structure ; a reduction of personnel in state forest enterprises and an increase in outsourced activities were observed. Methods of timber sales have altered during the last 20 years; in several countries, the state forest management organisations play a role in stabilising the domestic timber market. The importance of forest values, such as environmental protection and forest-related recreation, is also increasing in the state forest sector.

Key words: forest ownership, state forest enterprises, organisational changes, central and eastern Europe

Introduction

All post-communist countries in central and eastern Europe (CEE) have been undergoing a transition from one political system (based on a centrally planned economy and a one-party system) to a radically different political system (based on a market economy and a democratic political system). Several new phenomena have emerged in the forestry systems of these countries too, such as: privatisation of the forest industry, the formation of a free timber market, increasing timber exports, as well as new modes of ownership (e.g. private forests and communal forests) and enterprises (e.g. private logging companies). All these changes have influenced the state forest sector.

Hare and Huges (1991) have stated that no theories for reforms have been developed regarding state forest enterprises (SFE). Generally, this means privati-

sation, usually in the form of outsourcing, selling or divesting licences. This method is used quite frequently in privatising state property, although some criticism for the approach in CEE countries exists (Hare and Huges 1991). Several approaches can be identified, including reprivatisation, which means restitution or compensation paid to former owners, direct sale of assets either to a single buyer or through an initial public offering of shares), and free distribution (to the whole population, the workforce of particular enterprises, or other institutions). State organisations can also be commercialised, i.e. converted to corporate forms.

Privatisation is an essential first step in the marketisation process. Privatisation has bloated (Yamin 1998) the size of the private sector, and because many state-owned enterprises were small and medium-sized enterprises (SMEs), it is considerably increased the number of SMEs in the private sector. Assaf (1998) notes that privatisation is a major instrument of the transformation because it develops SMEs in the former European communistic countries.

The knowledge about discrepancies in the path and policies of economic transition can support private sector development in countries expecting to undergo privatisation processes. CEE countries are known to use the "shock therapy" approach and the East Asian "gradualism" approach (e.g. Marangos 2003, Dehejia 2003 and Katz 1995). Katz (1995) describes the CEE "shock therapy" approach as either the shift of economic decision-making to the private sector and the exclusion of government intervention in the national economy, or private enterprises operating in a framework of market-determined prices, but abolishing the need for public sector involvement on the macro-level in a national economy. In early discussions between shock-therapists and gradualists, the speed of transitions was in the centre of the debate; however Popov (2000) argued that the strength of the new institutions is more important than the speed of the process.

The privatisation of state-owned companies can be carried out in different ways. Several voices prefer SMEs as alternatives to former state owned enterprises, while highlighting the need for an even distribution of large, medium, and small enterprises (Alam et al. 2009, McIntyre 2001). As an alternative to complete privatisation commercialising company functions has been found an option. Some positive examples have shown that commercialising can be instrumental to give hold to corruption that is frequently associated with privatisation processes (Alam et al. 2009).

Many successful SMEs in CEE are in fact not new, but are often spin-offs of pre-existing state-owned companies, cooperatives or transnational companies (Dallago 2003). Similarly, Klapper et al. (2002) have noted that many present-day companies are the result of restructuring and downsizing large firms, privatisation, or outsourcing of support services and vertical fragmentation of products.

If a centrally planned economy is transformed to a market-oriented economy, the reduction of government ownership in business is a necessary condition. However, a smaller or weaker public sector may also hamper private sector growth, as experienced by some CEE countries, when they kept private enterprises operating in a framework of market-determined prices, but eradicated the public sector involvement (Katz 1995).

Regardless of the political and cultural context, in the early stage of the economic transition process, when institutional support and market conditions are not apparent, the state and public sectors play key roles in determining the success of establishing the private sector (Dallago 2003). In this sense, strategies to restructure the often inefficient state-owned companies to better meet the requirements of a global world are an essential part of privatisation.

The forestry sector plays an important economic and environmental role in Baltic countries (Estonia, Latvia and Lithuania) and in other selected eastern European countries (Serbia and Slovakia). The domination of state forest ownership, state capital goods and centralised planned management characterised these countries until 1990. A reduction in state forest areas and the development of market relations influenced the state forestry transformation after 1990. This resulted in the restructuring of state forest management organisations (SFMO).

Earlier studies covering the target countries and forestry related organisations' development have mainly focused on private forestry and its organisations (e.g. Weiss et al. 2012), or focus on SFMO development in a single country (e.g. Larsen and Brukas 2000, Deltuvas et al. 2006, Dudutis and Lazdinis 2008). Nordberg (2007) examined the reforms of state forest management in three post-Soviet republics, among them only Latvia is in the scope of this study. The present article concentrates on the organisational structure and changes in SFMO (e.g. type and number of enterprises), and on changes in the implementation of forestry activities and functions fulfilled by SFMO. The primary objective of this study is to identify the major changes in state forest enterprises and their altered functionalities over the last 20 years in the five selected central and eastern European countries.

Materials and Methods

The current study uses the definition by EUSTAFOR (2014) that the state forest management organi-

sation (SFMO) is a commercially oriented, state-owned forest company, enterprise or agency, which executes sustainable forest management and wood production as its major concern. In all observed countries, the term "state forest enterprise" was mainly used under socialism prior to the large changes at the beginning of the 1990s. To describe the situation in 2010, the abbreviation SFE for a state forest enterprise is only used in cases, when this term is actively used in a specific country.

The analysis covers Estonia, Latvia, Lithuania, Serbia, and Slovakia, which have similar forest resources: a forest area of approximately 2-3 million ha and forest cover between 31 and 54%. The growing stock is between 400-600 million m³. The coniferous forests are dominating in the Baltic countries, whereas in Slovakia and especially in Serbia broadleaved species are dominating (Table 1).

Table 1. Statistical forestry data of the countries studied (2010)

Country	Forest		Growing stock			Fellings	
	×1000 ha	% of land area	million m³	m³/ha	Coniferous %	× 1000 m³	m³/ha
Estonia	2203	52	441	200	55	5714	2.8
Latvia	3354	54	633	179	53	12421	4.0
Lithuania	2165	35	479	221	57	8600	4.6
Serbia	2713	31	415	153	12	2696*	1.2*
Slovakia	1938	40	514	265	45	10418	5.9

Source: MCPFE 2011, *SORS 2011

The analysed countries have developed legal forest policy frameworks: the forest law and the national forest programmes. All selected countries started revising their forest management related legislation after the collapse of the socialist camp and during the political changes in the early 1990s; the exception is Serbia, where the revision started only in 2000.

To describe the situation regarding state forest enterprise restructuring on a national level, a combination of two methods was applied: a country case description based on (i) literature analysis and (ii) expert knowledge and questionnaire survey. The study is based on the hypothesis that state forest enterprises have been reorganised. The reorganisation of SFMOs includes a new organisational structure, a change in legal status, rational restructuring of labour force (reducing the number of employees), and a change in forest management activities.

The restructuring of SFEs in each country was analysed according to changes of several topics in 1990 and in 2010: managed forest area, number of enterprises, type of SFMO, felling intensity, outsourcing and types of forestry operations, persons employed, method of timber sales, relations with the private forest sector, major services delegated to SFMO and nature protected areas.

Country case studies

Estonia. The big changes resulting from restructuring the state forest management system had been discussed already at the end of the socialist period, from 1988 to 1990, as a part of the programme of self-sufficient Estonia (Etverk 2005). The first big reforms in the state forestry started on March 01, 1992, when forest management (state forest districts) was separated from the industrial parts of SFEs, which were later privatised. As a result of these reforms, 186 legally independent state forest districts were established under the supervision of the National Forestry Board. During the years 1995–1997, the Estonian Forestry Development Program (EFDP) was carried out with technical assistance by the Government of Finland (Kallas 2002). EFDP partly prepared new ideas and structures for the next changes in Estonian state forest management. In 1997, the number of state forest districts was reduced by 71 by merging the districts, while some districts had been merged already in 1993 – 1996. Finally, on 01 January 1998 in Estonia there were 102 state forest districts.

The new version of the Estonian Forest Act in December 1998 created a legal base for the new structure of state forest management. The act was a legal base for the establishment of the profit-making state agency, the State Forest Management Centre (in Estonian *Riigimetsa Majandamise Keskus* hereafter referred to as RMK). Following the Forest Act (1998), among other tasks, the RMK has to generate income and transfer revenues to the state budget. In addition to sales of wood to timber industries in an amount that ensures the balanced incomes to state budget from woodworking industries, the RMK holds mechanisms to apply, which stabilise the timber market. The RMK started operations in January 1999, after which the majority (except for mainly educational forests) of the state forest management was centralised into one legal entity. By its legal status the RMK is a profit making state agency, the only legal entity of that kind in Estonia. At the end of the second year of RMK activities the number of forest districts decreased to 77 and their work was organised in 5 regions. By the beginning of 2008 the number of forest districts was decreased to 63. When RMK started to operate at the

beginning of 1999, the total staff was 2,280, gradually shrinking to 1,658 in 2001, 1,179 in January 2006, and 1,118 employees at the beginning of 2008.

The structural reform in state forest management was carried out in 2008, when on 1 July a functional management scheme replaced the previous territory-based management. Under the territory-based management the local forester was responsible for all activities in his forest district, but the new functional management scheme has created a very narrow specialisation of forestry specialists. Following this scheme, in the same forest area different forestry specialists are responsible for different activities, but their management territory is considerably larger than before. After the reform the RMK forest administration is performed in 17 forest administration districts, and forest management activities are carried out in three regions. After the reform in 2008, the number of staff decreased to 836 at the beginning of 2009. At the end of 2010, 851 employees (454 foresters and other specialists, 345 workers, 52 directors and other administrative officers) worked in the RMK. In addition to direct employment, the RMK estimated that the total number of people employed in the state forest sector was 4,000 including outsourced personnel (RMK 2011).

RMK operating areas are: forest administration, forest management, timber marketing, preservation of the natural environment and recreation management, seed and plant management. The RMK has to earn income for the state by logging and selling wood material. Apart from that, the RMK has tasks that do generate direct economic income, but are to bring benefits for the whole country: maintaining the unique forest nature, nature friendly forest works, offering free recreation possibilities. In 2011, the RMK quit dealing with hunting services; suitable hunting areas are rented out by means of public auctions to hunting organisations.

In 1988, different nature protection categories in the forests of the 1st group covered 28.1% of total forest land, while in SFE forests their share was 30.1% (MNFC 1988). In 2010, the state forests under the RMK management were divided as follows: managed forests (commercial forests) comprise 63.7%, forests with economic limitations (corresponding to protection forests) comprise 19.7% and strictly protected forests constitute 16.6% (RMK 2011).

Until 1990, harvesting operations in final cutting were mostly performed on stumpage basis by another type of forest harvesting enterprises. The SFEs carried out mostly thinning operations, and to minor extent final fellings. In 2010, about 90% of wood harvest operations in the RMK forests were performed by contractors. The RMK is responsible for delivery of roundwood to buyer yards, while the lorry transport is outsourced. In 2010, the RMK sold 2.87 million m^3 of timber products, out of which 90% was sold as roundwood assortments and only 1% as stumpage (sanitary fellings for firewood and for local people). The rest (9%) was mostly sold as forest chips and a small amount as forest residuals (RMK 2011, Yearbook Forest 2010). Until 1990, afforestation, reforestation and forest protection was performed by SFEs. In 2010, half of these activities were done by the RMK, while the other half was outsourced.

Latvia. At the end of the socialist period, 24 SFEs, Gaujas National Park, 2 Nature reserves, Kalsnava Forest Research Station and Ogre Training Centre were managing the state forests (Saliņš 1999). In 1988, the SFEs managed 1,745 thousands ha or 63.3% of forest area, agricultural enterprises (collective farms) managed 916 thousands ha and other forests covered 96 thousands ha. At the end of 1988, there were 637 forestry specialists in agricultural enterprises and 2,414 in the SFEs (Grišāns 1990). The felling quantity in the state forests was 3.8 million m^3 in 1989. There were 43 sawmills and 31 carpentries or other timber processing units under the SFEs (Kronītis 1991). In 1990, the total felling amount in Latvia reached 5.0 million m^3 (Saliņš 1999).

In 1990, supervision, control, planting and road constructions were separated from the SFEs. The Forest Ministry was established, and 34 forest regions with 250 local units and 1,800 districts of forest rangers were initiated (Saliņš 1999). In 1993, the Forest Ministry was reorganised to the State Forest Service (SFS). In 1995, 32 forest regions, Gaujas National Park and training, education and research institutions were under the SFS.

At the beginning of 1990s, most of the SFEs were closed due the bankruptcy; only about 7 to 9 of them kept their positions in the market. During 1993 – 1996 most of the previous SFEs were privatised and forest harvesting became a private business. Long term logging contracts (LTLC) for 10 to 20 years were facilitated by the state to support stable deliveries to industries (state order was 50% from harvesting volume). In 1993, about 46% of harvesting volume was sold through LTLC, 5% in auctions and 49% to municipalities for social needs, forest regions and other consumers. In 1998, the same figures changed to 63%, 27% and 10%. In 1997, there were about 900 harvesting enterprises and 320 of them had LTLCs. The system of LTLCs ended in 1998, but 327 LTLCs were still in force under the new system in 2000 (Saliņš 1999).

In 1998, the forest policy of Latvia was approved. The Latvia–FAO Project "Optimization of state administration system of the Latvian forest sector" (1998-

2000) prepared a conception for reforms of state administration and policy implementation. Based on this project the administration and management of the state forest sector was reorganised and the new system entered into force in 2000.

The Latvian Ministry of Agriculture is responsible for the development of forest policies and legislation. The SFS controls and supervises forest management practices in all ownership types. It also carries out fire protection and maintains a forest register. A new commercial structure, the state-owned joint stock company "*Latvijas valsts meži*" (Latvian state forests, further as LVM) was established in October 1999 by the order of Latvian Government to ensure effective management of state owned forests. The Latvian State, represented by the Ministry of Agriculture, is the shareholder of the LVM. After the reorganisation in 2000, there were 26 forest regions under the SFS with 1,600 employees and the LVM with around 500 employees (DFSL 2001).

The LVM provides sustainable management of state forests and runs tree nurseries to produce seeds and plants, but also deals with hunting, fishing, recreation and tourism, and supports education and research.

In 2010, 1.63 million ha of land was under the management of the LVM, from which 1.59 million ha was forest land (1.4 million ha forest) (LVM 2011a). In accordance with the accepted strategy, nature protection is the main target in 21% of the total area managed by the LVM. 5% from the total land area are managed for recreation and nature education, while 74% of the total area are designated for timber production (LVM 2011a).

In 2000, the LVM sold 3.72 million m^3 of timber (2.9 from final fellings). In accordance with the "Sale Concept for Growing Trees in 2001 – 2003" 67% of timber were sold under the provisions of LTLC and 33% were sold in auctions of felling areas. The income from the sales of growing trees made 91.5% of the total income, while the rest was generated from renting the hunting areas, sales of seeds and plants etc. (LVM 2001). Selling of roundwood in auctions started in 2003. All activities are based on open tenders for roundwood delivery, harvesting and transport services. Since 2003, the share of roundwood assortments has been increasing every year reaching 69% in 2010 (LVM 2011b).

The allowable cut for a 5-year period for the LVM is approved by the Latvian Government. For 2001 - 2005 the allowable cut comprised 15.6 million m^3, for 2006 – 2010 it was increased to 20.5 million m^3. During the economic crisis in 2008, the sales from private forests decreased. As the forest sector has an important role in the Latvian economy, the allowable cut was extended by the government up to 24.5 million m^3 during the economic crisis in order to stabilise the national economy and to support the national woodworking industries and rural employment with the consequence that the LVM was cutting more than on average before. Whilst before 2007 the felling amount per year did not exceed 5 million m^3, in 2008 it was 5.5 million m^3, in 2009 and 2010 it was around 7.7 million m^3. After the crisis, the volume of felling decreased to 6.7 million m^3 in 2011 (LSFS 2013)

Lithuania. From the years 1957 to 1992 several structural reforms have been implemented in the forestry sector. In 1987 Lithuanian forests were managed by 10 forest enterprise associations, four state forest enterprises and 10 forest industry companies. One year later in 1988 this was organised by 8 forest enterprise associations, 20 state forest enterprises, 15 forest industry companies, one national park and one experimental station. Later, enterprise associations were reorganized to state forest enterprises while forest industry companies abolished (LRAM 2003). Before the restoration of independency (1990) about 31.8% of total forests area were managed by agricultural enterprises. According to data of state forest inventory in 1988 the forest enterprises and the national park managed 1490.9 thousand ha or 68.2% of forest land (LRAM 2003). After the structural reforms, 43 SFEs and 4 national parks were established. In 1992 the protection and the limited management of forests by agricultural enterprises was delegated to the newly reformed SFEs. The structure of forest ownership had changed due to an ongoing land reform process. In Lithuania, the land reform and restitution started in 1991 and further influenced the development of SFEs activities.

In 1996 the Directorate General of State Forests at the Ministry of Environment was established. This institution was designated as a coordinator of the activities of SFEs. The Directorate General of State Forests establishes the mandatory norms for forest enterprises regarding reforestation, protection and management of forests; organises and co-ordinates the application of advanced technologies in reforestation, protection, improvement and utilisation of forests and forest resources. In 2000 the number of SFEs was reduced from 43 to 42 and the management of forests areas in three national parks was delegated to SFEs. The activities of state enterprises are regulated by the Law on State and Municipal Enterprise, the Law on Forests and other legal acts and regulations.

The number of persons employed in the forest enterprises was reduced from 14.6 thousand (1990) to 9.6 thousand (2010) (LRAM 2003, LSYF 2011). This reduction was applied in all personnel categories and can be assigned to several reasons: 1) the significant

share of forestry works (reforestation, forest maintenance, felling etc.) was transferred to contractors; 2) sawmills of SFEs were sold to the private sector; 3) the managed forest area decreased due to the restitution to former private forest owners; 4) hunting activities were transferred to other organisations, and pine resin collection was eliminated in state forests; 5) new technologies or machinery were less labour-intensive.

In 1990, all forestry work was performed by SFEs. In 2010 forest logging, reforestation and afforestation were mainly implemented by contractors: felling of trees amounted 93%, timber extraction amounted 65%, and timber transport amounted 68%. The intensity of forest utilisation increased from 2.3 m^3 per ha (1990) to 3.5 m^3 per ha (2010).

In 2010 only 8% of wood were sold on stump with the main part as roundwood. In 2013 the electronic auction system of roundwood sales started to operate in Lithuania. This system ensures transparency of roundwood sales in state forest sector and attracts larger timber buyers, who can pay higher prices.

Since 1995 Lithuanian forests have been divided into 4 functional groups: I – forests of strict nature reserves, II – special purpose forests – ecosystem preservation and recreation, III – protective forests, and IV – commercial forests. Nowadays (2010), 28.7% of state forest area are nature protected forests. In 2010, the forests under SFE management were distributed as follows: strict nature reserves (group I) comprised 2.5%, special purpose forests (group II) constituted 15.0%, protective (group III) amounted 11.3%, and commercial forests totalled 71. 3% (LSYF 2010).

According to the Law on Forests of the Republic of Lithuania, consultation and training of private forest owners is financed from the Programme of State Budget for Financing General Forestry Needs (National Report 2013). SFEs are among other institutions involved in the advice and training of private forest owners. The SFEs provide advice to private forest owners on forest management issues and further forestry services. In 2010 SFEs organised 54 training courses attended by 764 private forest owners, and gave advice on forestry to 13,147 private forest owners, and sold 12.8 million tree seedlings.

In recent years, there has been a strong public demand for recreational services. The adaptation of recreational objects in the forests for the needs of disabled is a new phenomenon in Lithuanian state forests. During the last years, over 2,000 recreational facilities have been installed in the state forests. More than 200 of these facilities have been adapted for people with motion disabilities.

Serbia. The Law on Forests from 1991 introduced significant changes in the organisation of state forest management in Serbia. It was centralised by incorporating management of all state forests in one state enterprise (SE) for forest management, i.e. "Srbijašume". A smaller part of state forests with a predominant protective function was not covered within the "Srbijašume" forest areas. For management of these forests, separated state enterprises of national parks (Tara, Kopaonik, Fruška Gora and Šerdap) and a state enterprise for the management of protective forests "Borjak" from Vrnjačka Banja were established during the period after 1991.

Until 2000, SE "Srbijašume" comprising 27 forest estates performed forest management and utilisation in the state forests over the whole territory of Serbia. Before restructuring, the parts of "Srbijašume" included three wood processing enterprises and one enterprise for production of food, mineral water and other agricultural products. Restructuring of SE "Srbijašume" started after democratic changes in Serbia (October 5, 2000), based on the programme of economic, organisational and technological changes, and on the initiative of the Government of the Republic of Serbia (Nonić et al. 2011). This included the following activities: privatisation of subsidiary enterprises; separation of non-core activities; renting of forest mechanisation to former employees with the right to buy it, and thus rendering them business partners; optimising and reducing the number of employees through social programmes; separation of the institute for forestry as an independent research institution; reorganising the loss-generating parts of SE etc. The reorganisation of SE "Srbijašume"[1] intended to reduce the number of employees from 9,183 employees in 1992 (Vučićević 2007) to 3,310 in 2010 (Srbijašume 2010) through a programme that would allow employees to become contractors and, eventually, business partners of SE, while utilising the forests (Nonić et al. 2012).

In accordance with the Law on Establishing Specific Competences of the Autonomous Province, 4 forest estates from the territory of Autonomous Province Vojvodina and "Srbijašume – lovoturs" separated from SE "Srbijašume" in late 2002 and formed a new public enterprise for the management of state forests, "Vojvodinašume". Currently, there are two independent SEs managing state forests: SE "Srbijašume" (in Central Serbia) and SE "Vojvodinašume" (in Vojvodina). SE "Srbijašume" manages 850,752[2] ha (i.e. 71.3% of all state forests in the country) while SE "Vojvodinašume" manages 129,878[3] ha (i.e. 10.9% of all state forest area).

The basic activities of these enterprises are: management of state forests, enhancement and utilisation of multiple benefit functions of forests (including management of protected areas), production of forest

assortments, and exploitation of other forest products and forest recreation, game breeding and hunting. Beside these basic activities, both enterprises perform professional forestry service in private forests.

In Serbia, there are also five national parks. Each national park is managed by its own SE, which were established in 1993, based on the law on national parks. In the national parks, there are three zones of protection. In the 3rd zone certain activities, such as forest management and utilisation, are permitted. The SEs of national parks manage around 100,000 ha of forests (Nonić 2010).

Slovakia. Forests are divided into the following categories according to their use – commercial forests (71%), protective forests (17%) and special purpose forests (12%). Around 200 thousand ha or 9.2% of forests are still reserved for restitution to unidentified owners (MASR 2011).

Until 1990, forest management had evolved in the framework of centrally planned economy. State forests (including military forests, educational forests and forests managed by the Ministry of Industry) managed 99% of the total forest area (Longauer et al. 2001). Private ownership and use of forests was in practice already up to 1977, until the forest act No. 61/77 and the act No. 100/77 on management in forests and state administration of forestry came into force and abolished "de facto" private use of forests, although private ownership "de jure" was preserved. At that time 99.14% of forests were managed by state forest organizations, while cooperatives used 0.81% and private owners 0.05% of forests (Sarvašova and Tutka 2005). The forestry sector employed 36,000-42,000 persons, then 2% of the economically active population of Slovakia (Lacko 1993). Forest land was managed by forest enterprises, commercial organisations, which were directly embedded in the state budget and centrally planned. Income from production activities (92% from wood products) was insufficient to cover costs, that is why forestry was subsidised by the state budget (Tutka 2000). After 1991, state funds for forestry assistance have been utilised by offering subsidies (Ilavský 2000, 2006), after 1990, Slovakia started the forest restitution process (Belacek 1997, Weiss et al. 2012). The Act on Regulation of Ownership Rights to Land and other Agricultural Assets, e.g. the Land Regulation Act, governed the issues relating to forest land (Schmithüsen and Hirsch 2010).

During the last decades, the organisational management structure of state forests has been modified. Nowadays, in Slovakia the area managed by the state (including rented forests from private owners) is about 55% or 1,066 thousand ha of the total forest area. Forests owned by the state are managed by the state organisations of forestry (educational forests are excluded) as follows:

• Organisations belonging to the competence of the sector of the Ministry of Agriculture of the Slovak Republic are: "Lesy SR" state enterprise including Forests of the Slovak Republic (manages 920 thou. ha); Forest-Agricultural Estate"Ulič", state enterprise (21 thou. ha) and State Forests of the Tatra National Park (38.8 thou. ha).

• Military Forests and Estates of the Slovak Republic, state enterprise (67 thou. ha) belongs to the competence of the Ministry of Defence.

Because of the share of managed forest area and the role in state forest sector (e.g. price maker) the major actor is "Lesy SR" state enterprise. The activity of "Lesy SR" state enterprises is described in the special order approved by the Minister of Agriculture in 1999. The forest enterprises provide some forest management services, such as seed purchase, or sale of wood using their own capacities. The remaining forestry operations are entirely outsourced, for example, private companies perform regeneration, afforestation, harvesting and tending, or forest protection activities. Besides the forestry issues, one of the basic goals of forest policy in Slovakia is to enhance multifunctional (functionally integrated) management of forests and protection of the potential of their functions. Ecosystem services, especially outdoor recreation in forests, environmental education, game and wildlife management have gained additional importance. The number of persons employed in the forest enterprises reduced from 34 thousand to 3.6 thousand (MASR 2011).

Cross-country comparison

Today, while all forests were nationalised in most countries during the socialist era (with the exception of Serbia and Slovakia), state forests comprise less than half of all forest area in the case study countries (Table 2). In the observed countries, the situation differs slightly. In Serbia, in the period after World War II, half of the forests were in state ownership and managed by the SFEs, the other half was in private ownership and managed by private forest owners. In Slovakia, the *de iure* private ownership has never been abolished; forests in the cadastre database were registered to the owners, but managed by state enterprises. In the Baltic countries, during the socialist era, nearly all forests were in public ownership but they were managed differently. Some forests were managed by the SFEs, while the rest of them was managed by agricultural collective farms. The forests managed by the SFEs were generally state-owned before 1940 and they remained state-owned after the large changes that took place in the early 1990s. Forest areas that were

in private ownership before World War II became a part of collective farms, and after the changes in the 1990s, they were either restituted or privatised.

Political and economic reforms in many central and eastern European countries have led to a change of forest sector ownership structure. In the majority of countries (excluding Serbia) the state owned and/or managed ones made up to 90-100% of forests (Table 2) in 1990. After the changes and reforms at the beginning of 1990, state forest ownership was approximately 50% in Latvia, Lithuania and Serbia, but less in Estonia and Slovakia, where it was approximately 4 0%. Four observed countries are new members of the European Union (EU) and one is a candidate (Serbia). The average public ownership for the new EU members (category EU N12) was 67.3%, whereas for all EU members the average public ownership was only 39.7% (RDEUSEIR 2012).

Table 2. Forests by ownership categories in 1990 and 2010

Country	1990[1]				2010			
	Forest area, ×1000 ha	Ownership/management by categories (%)			Forest area, ×1000 ha	Ownership by categories (%)		
		private	state (public)	other		private	state (public)	other
Estonia	2090	-	100.0	-	2212	45.3	39,9	14.8*
Latvia	3173	1.0	98.7	0.3	3354	47.0	50.3	2.7
Lithuania	1945	-	100.0	-	2160	38.4	49.4	12.2*
Serbia	2313	50.6	49.4	-	2252	47.0	53.0	
Slovakia[2]	1922	-	100.0	-	1939	49.9	40.9	9.2*

[1] Sources: Data for 1990: FRA 2010 Country reports.
Data of the year 2010: Estonia – Yearbook Forest 2010; Latvia – LAM 2011; Lithuania – LCYF 2010; Serbia – SIRS 1983, Banković et al., 2009; Slovakia – MASR 1996, MASR 2011. All percentage calculations were performed by authors.
[2] Slovakia – management categories
* Forest land subject to privatisation (Estonia national category) or reserved for restitution (Lithuanian and Slovak national categories)

The major forestry reforms were generally carried out at the beginning and middle of the 1990s, in Serbia it happened one decade later. For the preparation of national forestry reforms, all the observed countries have used know-how support or consultancies from other countries or international organisations. The reforms in state forest management have been carried out differently; there are no similar patterns for all the case-countries.

The political and economic reforms and the introduction of a market economy in all observed countries have influenced the state forest management enterprises. The economic activities of forest enterprises, which were not related to forest management (e.g. sawmills), were privatised in the early 1990s. The activities related to forest management have undergone different reforms. The number of SFMOs decreased in some countries (Estonia and Latvia), where only one legal institution (excluding forestry schools and universities, military areas) is dealing with the state-owned forest management. In Slovakia, the number of state enterprises also decreased. There, the majority of commercial forests are managed by the state enterprise Lesy SR, a smaller proportion is managed by the Forest-Agricultural Estate Ulič. In Serbia the second SFE "Vojvodinašume" was formed (2002) from the previous unique "Srbijašume" (established in 1991) (Table 3).

The number of SFEs in Lithuania during the last decades has not changed, but their functions were slightly modified. For example, the SFEs started to play a very strong role in providing recreational services for the society, as well as advisory and forest-related services were offered to private forest owners.

In 2006, a study on state forest sector development was carried out by researchers of Lithuanian University of Agriculture (currently Aleksandras Stulginskis University). Five alternative proposals were presented for state forest sector development: 1) to maintain the structure of 42 state forests enterprises without changes; 2) to merge less efficiently operating state forest enterprises with neighbouring enterprises; 3) to organize large regional units (e.g. out of 10 units); 4) to establish associations of state forest enterprises; 5) to establish one state forest enterprise (Deltuvas et al. 2006). Despite of the heavy discussions about merging the 42 SFEs, changes were not adopted by the Lithuanian parliament decision in 2010 (Resolution 2010).

At present, the state owned commercial forests are managed by the following types of organisations: 1) state-owned joint stock companies such as in Latvia, or 2) state enterprises or other types of profit making

Table 3. Number of SFMOs that manage commercial forests

Countries	1990	2010
Estonia	22	1
Latvia	24	1
Lithuania	43	42
Serbia	1*	2
Slovakia	9	2

*established in 1991

agencies such as in Slovakia, Estonia, Serbia and Lithuania (Table 4).

Table 4. Types of SFMOs

Types of SFE	Estonia	Latvia	Lithuania	Serbia	Slovakia
			1990		
Under public administration	+	+	+		
State enterprise under law on state enterprises				+*	+
			2010		
Joint stock company		+			
Profit making state agency	+				
Under law on state enterprises			+	+*	+

* SE "Srbijašume" was established in accordance with the Law on Forests from 1991 and SE "Vojvodinašume" was established in accordance with the Law on Establishing Specific Competences of the Autonomous Province Vojvodina from 2002

In Serbia and Slovakia separate state forest administration and state forest management enterprises for state forest management had existed during the socialist era. In Estonia and Latvia, they were not separated after the countries became independent, different state administrative tasks were separated from the state forest management related activities, and new governmental organisations were established (currently, Environmental Board in Estonia and State Forest Service in Latvia). The state forest administration and state forest management functions were separated in Lithuania as well, but the separation level was not as strong as in Estonia or Latvia. In 1996 the Directorate General of State Forest was established for coordination of SFE activity.

The level of forest utilisation has generally increased, as felling intensities in four countries confirm. In Serbia it has remained on almost the same level (1.70 …1.98 m^3/ha/year), because there were no major changes in the system of state forest management planning and organisation (Figure 1). The trend for Latvia shown in Figure 1 demonstrates the state influence in overcoming the national economic crisis: in 2009 the felling intensity increased significantly (5.52 m^3/ha/year) and then for the year 2012 decreased (4.11 m^3/ha/year) to the same level of Estonia, Lithuania and Slovakia.

In forest management-related areas the previous institutional structures operated with low efficiency, but due to reforms, the number of staff decreased and efficiency increased. The rationalisation and innovations of the forest sector have also influenced forest management activities, and currently, the implementation of many forest operations has been transferred to contractors (Table 6). All the countries outsource a major part of harvesting services; the level of outsourcing of timber transport services depends on the forms of timber sales. Reforestation and forest protection services are not as actively outsourced as services related to harvesting.

Table 5. Outsourced forestry operations of SFMOs in 2010*

Forestry operations	Estonia	Latvia	Lithuania	Serbia	Slovakia
Harvesting	M	M	M	M	M
Transport to buyers	M	M	M	M	S
Afforestation, reforestation	H	M	M	N	M
Forest protection	H	M	S	N	M

* N is for none, S is for some, H is for half, and M is for major part or all

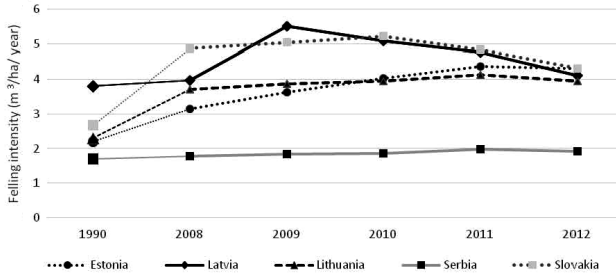

Figure 1. Felling intensity of SFMOs
Sources for 1990: Estonia (instead of 1990, data for 1988 is given), MFNC 1988: Latvia Kronītis 1991, Lithuania LSYF 2010; Serbia Vučićević 2007; Slovakia MASR 1996. Sources for 2008 – 2012. Estonia - Yearbook Forest 2013, the rest – authors calculation

Technical innovations in forestry operations, development of all types of computer based forest information systems and electronic timber sales possibilities, on the one hand, and outsourcing, on the other, have influenced employment in state forestry; these processes have led to a reduction in the number of staff (Table 6). As the outsourcing schemes are different, total forest management practices differ by countries and it is difficult to estimate the influence on employment in the national forest sector. Based on the Estonian estimate, one person employed in the SFMO gives additional employment to approximately four persons in the private sector (RMK 2011). The outsourcing provides employment or entrepreneurship possibilities for foresters, who were dismissed from the SFMOs during the reforms.

Table 6. Persons employed in SFMOs

Countries	1990	2010
Estonia[1]	7580*	851
Latvia[2]	n.a.	894
Lithuania[3]	14559	3811
Serbia[4]	9813**	3310
Slovakia[5]	34338	3624

*1985; **1992
Sources: 1. MFNC 1988, RMK 2011; 2. LVM 2011b; 3. LSYF 2001, LSYF 2010; 4. Data for SE Srbijašume. Vučićević 2007, Srbijašume 2010; 5. MASR 1996, MASR 2011

There are not correct figures to precisely estimate sales methods in the 1990s. In Slovakia, all timber was sold in the form of assortments. In other countries (e.g. Estonia), there has been a combination of stumpage and assortment sales. Due to innovations and different reforms, the share of stumpage sales has decreased while roundwood assortment sales have increased. In countries, where the share of roundwood assortments comprises more than 90%, differences may exist regarding the place of delivery, which determines outsourcing needs for timber transport services (Table 7).

Table 7. Forms of timber sales (%) in 2010

Indicators	Estonia	Latvia	Lithuania	Serbia	Slovakia
Stumpage	1	30	8	29	-
Harvested assortments	99	70	92	71	100

Currently Estonia's RMK is selling all assortments delivered to buyers' yards, where actual measurement of the timber is in the buyer's responsibility. 85% of logs are sold under long-term contracts at a negotiated price, but smaller quantities are sold in pre-negotiated biddings and auctions. With long-term contracts, logs are sold to timber companies located in Estonia. Furthermore, 85% of pulpwood are sold under long-term contracts and 15% are sold in auctions. Auctions are held to obtain price information and provide opportunities for new customers. Firewood contracts are made for different periods, and the smallest quantity is a truckload; the largest quantities are sold under long-term contracts, with a maximum length of five years. Long-term contracts guarantee stability for both sellers and buyers, allowing clients, mostly local timber companies, to engage in the stable business environment. (RMK 2014)

In Slovakia, the "LESY SR" state enterprise has concluded sales contracts for a period of more than one year for approximately 40% of wood. Other contracts are usually concluded for a period of three months or one year. A basic condition for concluding sales contracts is to provide collateral to the seller, i.e., a permanent deposit or bank guarantee. Approximately 5% of wood is sold through electronic auctions, public auction prices are quoted in parity point of sale (hauling place or expedition warehouse) without loading the vehicle. Transportation from point of sale is carried out by customers at their own expense

Changes in the SFMOs have generally been based on bigger discussions: national forestry policies or programmes, forestry legislation or specific acts of the SFMO establishment. Something related to forest product sales is always in the background, along with the facts on how all countries' woodworking industries would benefit from state forests. For instance, according to the Estonian Forest Act, the supervisory board of RMK has 9 members: two parliament members, four representatives from different ministries and three experts upon the proposal of the minister, responsible for the field (currently, the Minister of the Environment). Generally, one expert, as a member of the supervisory board, has been assigned from the domestic woodworking industries or forestry related firms.

In countries where there is only one large SFMO, the state role in stabilising the local timber market is evident, especially during economic crisis or natural disasters. If there is a storm damage in forests and it is impossible to quickly carry out roundwood assortment sales contracts to supply woodworking industries near damaged areas, a large organisation can fulfil the same contract by delivering a specific assortment from remote areas within the same SFMO, a type of practice that has existed, for example, at the RMK. In Lithuania there are 42 separate SFEs, and each of them is responsible for its own sales contracts. From the beginning of 2012 the Electronic System of Roundwood Sales AMEPS (auctions) started to operate in Lithuania (LSF 2013). This system ensures transparency of roundwood sales in state forest sector and attracts larger timber buyers, who can pay a higher price.

The advantage of large SFMOs can be observed in cases of long-term outsourcing contracts. If one large organisation is outsourcing to a private compa-

ny for a specific forestry operation, the subcontractor can operate in larger territories and the SFMO can set the priorities within the organisation. In cases, where there are several smaller SFEs, the subcontractor might have contracts with several SFEs and it will be difficult to agree on seasonal priorities with several employers.

As of 2010, the control and advisory function of private forest owners is delegated to the SFMOs in Serbia (Table 8). The SEs have considerable influence on the private forestry sector in Serbia, where they can offer the following services to private forest owners: elaboration of forest management plans, marking trees for felling, calculation of fees for felled and marked timber, and control and recording of implemented activities (Srbijašume 2014b). In Lithuania, the SFEs provide forest related services, such as advising, marking trees for felling, reforestation, harvesting and forwarding, and selling of seedlings for forest planting. In Slovakia and Estonia, the SFMOs also manage woodland for (temporarily) unknown private owners. Mostly there are unclear owners, e.g., heirs, who have not claimed their properties. In Slovakia, some private owners lease the forest to the SFMOs and do not manage it themselves.

Table 8. SFMOs and private sector (2010)

Indicators	Estonia	Latvia	Lithuania	Serbia	Slovakia
Forest management planning for private forest owners is delegated to SFMOs	N	N	N	P	N
Control of private forest owners is delegated to SFMOs	N	N	P	Y	N
Advisory service for private forest owners is provided by SFMOs	N	N	P	Y	N

N is for No, Y is for Yes, and P is for Partly

After the accession of Estonia, Latvia, Lithuania and Slovakia to the EU, the governance of natural resources in these countries has gained even greater international importance. In this context, the governance of natural resources must now also follow European Community development and environmental conservation objectives and commitments in addition to domestic priorities. The statistical data related to environmental protection or forest protection is generally given on the national level, based on harmonised criteria. Table 9 shows the shares of protected forest areas according to the MCPFE (Ministerial Conference on the Protection of Forest in Europe) assessment guidelines classes of 1.1, 1.2, 1.3 and 2. Generally, the SFMOs are not calculating the comparable data of their organisations; moreover they are publishing the information according to the national legislation in the given period. The shares of protected forest areas of the SFMOs in Table 9 describe the situation in the selected countries in specific years, thus the data of 1990 and 2010 are not fully comparable, with implications on the cross-country comparison in the same year.

Environmental management has gained importance within the framework of sustainable forest management, with social issues likely to play an increasing role in multifunctional utilisation of forests and ecosystem services. The changes in the forestry sector have resulted in ecosystem services becoming more important for state forests. For example, nature-protected areas make up to 45.7% of forest area managed by state forest enterprises in Slovakia today, whereas in 1990 the figure was only 37% (Table 9). In some countries, the share of protected forests in state forestry is higher than in average. For instance, according to an expert opinion based on Estonian national forest inventory data, and including all the IUCN (International Union for Conservation of Nature) protected area management categories I…IV, the share of protected forest areas in the RMK forests were 20%, in other ownership groups 4%, for all Estonia in average 10% (Adermann 2015)

At the end of the 1980s, in Estonia almost all SFEs had some budget for recreational use. In many forest districts, special educational clubs called 'school forest districts' existed. As a result of the 2008–2009 re-

Table 9. Shares of protected forest areas (%)

Countries	Share of protected forest areas in SFMOs (%)		Share of country's protected forests area from total forest area[6]
	1990	2010	2010
Estonia[1]	28*	36	22
Latvia[2]	n.a.	26	14
Lithuania[3]	38**	27	17
Serbia[4]	n.a.	45	n.a.
Slovakia[5]	37	46	43

*1985; **1988; Sources: 1. MFNC 1988**,** Yearbook forest 2010; 2. LVM 2011a; 3. MUM 1991, LSYF 2010; 4. Vučićević 2007, Srbijašume 2010, Vojvodinašume 2014a; 5. Expert opinion, unpublished data; 6. Forest protected according to MCPFE Assessment Guidelines Classes 1.1, 1.2, 1.3 and 2. Authors calculation, based on MCPFE 2011 data

forms in the forestry sector, the RMK had to take over the management of national parks and some educational activities related to nature. For that purpose, the RMK has a structure called a Nature Management Department that is responsible for practical activities and

visitor management in state-owned areas: five national parks and approximately 40 other protected areas. In addition, the Nature Management Department has created 13 recreational areas with different facilities across Estonia. The RMK established 17 Nature Centres, which primarily disseminate various informational materials and handle a variety of educational projects. Whereas the school forest district was a side activity of foresters during the socialist era, specially trained persons handle educational activities related to nature under the new structure.

In Slovakia, many foresters are now trained in forest pedagogy and they provide environmental education in addition to their daily forestry work. In Latvia, the LVM has a special branch called Mammadaba (Mother Nature) for educational and recreational programmes, where the Tērvete Recreation and Nature Park is the most well-known area to visit. Currently, the SFMOs also manage forestry museums, e.g., Sagadi in Estonia, Jaunmokas Castle in Latvia, and the open-air museum in Čierny Balog, Slovakia.

Conclusions

The main objective of the study was to clarify changes in the state forest enterprises during the last 20 years in åšó selected countries of central and Eastern Europe. The analysis covered five post-socialist countries: Estonia, Latvia, Lithuania, Serbia and Slovakia. Some common elements can be identified in the SFE reforms:

• reforms were implemented due to the introduction of market economy, restitutions and privatisation;

• reform processes have been gradual, taking time, and have often been implemented step-wise (gradualism approach);

• some countries, which used know-how support or consultancies from other countries or international organisations for national forestry reforms, showed more radical reforms in the state forest management;

• reform processes have covered all key functions in state forest management organisations: reorganising state forest administration, development of forest information systems, forest management operations, sales of timber products, recreation and related educational activities, and in some countries advisory and practical services for private forest owners;

• forest area managed by the state, the number of SFMOs and the number of employees have decreased. Nowadays a significant part of forest works is performed by contractors, which has offered occupation and entrepreneurial possibilities for people, who previously worked in the SFMOs;

• the intensity of forest utilisation has generally increased, and roundwood assortments dominate timber sales;

• in some countries, the SFMOs have a role in stabilising timber markets;

• environmental management has gained importance within the framework of sustainable forest management, implementation of the EU environmental policy (e.g. NATURA 2000 directives), or multifunctional utilisation of, for instance, forest ecosystem services. There is a trend that there are more protected areas in state forests than in private forests;

• recreational activities are becoming an important service provided by the SFMOs on a non-commercial basis. The countries that have one large organisation for state forest management can afford special departments or subsidiaries, which manage specific facilities for nature or forest related educational and recreational purposes.

Acknowledgments

The authors would like to thank the EFI regional office EFICEEC for the opportunity to participate and conduct research in the 2010-2012 project "Innovation and sustainability in forestry in CEE: challenges and perspectives (SUSI-CEE)" funded by the Austrian Ministry of Science.

Diana Mizaraite's research findings were obtained through the long-term research programme "Sustainable forestry and global changes".

Some of Meelis Teder's research findings were collected by the support of Estonian Environmental Investment Centre Forestry Programme under the project "Innovation in the forest sector".

Zuzana Sarvaovį was supported by the Slovak Research and Development Agency under contract No. APVV-0057-11 and the Czech Agency for Agriculture Research under contract No. QJ1220313.

Authors would like to thank the anonymous reviewers and Dr Bernhard Wolfslehner from EFICEEC office, for their valuable comments.

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Received 02 May 2012
Accepted 08 October 2015

Footnotes

[1] Project "Participatory Development of a Plan to Implement Srbijasume's Restructure", conducted during 2005, in cooperation with Austrian Development Agency and Osterreichische Bundesforste AG Consulting gave significant technical contribution to these processes.

[2] Source: http://www.srbijasume.rs/sumskifonde.html, accessed 11.06.2014. and authors' calculations

[3] Source: http://www.vojvodinasume.rs/en/forests/information-on-forest-fund/, accessed 11.06.2014. and author's calculations

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Bouriaud, L., Nichiforel, L., Weiss, G., Bajraktari, A., Curovic, M., Dobsinska, Z., Glavonjic, P., Jararský, V., Sarvašova, Z., **Teder, M.**, Zalite, Z. 2013. Governance of private forests in Eastern and Central Europe: An analysis of forest harvesting and management rights. Annals of Forest Research, 56(1): 199─215.

Ann. For. Res. 56(1): 199-215, 2013

ANNALS OF FOREST RESEARCH
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Governance of private forests in Eastern and Central Europe: An analysis of forest harvesting and management rights

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Bouriaud L., Nichiforel L., Weiss G., Bajraktari A., Curovic M., Dobsinska Z., Glavonjic P., Jarský V., Sarvasova Z., Teder M., Zalite Z., 2013. Governance of private forests in Eastern and Central Europe: An analysis of forest harvesting and management rights. Ann. For. Res. 56(1): 199-215, 2013.

Abstract. A property rights-based approach is proposed in the paper to underline the common characteristics of the forest property rights specification in ten ECE countries, the specific patterns governing the harvesting of timber in private forestry and the role of the forest management planning in determining the content of the property rights. The analysis deals with the private forests of the individuals (non industrial ownership) from ten countries, covering 7.3 million ha and producing yearly some 25 million m^3 timber. The study shows that the forest management rights in private forests belong to the State and that the withdrawal rights on timber, yet recognised in the forest management plans, are in reality strongly restricted from an economic viewpoint. The forest management planning is the key instrument of the current forest governance system, based on top-down, hierarchically imposed and enforced set of compulsory rules on timber harvesting. With few exceptions, the forest owners' have little influence in the forest planning and harvesting. The rational and State-lead approach of the private forest management has serious implications not only on the economic content of the property rights, but also on the learning and adaptive capacity of private forestry to cope with current challenges such the climate change, the increased industry needs for wood as raw material, or the marketing of innovative non wood forest products and services. The study highlights that understanding and comparing the regime of the forest ownership require a special analysis of the economic rights attached to each forest attribute; and that the evolution towards more participatory decision-making in the local forest governance can not be accurately assessed in ECE region without a proper understanding of the forest management planning process.
Keywords forest management planning, private forests, governance, owners' participation, harvesting, Eastern, Central and Baltic Europe, property rights.

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Manuscript received February 04, 2013; revised March 13, 2013; accepted March 23, 2013; online first April 08, 2013.

Introduction

The economic analysis of the property rights acknowledges the fact that, due to high transaction costs, many attributes of an asset may be left in the public domain, no matter if the asset belongs to a private of a public ownership entitlement (Barzel 1997). Forest represents an asset with a complex panoply of attributes, producing a variety of goods ranging from public to private goods in economic sense (Glück 2000, 2002; McKean & Ostrom 1995). Many positive forest externalities can barely be priced out and have the statute of a public or common-pool good. For instance, the recreational use of the private land poses a common-pool resource problem, landowners having a limited ability to regulate the visitors' flow and to exclude tourists from consuming the recreational services (Vail & Hultkrantz 2000). At this point, the distinction between the legal rights (rights based on legal entitlements) and the economic rights (what the owners is actual able to capture from the value of his asset, due to the legal constraints and/or de facto practices) is required to understand the bundle of rights related with the use of the forest resource. The apparent variety of property rights specifications (how much is delineated to the owners from the bundle of rights upon resource) and of the governance systems (how the rules are created to solve the potential conflicts upon conflicting resource uses) depicts the complexity of the resource attributes and of our own capacity to assess the resource attributes (Smith 2002).

Many scholars acknowledge that the definition and the enforcement of the property rights upon a natural resource is a matter of social and political setting in which the property rights are embedded (Kissling-Näf & Bisang 2001, Vatn 2005, Irimie & Essman 2009). The system of law is supposed to define the limits in which individuals are allowed to pursue their interests (Legrand 1999). A number of studies analysed and argued for the participation in forest governance institutions by local forest users as being strongly associated with jointly positive outcomes for forests (Chhatre & Agrawal 2008, Persha et al. 2011). In the context of an international policy trend promoting the dialogue and the participation of the civil society into the governance processes

(Coleman & Perl 1999, Krott 2005, Lawrence 2007, Treib et al. 2007), the topic of the forest owners participation in deciding the rules of the forest management is not well covered in the Eastern and Central Europe (ECE) region. With few exceptions (REC 2010, Weiss et al. 2011) there are no studies comparing the property rights specification and the local governance system of the private forestry in ECE countries. In a more general level, the interrogation on the role of the forest management plan as policy instrument is a recent issue (Brukas & Sallnäs 2012) poorly studied for the private forests. A property rights-based approach is proposed in this paper to underline the common characteristics of the forest property rights specification in ten ECE countries, the specific patterns governing the harvesting of timber in private forestry and the role of the forest management planning in the property rights specification. The consequences in terms of the governance of the forest resource are discussed. Our study focuses on the forest landowners' managements and withdrawal rights of timber as indicators of what the owners really own from the forest resource and of what they can really influence in the forest management.

Forest governance and private forestry in countries in transition

In the past two decades, the main governance changes that happened in the post-socialist countries were related to the reform of the property rights and consequently with the mechanisms for resource allocation (Bouriaud & Schmithüsen 2005, World Bank 2005). Forest sector has had to accommodate with the logic of the market mechanisms and the profit maximization. The need for change in forest sector was driven by factors that were largely exogenous to it (World Bank 2005). Deep institutional changes were undertaken in early 90'ies in some countries or after the year 2000 in some others in order to separate the management function, the regulatory function and the control function performed up to then by a single forest agency. After more than two decades of economic and political transformation, the ECE countries share several common features (Table 1), such a relatively high share of the agriculture contribution in the gross domestic product that is correlated with a relatively high share of rural population; rather modest corruption-related scores which means slow progress of the countries towards transparency and accountability of their governments; and a relatively high share of the forests in public ownership that varies from 90% in Macedonia to 40% in Estonia. The situation of the illegal logging, e.g. tree removal in violating the national laws, has improved compared with the period 1990–2000 (Bouriaud 2005), yet some NGOs' reports claim that illegal logging represents still a serious problem in several countries.

In the ten studied countries, the share of private ownership exceeds 40% of the forest area only in Slovakia, Serbia and Latvia. The private forests owned by physical persons (forests owned by families or by individuals, known also as non-industrial private forests) represent between 9.8 and 48% of the forested area (Table 2), which means a relatively smaller share of private ownership on forest land compared with the Western Europe (Schmith üsen & Hirsch 2010). The fragmentation of the private forests in small holdings is also a common characteristic of the private forests, particularly in Bulgaria, Czech Republic, Kosovo, Macedonia and Serbia, where more than 90% of the private forests have less than 10 ha area. Only in Estonia, Latvia and Slovakia the small-size private properties represent less than one third of the private forests. The area of the private forests is expected to slightly increase in the next years following the afforestation of the abandoned agricultural land and the continuation of the process of the privatisation and restitution of the forestland.

Due to the small size of private forests, but

Table 1 Country-level basic economical and forestry data

Indicator	GDP per capita, (US$, 2005)	Agriculture contrib. to GDP (% 2010)	Forestry contrib. to GDP (% 2010)	Forest cover (% in total area 2005)	Share of rural population (% in total population 2008)	Corruption index* 2010	Public forests (% 2005)	Illegal logging (% in total removal, 2008)
Country	1	2	3	4	5	6	7	8
Bulgaria	6335	5.00	0.30	33.00	30.00	3.30	86.00	1.00
Czech Republic	18910	1.09	0.60	34.00	26.00	4.40	76.00	0.70
Estonia	14062	3.00	0.90	49.00	31.00	6.40	40.00	0.80
Kosovo	3150	12.00	2.00	42.00	60.00	2.90	57.00	100.00
Latvia	10723	4.00	1.30	47.00	34.00	4.20	54.00	1.00
Macedonia	4434	11.00	0.40	45.00	33.00	3.90	90.00	25.00
Montenegro	6510	9.00	0.00	54.00	40.00	4.00	67.00	5.00
Romania	7539	7.00	0.40	28.00	45.00	3.60	70.00	1.00
Serbia	5270	9.00	0.30	29.00	48.00	3.30	51.00	1.00
Slovakia	16036	4.00	0.40	45.00	43.00	4.00	52.00	1.40

Note. * Corruption index relates to perceptions of the degree of corruption as seen by business people and risk analysts, and ranges between 0 (highly corrupt) and 10 (highly clean)(Transparency International 2010). Corruption is considered to be the misuse of public or entrusted authority for personal gain. Sources for column data: #1 - World Bank (2010); #2 - World Bank (2010), Forest Europe (2011); #3 - Forest Europe (2011, p. 324), for Serbia - REC (2010:41), FAO (2010); #4 - Forest Europe (2011, p. 288); #5 - FAO (2010, p. 220-221); #6 - Transparency International (2010); #7 - FAO (2010, p. 236-237); #8 - REC (2010); Greenpeace (2012); Ecopolis (2012); Ministry of Agriculture and Rural Development of the Slovak Republic (2011); State Forest Service, Latvia (2010); Ministry of Environment, Estonia (2009); ECLO (2009); WWF (2008); USAID (2007).

also due to the self-consumption of wood in the households, the forest land is managed by the owners themselves, concessions or renting of private forests being rather the exception than the rule, e.g. leasing of the forest holdings is practiced in Slovakia. The proportion of firewood harvesting in individual and family forests is substantial, for instance, in Bulgaria (49%), Romania (35%) and Serbia (43%) (Schmithüsen & Hirsch 2010), in Western Balkans (52%) (Glück 2011) while in Kosovo the private owners use practically all the timber cut as firewood (ECLO 2009). The extension services for private forests are under development. A slow, but steadily advancement in creating forest associations is noted (Weiss et al. 2012, Glück 2011, Weiss et al. 2011, Schmithüsen & 202 Hirsch 2010, Milijic et al., 2010), yet one lacks accurate data. The forest agencies (in form of public forest administration, State forest managing structures, State forest service, or the public controlling bodies) still keep a central role in guiding and supervising the private forest management (Weiss et al. 2012, Weiss et al. 2011).

Materials and methods

Theoretical framework

Property rights are defined variously and inconsistently in the economics literature, sometime distinctly different from the meaning

Table 2 Main information on private forests in the analyzed countries

Indicator	Forest area (thousand ha)	Forest area with a FMP* in the total area of private forests (%)	Forest area under private, non-industrial, ownership (thousand ha)	Forest area under private, non-industrial ownership in the total forests (%)	Private forests smaller than 10 ha (%)	Annual volume harvested from private forests (thousand $m^{3,}$ 2010)
Country	1	2	3	4	5	6
Bulgaria	3927.0	100	421.9	10.2	98	2100.0
Czech Republic	2657.0	100	530.0	19.0	95 (estimation)	4183.0
Estonia	2203.0	69	757.3	34.0	24	2577.0 (unpublished NFI data)
Kosovo	464.8	100	185.9	40.0	90	360.0
Latvia	3354.0	90	1044.4	46.0	29	6000.0 (estimation)
Macedonia	998.0	0	94.0	9.8	95	153.5
Montenegro	467.0	2	244.0	33.0	75	140.0
Romania	6573.0	70	2079.0	32.0	60	4377.0
Serbia	2713.0	100	1058.4	47.0	98	1000.0 (estimation)
Slovakia	1938.0	100	938.0	48.0	13	4588.0

Note. * Forest management plans, simplified forest management plans or equivalent. Sources for column data: #1 - Forest Europe (2011:288); #2 - Forest Europe (2011:63), Schmithüsen and Hirsch (2010:10), for Latvia and Romania were used estimations. #3 to 6 - MAF (2013), Adermann (2012), Andjelic et al. (2012), EEIC (2012), MA (2012), Weiss et al. 2012, Glück (2011), MPSR (2011), UNECE (2011), EAGRI (2010), MMP (2010), Nuhodžić and Ferlin (2010), Schmithüsen & Hirsch (2010), MAFWM (2009), Velichkov et al. (2009), USAID (2007), WWF (2007).

given by legal literature (Cole & Grossman 2002). In the philosophy, the right to own opposes two views: (i) the property is a natural right, therefore the role of the State is to protect and guarantee the exercise of the owner right (Locke 1823), to grant "legitimacy and security to a specific resource or benefit stream" (Vatn 2005); (ii) the property is a socially recognized right, one effect of the social contract, therefore the State should monitor that the property rights are exercised according to the general interest (Rousseau 2008). The theory of the social contract suggests that in exchange of the protection offered by the State, the forest owners would have to respect a range of duties according to the general interest, defined in the forest laws and regulations.

These two views over property rights inspired divergent normative judgments and economic doctrines about property rights and their place in the governance processes. Adopting the Rousseau' position, our study acknowledges that restricting the forest ownership rights is justified in many aspects, e.g. general public interest on the environmental services that forests perform, the public nature of many forest attributes, or the common-pool problem for some other attributes. Therefore, the rules, e.g. regulations, legislation and procedures, relevant to a certain policy domain (Kiser & Ostrom 1982, Giddens 1984, Ostrom 1999) restrict the right of the owner to harvest the forest resource. Understanding which right is affected by which restriction can be done us-

ing the analytical frame defined by Schlager & Ostrom (1992:250) that differentiates five relevant economic property rights: (i) "the right to access, meaning to enter a defined physical area and enjoy non-subtractive benefits; (ii) the withdrawal right, as to obtain a resource unit or product of a resource system; (iii) the management right, as to regulate internal use patterns and transform the resource; (iv) the exclusion right, as to determine who will have access and withdrawal rights and how those rights may be transferred; (v) the alienation right, as the right to sell or lease management and exclusion rights".

The study focuses only on the withdrawal and management rights on timber. The first argument relays on the fact that rules establishing how much can be cut, when, where and how and the rules establishing who and how decide about the harvesting have a direct impact on the forest owners' income. The forest ownership economic benefit is, with few exceptions, mostly derived from the timber harvesting and selling. The remaining three categori of rights (the rights to access, to exclude and to alienate) have only an indirect impact on income. Moreover, the rights to access, to exclude and to alienate were granted without restrictions to the forest owners within the privatisation and restitution process and they are guaranteed through the national civil and penal laws (Bouriaud & Schmithüsen 2005). In contrast, the regulation of management and withdrawal rights is relegated to the specific forest laws and policies, and various restrictions apply (Weiss et al. 2011, Bouriaud & Nichiforel 2010, Bouriaud & Schmithüsen 2005). The second argument of choosing to analyse the withdrawal of the timber is its private nature in the economic sense. The timber is one of the few forest attributes market valued and its specification (identification, measurement of the units, estimation of the flow) does not involve high transaction costs.

Data collection

The authors have assessed the withdrawal and the management rights in applying a set of key-questions from a standardised data protocol collection. The method is specific for a positive law analysis approach: the answers to the key questions were searched in the legal rules prescribed in the main forest law or the forest act of the country, or in the specific regulations dealing with the timber harvesting. To assess the management rights, we have identified who has the authority to regulate the internal use patterns of the forest resource and to transform the forest on long term. To assess the withdrawal rights, we have identified who has the authority to determine how, when, and where harvesting from a resource may occur (Schlager & Ostrom 1992).

A central instrument of the forest management is the forest management plan (FMP), aiming at regulating the extraction of resource units on long term, most generally ten years (Ferlin et al. 2010, Bouriaud 2002, Tittler et al. 2001). The fact that the FMP optimises the future shape of the forests via the spatial and temporal distribution of the timber harvesting is blurring into a certain extent the distinction between the management and the withdrawal rights. To avoid this, the analysis of the management rights has focused on the question whether the forest owner has the power to change or influence the structure or the management of the resource, even in the cases when a compulsory FMP applies. Therefore, the forest owner' participation in the forest management planning and their capability to determine the management goals are considered reliable indicators of the management rights, while the withdrawal rights were identified at the level of the operational rules, e.g. who does establish the quantity of the timber to be harvested, the age at which a stand can be harvested and who has the authority to select the trees to be cut.

Results

The management rights. In all the countries, only the forests with a FMP can be harvested (Table 3). The Forest management plan, ten-years based or in a form of annual or simplified operational plan is compulsory and it is conditioning the legal exercise of the harvesting rights. In the Latvian and Estonian case the FMP is compulsory only if the forest owner intends to do timber harvesting (what is conceived as an active forest management). To address the problem of small size forests, the FMP is not compulsory in forests smaller than two ha, respectively 50 ha in Bulgaria and in Czech Republic, or the plans are done on the area covered by a larger administrative unit (Kosovo), irrespective of the ownership situation. In Romania the problem of planning in small size forests is not solved yet. The simplified FMP can be a solution for small-size forests, but this solution was prohibited in the

Table 3 Governance of the forest management rights

		1. Is the forest management plan required for the private forests?	2. What is the degree in which the owner has the right to participate in forest planning?	3. Is the owner able to determine the management goals?
1	Bulgaria	1. The FMP is compulsory for all forests larger than two hectares and the State Executive Forest Agency controls its development and implementation.	2. The owner has the right to participate, yet the process is not lead by the forest owner.	3. The forest owner has little influence in setting up the management goals.
2	Czech Republic	1. The FMP is compulsory in all forests larger than 50 hectares. However, even for forests smaller than 50 hectares the State forest administration can decide to impose a simplified FMP in order to ensure rational forest management.	2. The owner has the right to participate. Forest owner' options should be recorded within the planning, but not necessarily included in FMP.	3. No. The owner can not influence the management goals for his/her forest. They are established in the regulations and then set up in the FMP.
3	Estonia	1. The FMP is compulsory only if owner wants to do active forest management (harvesting). If the owner does not want to harvest timber, the FMP is not required.	2. The owner has the right to participate. The forest inventory and the FMP cannot be done against the forest owner willingness and can not ignore his options.	3. The owner has the possibility to choose the type of forestry works within the limits of Forest Act, Rules of Forest Management and other legislative acts.
4	Kosovo	1. The FMP is compulsory for all forests (10 years based FMP and annual-based operational plans). The plans are done at the level of larger administrative units, e.g. forest area within a municipality.	2. No participation. The local community (municipality) may eventually formulate some observations about the planned cuttings.	3. No. The owner can not influence the management goals for his/her forest.
5	Latvia	1. The FMP is compulsory only if owner wants to do active forest management (harvesting). If the owner does not want to harvest timber, the FMP is not required.	2. The owner has the right to participate. His/her participation is kindly welcome. The owner's option is a priority in planning.	3. The owner has the right to participate in establishing forest management goals. The forest owners can choose the type of the forestry works to be undertaken.

Table 3 (continuation)

		1. Is the forest management plan required for the private forests?	2. What is the degree in which the owner has the right to participate in forest planning?	3. Is the owner able to determine the management goals?
6	Macedonia	1. The FMP is compulsory for all forests. The owner has to cover the expenses of the forest management planning, even in the case of forests with protective functions.	2. No participation. Only for forests in a single patch having more than 100 ha the forest owner's needs may be considered. In this case, the FMP should be adopted with his agreement.	3. Normally no possibility to influence. Only for forests in a single patch larger than 100 ha the forest owner can influence the objective of the FMP.
7	Montenegro	1. The FMP is compulsory for all forests. Forest owners are obliged to have a 10 years based FMP and annual-based operational plans.	2. The owner has the right to participate. The concerned forest owners association should be consulted previously when establishing the FMP.	3. The owner has the right to participate in establishing forest management goals. The competent administrative authority should cooperate with the forest owners in developing the annual operational plans.
8	România	1. FMP is compulsory for all forests. The FMP applies for a period of 10 years.	2. The owner has the right to participate, but their preferences are not recorded, nor considered. The FMP is based on technical prescriptions only.	3. No possibility to influence.
9	Serbia	1. The FMP is compulsory for all forests. The FMP applies for a period of 10 years.	2. The owner has the right to participate. Forest owner' options should be recorded within planning, but not necessarily included in the FMP.	3. The private forest owner does not have the right to choose the type of harvesting that will apply to their forest.
10	Slovakia	1. Since the year 2005, the FMP is compulsory for all forests and for all sizes of forest area. The FMP applies for a period of 10 years.	2. The owner has the right to participate. Forest owner' options should be recorded within planning, but not necessarily included in the FMP.	3. Normally no possibility to influence, but a trade-off with the authorized forest manager may occur.

new Romanian Forest Code from 2008. As consequence, all harvesting operations done in a forest without a FMP will be illegal in Romania, irrespective of the real needs of the stand for the forestry works, e.g. an over-mature productive forest cut without a FMP will be treated as a penal law infringement.

A synthetic view of the rules in establishing the forest management plans is proposed in the Table 4.

The participation of the landowner in the forest management planning processes is generally acknowledged, but the extent and the outcomes of his/her participation largely varies. Thus in some countries the forest owners' options are priorities in the planning process (Latvia, Estonia, Montenegro), in some other cases the owners' options are recorded along

Table 4 Rules of establishing the forest management plans

Forest management planning in private forests			1 BG	2 CZ	3 EE	4 KO	5 LV	6 MK	7 MN	8 RO	9 SB	10 SK
Binding force	The FMP is compulsory while harvesting only				x		x					
	The FMP is compulsory in any case and any forest*		x	x		x		x	x	x	x	x
Who does initiate	The owner (through public/private advisors or agencies with specific license for such activities)			(x)	x		x					x
	The State (undertaking the FMP on the behalf of the owner)		x	x		x		x	x	x	x	
How	Owner participation	The owner's preferences are considered priority in planning (if lawfully)			x		x	x**	x			
		The owner's preferences are only recorded		x		(x)					x	x
		No contribution from the owner' side	x					x		x		
	Public participation	Public debate is possible	x						x	x	x	x
		Nothing specified about		x	x	x	x	x				

Note. * In Czech Republic and Bulgaria the forest management planning is compulsory for forests reaching a minim threshold area e.g. 50 ha and, respectively, 2 ha. ** In the case of forests larger than 100 ha.

the planning process, but not necessarily included in the FMP (Czech Republic, Serbia, Slovakia and, into a certain extent, Kosovo), while in some other cases their options are not relevant in the planning process (România, Macedonia, Bulgaria).

The capacity of the forest owners to choose management goals and to implement them within the forest management plans varies from a country to other, but one may have three different cases: (i) the forest owner can solely decide on the management goals and on the forest works to be undertaken, of course, within the limits of the law (Latvia, Estonia); (ii) by law the management goals should be negotiated with the forest owner (Montenegro, also in Macedonia, if the forest is larger than 100 ha); (iii) the forest owner can not decide on the forest management goals that are set up in technical norms for forest planning and imposed through specific forest administration agencies (Romania, Czech Republic, Bulgaria, also Macedonia, for private forests smaller than 100 ha).

The fact that the FMP is compulsory for all private forests and the fact that, with few exceptions, the forest owner does not participate to the establishment the forest management goals characterise a common pattern of the property rights in ECE region: here the State owns (in economic sense) the management rights over the forest resource. A second common pattern is the fact that higher is the forest area owned, higher are the chances that the forest owner retains a residual control over the forest management rights. For larger properties, the owners may eventually participate and contribute in the planning process.

As governance pattern, the Table 4 clearly shows that the forest management planning is not used as a place of negotiation, knowledge sharing or capacity building. In many ECE countries, the forest management planning is a way to extend the central-regulatory decision-making process to the resource-unit level. The State through specialised forest agencies has

the authority to regulate the use of the forest resource and to transform the forest on long term. Therefore the forest owner has little power to change or influence the structure or the management of the resource.

The withdrawal rights. In most CEE countries, the provisions of the forest management plan regulate the timber harvesting rights. Additional administrative procedures apply, such operational plans, special plans, harvesting permits, notification of the harvesting, compulsory recording of the timber to be cut. In some countries the restrictions apply only for the final harvesting, e.g. the owner is not obliged to ask for administrative permits in the case of the sanitation cutting, tending or harvesting in young stands. In Estonia and Latvia the amount of timber to be harvested can be decided under certain limits by the owner himself (Table 5), besides the fact that under a certain harvested volume the owner is not obliged to any administrative authorisation for timber withdrawal. This is to compare with the Romanian case were even for a sanitation cutting of one cubic meter per hectare and per year the owner is obliged to require an administrative permit and to proceed to the recording of wood, marking of trees and procurement of the transportation documents. Generally, in all the countries age restrictions apply for the final harvesting of the stands, e.g. the stands can not be harvested before reaching a certain threshold age. However, for Norway-spruce based stands, the minimum age to be reached before cutting varies between 80 (Czech Republic & Estonia) and 110 years (Romania). Only in Latvian case may this minimum legal threshold be lowered at the forest owner's request. Strictly set up in the legislation, the rotation period is limiting the owner' ability to benefit from the forest resource or to harvest as reaction to the market opportunities or to the cash flow needs.

In all cases except Estonia, an authorized forest manager does the selection and the marking of trees. In some legislations (Kosovo, Macedonia) the forest manager should even have a minimum experience on forest management (one to three years) to be authorized for marking. Only in Estonia can the owner select the trees by himself, while in Czech Republic and Slovakia the marking of trees is not required in young stands. In all the cases where the service of tree marking is mandatory, the owner has to pay for it.

Once the volume to be cut is established, e.g. in the FMP, one may think that the owner can fully benefit from its withdrawal right. However, the administrative authorisations needed and the compulsory marking of tree by a forest official show that the owner has not the authority to determine how, when, and where harvesting from the forest resource may occur. Therefore the common pattern of the withdrawal rights in ECE countries is that the owner holds only a residual control of the withdrawal rights: he can only accept or reject the amount of timber entirely specified in a technocratic-lead process.

As common governance pattern, it should be noted that the implementation of the withdrawal right is fully depending on a forest agency, and often one other forest agency will control and enforce it. The power of the forest agencies over forest management in general is connected with a luck of trust in the forest owner who is not trained enough to select by himself the trees to be harvested.

Discussion

The results of the study are consistent with conclusions from Agrawal & Ostrom, (2001), e.g. in forestry it is common to assign only operational-level property rights (access and withdrawal), while management, exclusion and alienation are limited. The study however goes further, in showing that: 1) not only the management rights are limited in the studied ECE countries, but they are even taken-over from the private forest owners (they remain

Table 5 Governance of the withdrawal rights for timber

		1. Who establishes how much timber can be harvested	2. Who establishes when timber can be harvested	3. Who establishes how/ which timber can be harvested
1	Bulgaria	1. The FMP or the State Executive Forest Agency (in forests under two ha).	2. The FMP establishes when. The State Executive Forest Agency will enforce the rule.	3. All the trees should be marked by forest staff based on FMP rules.
2	Czech Republic	1. The FMP, according to the category of forest, the forest shape and the needed forest works.	2. The FMP. Final harvesting is to be done after 80 years stand age. The State Forest Administration may allow earlier harvesting at the request of the forest owner.	3. All the trees should be marked by authorized forest manager. Marking is not required for harvesting in stands younger than 40 years.
3	Estonia	1. The FMP. The forest owner is allowed to cut without forest notification three cubic metres of wood per year and per hectare where such cutting is permitted by legislation, but no more than 20 cubic meters per property. For more than 20 cubic metres, a notification of the forest authorities is required.	2. Clear-felling ages are set by the Forest Act, e.g. in pine forests 90 – 160, spruce 80 – 120. Details by different forest types are established in the legislation.	3. The legislation does not require the marking of the trees to be harvested. If the forest owner is interested, he may order the marking at his own costs.
4	Kosovo	1. The amount of timber to be cut is established by the State Forest Agency in annual operational plans and is binding for all forest owners and all timber withdrawn from forests.	2. The State Forest Agency.	3. The trees for felling are selected and marked by the local forest technician (State Forest Agency).
5	Latvia	1. The forest legislation. The owner needs a harvesting permit (but not in the sanitary cuttings, in the case of the wind damages, and in the thinning of forest stands with stump diameter under 12 centimetres). The harvesting permit is not needed if less than 10 cubic meters per year are extracted.	2. The Law on Forests establishes when the tree harvesting is allowed according to the type of forest.	3. The selection and marking of trees is done by State Forest Service employees. Forest owner has to pay for this service.
6	Mace-donia	1. The forest regulations and the special plans. The private forest owner should require a harvesting permit. The approval of felling is done by the public forest enterprise.	2. The age of stands to be cut, and the way of cutting is decided in forest regulations. Private forest owners are obliged to use in this purpose the services provided by the public forest enterprise.	3. The felling marking is carried out by the public forest enterprise according to the rules established in the special plans.

Table 5 (continuation)

		1. Who establishes how much timber can be harvested	2. Who establishes when timber can be harvested	3. Who establishes how/ which timber can be harvested
7	Monte-negro	1. The FMP. The harvesting itself requires an administrative order issued by the competent administrative authority.	2. The forest owners and the authorities take the decision jointly.	3. The trees could be harvested only after their selection, marking and recording. Marking can be done by the both legal entities and entrepreneurs qualified.
8	România	1. The FMP. Without the FMP, a forest cannot be legally harvested, even if the stands arrived at the maturity age. The maximum amount that the owner can harvest without a FMP is one cubic meter per year and per ha as sanitation cutting.	2. The age for final cuttings is set in the regulation on FMP (e.g. harvesting age is 110-120 years for Norway spruce and 140-160 years for oaks) and enforced by the State forest inspection.	3. The trees could be harvested only after their selection, marking and recording. Marking can be done only by the forest administration. The owner has to pay for this service.
9	Serbia	1. The type and the amount of cut are determined by FMP or Forest Management Programme and they vary with the origin of the forests (seeds or coppice), the purpose of forest management and the main function assigned to the forest.	2. The age of cut is determined by planning documents for private forests, e.g. for beech harvesting age varies between 120 years (high forests) and 80 years (coppice).	3. Marking trees is done by the technicians licensed to perform professional activities in forest management.
10	Slovakia	1. The amount of timber that can be cut it set in the FMP and is binding for forest owners or forest managers.	2. The State Regulation on the FMP states the age of stands when a forest can be harvested.	3. An authorized forest manager selects and marks the trees to be harvested. Marking is not required for tending forest stands under 50 years old. The owner has to pay for this service.

in the public domain), and 2) the withdrawal rights on timber, yet recognised in the forest management plans, are in reality strongly restricted from an economic viewpoint (the owner hold only a residual control over withdrawal rights). The study reminds that the ownership in the economic sense pertains to the attributes of the assets rather than to the assets themselves (Foss & Foss 2001), e.g. ownership on timber would have different characteristics than ownership on forest land (Bouriaud & Schmithüsen 2005). Therefore understanding and comparing the different national regimes of the forest ownership should pay attention to the economic rights attached to each forest attribute.

The literature largely admits that the high level of the transaction costs explain why some forest benefits remain in the public domain (Barzel 1997). However, the fact that the forest management rights remain in the public domain, even for a private forest, is not explained by the high level of transaction costs for the specification, measurement and delineation of

the timber. One should rather remember that most forest attributes ecologically-valued are critically pending on the existence of the standing timber, the essential element of the forest ecosystem. Thus the restrictions on timber withdrawal rights and the take-over of the forest management rights are in fact the solutions adopted to address the problem of the forest attributes that are public or common-pool featured. The high transaction costs related with the specification and delineation of these forest attributes explain why the State is so deeply involved in regulating the private forestry, at the point to fully take-over the forest management rights. The study brings into attention a potential field for future comparative research, e.g. in which governance-related conditions some forest attributes are left in the public domain.

For some authors, the governmental allocation is an efficient way to protect the attributes that do not have a market value (Barzel 1997), yet constant efforts are undergoing to establish property rights systems to less tangible forest products, e.g. forest carbon. Nonetheless two main problems should be acknowledged. First of all, the modest corruption-related scores in the ECE region represent a strong reason for questioning the efficiency of State ownership over forest management rights in protecting non-specified forest attributes. Recent papers highlighting are problems with the forest protection and sustainable forest management in ECE countries, particularly in Carpathian region (Knorn et al. 2012a, Knorn et al. 2012b, Bouriaud & Marzano 2013, Kuemmerle et al. 2007). Key conditions for corruption appear when the State regulates private and community owned forestland and, in the same time, the State is responsible for the supervision of the forest production e.g. delivering permits, authorisations and monitoring the legality of all forest-related activities (Kishor & Damania 2007, Callister 1999, Contreras-Hermosilla 2000).

Secondly, when the governmental allocation applies indirectly, through capturing the management rights upon a private amenity such timber, distributional and ethical effects of such allocation should be considered. By now, a paternalistic State paradigm (Drăgoi et al. 2011) dominates the governance of the private forestry and the participatory mechanisms are rather absent in ECE countries (Howard 2002). In other words, the forest management planning is in that "first generation" stage, in which "the socio-ecological system is assumed to be unproblematic and a cognitive rational approach is used to address its management" (Lawrence 2007). In contrast to Western countries were FMPs may serve for informational steering only (e.g. Sweden case analysed by Brukas & Sallnäs 2012) in all ten studied countries the FMPs fulfil regulatory function. The forest management planning, including the enforcement of the harvesting rules, seems to be one of the *raison d'etre* of the strong forest bureaucracies in ECE countries, legitimating their knowledge and expertise on forest management. The current local forest governance system, based on top-down, hierarchically imposed and enforced set of compulsory rules, is far from implementing a plurality "of visions, practices, expectations, technical, economic and social discourses, decision-making regimes" (Mermet & Farcy 2011).

The State regulation is perceived as limiting foresters' (Lawrence 2009) and owners' (Glück 2011, Nichiforel 2010) ability to use their knowledge and expertise to manage the forests. The rational planning and the over-regulation of forest management and harvesting pose thus a problem in the perspective of the individual adaptation and learning to new challenges of the forest management such the adaptation of the forest management to the climate change.

Conclusions

Our study focuses on the forest landowners' managements and withdrawal rights of timber

as indicators of what the owners really own from the forest resource and of what they can really influence in the forest management. The analysis of economic rights on timber shows how full (legal) private ownership on forestland co-exists with a public (economic) appropriation of the forest management rights. There are two kind of implications here. One implication is methodological and consists on the fact that understanding and comparing the regime of the forest ownership requires a special analysis of the economic rights attached to each forest attribute. One second implication, policy-related, is that the meagre current impact of the landowners' behaviour in the forest management in ECE region should be acknowledged in policy measures addressing private forestry.

In all studied countries, the forest management is subject to a compulsory forest planning, done by a State agency or under the supervision of a State agency, with little if any contribution from forest landowners. The restrictions on timber withdrawal deal with the age of stands to be cut, the method of harvesting and the observation of some enforcement rules, e.g. marking of tree prior to be cut by a forest specialist. The main target of the restrictions is not the regulation of the timber flow as such, but the enhancement of a satisfactory level for non-specified forest attributes, public or common-pool featured, but with high ecological value. The State-led planning is viewed in the Eastern and Central Europe as the main instrument of ensuring sustainable management of the forest resource, implementing and transposing the central legal norms at the local level.

Since the FMP prescribes the allowed timber production, therefore the owners' income for the next ten years, one may expect that forest owners would have an active role in the planning process. The results of the study do not confirm this expectation, the forest owners being put outside of the planning process (Bulgaria, Czech Republic, Macedonia, Romania) or being only consulted, with no real influence in the process (Serbia, Slovakia, Kosovo). They cannot decide how, when, and where harvesting can take place, and they cannot change the structure of the resource, e.g. switch from one tree species to other, modify the tree canopy (lowering the stand density), change from regeneration by seeds to vegetative regeneration (from high forests to coppice), shortening the rotation age, etc. This situation applies for a forest area of more than 7.3 million ha (larger than current Romanian forests) and an annual volume harvested higher than 25 million m^3. The absence of local self-governance mechanisms has serious implications on the learning and adaptive capacity of private forestry to cope with current challenges such the climate change, the increased industry needs for wood as raw material, or the marketing of innovative forest products and services.

Systemic governance changes are supposed to affect the forest sector in the next years under the international regime of forests. The results of this study suggest that the evolution towards more open, participatory and accountable decision-making rules would be rather difficult or improbable in eight of the ten selected countries. Moreover, the effectiveness of the participatory decision-making in local forest resource governance can not be accurately assessed without a proper understanding of the forest management planning process. The forest owners' degree of participation in negotiating the rules within the forest planning may be a reliable indicator of changes in the forest sector governance, if they were happen.

Acknowledgements

All the authors were supported by Bundesministerium für Wissenschaft und Forschungand through the project Innovation and sustainability of forestry in Central-Eastern Europe: challenges and perspectives (SUSI-CEE). S.Z. was supported by Slovak Research and

Development Agency (contract APVV-0057-11) and V.S. by Czech National Agency for Agricultural Research (contract QJ1220313). L.B. was supported by Romanian Agency UEFISCDI (contract HubforClimate PN-II-RU-TE-2011-2 116/5.10.2011) and by FP7 Collaborative Project MOTIVE (Models for Adaptative Forest Management)(grant agreement 226544/2009). The authors are grateful to Insa Theesfeld, Audun Sandberg and to three anonymous reviewers for their pertinent observations that helped to improve the paper.

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CURRICULUM VITAE

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Surname:	Teder
Citizenship:	Estonian
Date of Birth:	30 January 1966
Address:	Institute of Forestry and Rural Engineering, Estonian University of Life Sciences, Kreutzwaldi 5, 51014 Tartu, Estonia
E-mail:	meelis.teder@emu.ee

Education

1998–2003	PhD studies in Forest Management, Faculty of Forestry, Estonian Agricultural University
1992–1994	MSc studies in Forest Management Planning, Faculty of Forestry, Estonian Agricultural University
1984–1991	Faculty of Forestry, Estonian Agricultural Academy, diploma in Forest Engineering
1973–1984	Põlva Secondary School

Foreign languages English, Russian

Academic degree:

1996	MSc in Forest Management Planning for the thesis 'Relationship of the Estonian wood market with foreign markets' from Estonian Agricultural University

Professional employment:

Since 2016	Estonian University of Life Sciences, Institute of Forestry and Rural Engineering, Department of Forest Industry, engineer
2014–2015	Independent researcher, subcontractor for Estonian University of Life Sciences

2003–2013	Estonian University of Life Sciences, Institute of Forestry and Rural Engineering, Department of Forest Management, lecturer
1998–1999	AS Varu, director of development
1997–2015	Metsaekspert OÜ, member of the board
1995–2015	Meltim OÜ, managing director
1994–1995	AS Repuit, sawnwood sales manager
1993–1994	AS Sylvester, sawnwood purchacing manager
1993–2002	Estonian Univeristy of Life Sciences, Faculty of Foresty, Department of Forest Management, assistant/lecturer (part-time)
1991–1992	Estonian Forest Research Institute, engineer
1991	Rosmet, sawmill worker
1988	Estonian Agricultural Academy, Faculty of Forestry, Department of Silviculture, technician
1984	Räpina State Forest Enterprise, Põlva forest district, groom

Research interests:

Forest policy, innovation and employment changes in the forest sector, motivations of foresty students, forest products marketing, forestry economics

Training and special cources:

2015	PhD course 'Qualitative and Mixed Research Methods', Swedish University of Agricultural Science, Sweden
2013	COST FP1201 Facesmap training school 'Stakeholder interaction', Solsona, Spain
2013	Course 'Multivariate statistics', Estonian University of Life Sciences, Estonia
2013	Course 'Statistical modelling', Estonian University of Life Sciences, Estonia
2012	Course 'Basics of statistics and modelling for lecurers and supervisors', Estonian University of Life Sciences, Estonia

2008	Course 'Forest design for multiple practices', Estonian University of Life Sciences, Estonia
2000	NOVABA course 'The economics of small-scale forestry', Estonia
2000	Seminar 'Free Movement of persons in the EU and the European Court of Justice', Tallinn Pedagogical University, Estonia
1998	Forest products marketing courses at the Univerity of Helsinki, Department of Forest Economics, Finland
1996	Course 'Integrating environmental values into forest planning', European Forest Institute, Estonia
1996	NOVABA course 'Forest policy in Nordic Countries and in Central Europe', Jelgava, Latvia
1992	'Advanced educational program for Estonian forest leaders', Holsteinborg Consult & Copenhagen Business College, Denmark
1991	Study and practice programme in Lincolnshire College of Agriculture and Horticulture, United Kingdom

Projects:

2015	'The analysis of potential use of forest resource', Ministry of Environment, principal investigator
2015	'Economic analysis of thinnings', Foundation Järvselja Training and Experimental Forest Centre, principal investigator
2014	'Financial evaluation of forest protection activities', Ministry of Environment, principal investigator
2014	'The analysis of the joint sale of wood by forest owners', Foundation Private Forest Centre, principal investigator

2011–2012	Compilation of the textbook *International Forest Policy and Sustainable Development in Forestry*, Foundation Environmental Investment Centre, principal investigator
2010–2011	'Innovation and Sustainability of Forestry in Central-Eastern Europe: Challenges and Perspectives', EFICEEC & BOKU University in Austria, responsible investigator
2009–2010	'Macroeconomic analysis of the Estonian Forest Sector', Centre of Forest Protection and Silviculture, principal investigator
2008–2009	'Innovation in the forest sector', Foundation Environmental Investment Centre, responsible investigator
2006–2007	'Innovation in the forest cluster', Foundation Environmental Investment Centre, responsible investigator

Other international projects

2008–2009	Tempus programme 'FORPEC – Developing MSc curriculum in Forest Policy and Economics', workgroup member
2005–2007	Erasmus Intensive Program 'INNO-FOREST: Integrating innovation and entreprenurship research in higher forestry education', tutoring teacher/local coordinator

R&D related managerial and administrative work:

2013–2017	COST FP1207 'Orchestrating forest-related policy analysis in Europe (ORCHESTRA)', Management Committee member
2012-2016	COST FP1201 'Forest Land Ownership Changes in Europe: Significance for Management And Policy (FACESMAP)', Management Committee member
2006-2010	COST E51 'Integrating Innovation and Development Policies for the Forest Sector', Management Committee member

MSc dissertations supervised:

2013	Kärt Sarjas, 'Natura 2000 network from legal point of view'
2013	Kaur Lõhmus, 'An overview of evaluating the profitability of private forestry in different countries and in Estonia from 2010 to 2011'
2012	Alo Rand, 'Woodworking company productivity analyses by example of Ecobirch AS Pärnu sawmill'
2010	Priit Põllumäe, 'Innovation in Estonian forest sector and structural changes in RMK'
2008	Hektor Uustalo, 'Innovation and entrepreneurship in Estonian forest sector'
2008	Rüllo Paas, 'The impact of storm damage in year 2005 on Estonian wood market'

ELULOOKIRJELDUS

Eesnimi:	Meelis
Perekonnanimi:	Teder
Sünniaeg:	30.01.1966
Aadress:	Metsandus- ja maaehitusinstituut, Eesti Maaülikool, Kreutzwaldi 5, 51014 Tartu, Eesti
E-post:	meelis.teder@emu.ee

Haridus

1998–2003	Eesti Põllumajandusülikool, metsandusteaduskond, doktoriõpe, metsanduse õppekava,
1992–1994	Eesti Põllumajandusülikool, metsandusteaduskond magistriõpe metsakorralduse erialal,
1984–1991	Eesti Põllumajanduse Akadeemia, metsandusteaduskond, metsamajanduse insener
1973–1984	Põlva Keskkool

Võõrkeelte oskus Inglise, vene

Teaduskraad

1996	Eesti Põllumajandusülikool, metsateaduste magister metsakorralduse erialal, magistritöö teemal: "Eesti puiduturu seos välisturgudega"

Teenistuskäik

2016–	Eesti Maaülikool, metsandus- ja maaehitusinstituut, metsatööstuse osakond, insener
2014–2015	Eesti Maaülikooli allhankijana erinevate uurimisprojektide põhitäitja
2003–2013	Eesti Maaülikool, metsandus- ja maaehitusinstituut, metsakorralduse osakond, lektor
1998–1999	AS Varu, arendusdirektor
1997–2015	OÜ Metsaekspert, juhatuse liige
1995–2015	OÜ Meltim, juhataja

1994–1995	AS Repuit, Tartu piirkonna juhataja, saematerjalide ostu ja müügijuht
1993– 2002	Eesti Põllumajandusülikool, metsandusteaduskond, metsakorralduse osakond, assistent/lektor (0,2–0,5 koormust)
1993–1994	AS Sylvester, saematerjalide ostujuht
1991–1992	Eesti Metsamajanduse ja Looduskaitse Teadusliku Uurimise Instituut, insener
1991	Väikeettevõte Rosmet, saeraami tööline
1988	Eesti Põllumajanduse Akadeemia, metsandusteaduskond, metsakasvatuse kateeder, tehnik
1984	Räpina Näidismetsamajandi Põlva metskond, tallimees-koristaja (0,5 koormust)

Uurimistöö põhisuunad

Metsapoliitika, innovatsiooni ja tööhõive muutused metsasektoris, metsandusüliõpilaste motivatsioon, metsandusökonoomika, puidutoodete turundus

Täienduskoolitus

2015	Doktorikooli kursus "Qualitative and Mixed Research Metoods", Rootsi Põllumajandusülikool, Rootsi
2013	COST FP1201 Facesmap treeningkoolitus "Stakeholder interaction", Solsona, Hispaania
2013	Kursus "Mitmemõõtmeline statistika", Eesti Maaülikool, Tartu, Eesti
2013	kursus "Statistiline modelleerimine", Eesti Maaülikool, Tartu, Eesti
2012	Kursus "Statistika ja modelleerimise baaskoolitus õppejõududele ja juhendajatele", Eesti Maaülikool, Tartu, Eesti
2008	Kursus "Forest design for multiple practices", Eesti Maaülikool, Tartu, Eesti
2000	NOVABA kursus "The economics of small-scale forestry", Tartu, Eesti

2000	Seminar ”Free Movement of persons in the EU and the European Court of Justice”, Tallinna Pedagoogikaülikool, Eesti
1998	Õpingud Helsingi Ülikoolis metsatoodete turunduse valdkonnas, Helsingi, Soome.
1996	Kursus “Integrating environmental values into forest planning ”, Euroopa Metsainstituut, Räpina, Eesti
1996	NOVABA kursus ”Forest policy in Nordic Countries and in the Central Europe”, Jelgava, Läti
1992	Täiendõppe programm Eesti metsandusjuhtidele, Holsteinborg Consult ja Copenhagen Business College, Holsteinborg, Taani
1991	Õpingud ja stažeerimine Lincolnshire College of Agriculture and Horticulture, Suurbritannia

Projektid

2015	„Olemasoleva metsaressursi kasutamise võimaluste analüüs“, Keskkonnaministeerium, põhitäitja
2015	„Harvendusraiete ökonoomiline analüüs“, SA Järvselja õppe- ja katsemetskond, põhitäitja
2014	“Metsakaitseliste tegevuste maksumuse hindamine“, Keskkonnaministeerium, põhitäitja
2014	„Puidu ühismüügi analüüs“, SA Erametsakeskus, põhitäitja
2011–2012	Õpik-käsiraamatu “Rahvusvaheline metsapoliitika ja säästev areng metsanduses” koostamine, SA Keskkonnainvesteeringute Keskus, põhitäitja
2010–2011	„Innovation and Sustainability of forestry in Central-eastern Europe: Challenges and Perspectives“, Euroopa Metsainstituut + BOKU ülikool Austrias, vastutav täitja
2009–2010	“Eesti metsasektori makroökonoomiline analüüs“, Metsakaitse- ja metsauuenduskeskus, põhitäitja

2008–2009	"Innovatsioon metsasektoris", SA Keskkonnainvesteeringute Keskus, vastutav täitja
2006–2007	„Innovatsioon metsaklastris", SA Keskkonnainvesteeringute Keskus, vastutav täitja

Muud rahvusvahelised projektid

2008–2009	Tempus programm "FORPEC – Developing MSc curriculum in Forest Policy and Economics", töögrupi liige
2005–2007	Erasmus Intensive Program "INNO-FOREST: Integrating innovation and entrepreneurship research in higher forestry education", juhendav õppejõud/kohalik koordinaator

Teadusorganisatsiooniline ja -administratiivne tegevus

2013–2017	COST FP1207 „Orchestrating forest-related policy analysis in Europe (ORCHESTRA)", juhtkomitee liige
2012–2016	COST FP1201 „Forest LAnd Ownership Changes in Europe: Significance for Management And Policy (FACESMAP)", juhtkomitee liige
2006–2010	COST E51 „Integrating Innovation and Development Policies for the Forest Sector", juhtkomitee liige

Juhendatud magistritööd

2013	Kärt Sarjas, "Natura 2000 võrgustik vaadatuna juriidilisest aspektist"
2013	Kaur Lõhmus, "Ülevaade erametsanduse kasumlikkuse hindamisest erinevates riikides ning erametsanduse tasuvuse hindamine Eestis 2010–2011"
2012	Alo Rand, "Puidutöötlemisettevõtte tootlikkuse analüüs Ecobirch AS Pärnu saeveski näitel"
2010	Priit Põllumäe, "Metsasektori innovatsioon ja RMK struktuurimuudatused"

2008	Hektor Uustalo, "Innovatsioon ja ettevõtlus Eesti metsasektoris"
2008	Rüllo Paas, "2005. aasta tormikahjustuste mõju Eesti puidukaubandusele"

LIST OF PUBLICATIONS

Publication indexed in the Thomson Reuters Web of Science database

Teder, M., Kaimre, P. The participation of stakeholders in the policy processes and their satisfaction with results: a case of Estonian forestry policy (manuscript, submitted to Forest Policy and Economics, special issue about Policy 'Orchestration').

Sirgmets, R., **Teder, M**., Kaimre, P. Use of foreign trade indices in the evaluation of sectoral competitiveness, based on Estonian and Latvian forestry. Baltic Forestry (manuscript, submitted to Baltic Forestry)

Teder, M., Mizaraitė, D., Mizaras, S., Nonić, D., Nedeljković, J., Sarvašová, Z., Vilkriste, L., Zalite, Z., Weiss, G. 2015. Structural changes of state forest management organizations in Estonia, Latvia, Lithuania, Serbia and Slovakia since 1990. Baltic Forestry 21(2): 326─339.

Bouriaud, L., Nichiforel, L., Weiss, G., Bajraktari, A., Curovic, M., Dobsinska, Z., Glavonjic, P., Jararský, V., Sarvašova, Z., **Teder, M.,** Zalite, Z. 2013. Governance of private forests in Eastern and Central Europe: An analysis of forest harvesting and management rights. Annals of Forest Research, 56(1): 199─215.

Bouriaud, L., Kastenholz, E., Fodrek, L., Karaszewski, Z., Mederski, P., Rimmler, T., Rummukainen, A., Sadauskiene, L., Salka, J., **Teder, M**. 2011. Policy and market-related factors for innovation in forest operation enterprises, in: Weiss, G., Pettenella, D., Ollonqvist, P., Slee, B. (Eds.), Innovation in Forestry: Territorial and Value Chain Relationships, pp. 276─293. CAB International.

Nybakk, E., Niskanen, A., Bajric, F., Duduman, G., Feliciano, D., Jablonski, K., Lunnan, A., Sadauskiene, L., Slee, B., **Teder, M.** 2011. Innovation in the wood bio-energy sector in Europe, in: Weiss, G., Pettenella, D., Ollonqvist, P., Slee, B. (Eds.) Innovation in Forestry: Territorial and Value Chain Relationships, pp. 254─275. CAB International.

Ollonqvist, P., Nord, T., Pirc, A., Ukrainski, K., Takala-Schreib, V., **Teder, M**., Strykowski, W., Viitala, A. 2011. Networks and local milieus as a furniture industry innovation platform, in: Weiss, G., Pettenella, D., Ollonqvist, P., Slee, B. (Eds.) Innovation in Forestry: Territorial and Value Chain Relationships, pp. 233–253. CAB International.

Publications in other peer-reviewed research journals

Teder, M., Ukrainski, K., Prede, M., Kaimre, P. 2007. Assessing the alignment and integration of innovation and development policies for the forest sector in Estonia. Metsanduslikud Uurimused | Forestry Studies, 46: 102─117.

Muiste, P., Kurvits, V., Mitt, R., **Teder, M**., Kakko, T. 2006. Forest Harvesting in Estonia during the Transition Period. Forestry Studies | Metsanduslikud Uurimused, (45): 164–171.

Kaimre, P., Muiste, P., **Teder, M**., 2001. Analysis of Estonian Forest Industry Enterprises - the Case Study. Baltic Forestry, 7(2): 50–56.

Muiste, P., Haarlaa, R., Välja, A., **Teder, M.** 1998. Baltian maiden metsätalous ja sahateollisuus 1990-luvulla [Forestry and Sawmilling Industry in the Baltic Countries in the 1990s]. Metsätieteen Aikakauskirja | Folia Forestalia, (3): 429–441 (in Finnish).

Articles in proceedings, in a book or in a collection

Teder, M. 2015. Assessing suitability of stakeholders' meeting notes for the qualitative data analyse: A case study of Travellab, in: Živojinović, I., Lidestav, G., Feliciano, D., Hujala, T., Lawrence, A., Weiss, G. (Eds.) Concepts, Methods and Findings in Forest Ownership Research in Europe. Mid-term Proceedings of the COST Action FP1201 Forest Land Ownership Changes in Europe: Significance for Management and Policy FACESMAP, pp. 115−119. EFICEEC-EFISEE c/o University of Natural Resources and Life Sciences, Vienna (BOKU).

Teder, M., Põllumäe, P., Korjus, H. 2015. Estonia, in: Živojinović, I., Weiss, G., Lidestav, G., Feliciano, D., Hujala, T., Dobšinská, Z., Lawrence, A., Nybakk, E., Quiroga, S., Schraml, U. (Eds.) Forest Land Ownership Change in Europe. COST Action FP1201 FACESMAP Country Reports Joint Volume, pp. 159−176. EFICEEC-EFISEE c/o University of Natural Resources and Life Sciences, Vienna (BOKU).

Teder, M., Sirgmets, R. 2012. Competitiveness of the Estonian timber products and comparison with Scandinavian and Baltic countries. Scandinavian Forest Economics, 44: 148–151.

Teder, M. 2009. Recent changes in Estonian Forest legislation and reforms in Estonian forestry. ICFFI (International Centre of Forestry and Forest Industries, St. Petersburg State Forest Technical Academy) News, 10: 92−96.

Ollonqvist, P., **Teder, M.,** Lähtinen, K., Viitanen, J. 2006. Delocalisation of woodworking industry from Finland to the Baltic countries, in: Niskanen, A. (Ed.) Issues Affecting Enterprise Development in the Forest Sector in Europe, pp. 253–277. University of Joensuu, Faculty of Forestry.

Teder, M. 1996. A Short overview of the changes in Estonian timber trade in 1994-1995, in: Hyttinen, P., Nilson, A. (Eds.), Integrating Environmental Values into Forest Planning. EFI Proceedings, 13: 131–133.

Published meeting abstracts

Teder, M. 2013. Changes and reforms in the Estonian State Forest management – is there some influence to the private forestry? In: Welcome to The Anthropocene! The Nordic Environmental Social Science Conference, 11-13 June 2013, Abstracts, p. 95.

Sirgmets, R., Kaimre, P., **Teder, M**. 2012. The evaluation of sectorial competitiveness on the basis of external trade, based on the example of Estonian forest management and logging sector. Scandinavian Forest Economics, 44: 242–242.

Teder, M., Põllumäe, P. 2010. Changes and reforms in the Estonian forest sector: Survey results before and after reforms in state forest management organization, in: Emerging Economic Mechanisms: Implications for the Forest Related Policies and Sector Governance; proceedings. FAO Headquarters, Rome, 5-7 October 2010. Rome.

Teder, M. 2009. The changes in forestry governance and management of public forests in Estonia: a case for innovation study, in: Buttoud, G. (Ed.) Pre-conference proceedings: Change in governance as collective learning process: Management, Politics and Ethics in Forestry. International Symposium Nancy, France, 21-24 June 2009. AgroParisTech-ENGREF, Laboratory of Forest Policy, pp. 188−189.

Popular scientific publications

Kaimre, P., Karoles, K., Korjus, H., Kosenkranius, E., **Teder, M**. 2012. Rahvusvaheline metsapoliitika ja säästev areng metsanduses. 128 p. (electronic publication) -http://mi.emu.ee/userfiles/instituudid/mi/MI/Projektid/Rahvusvaheline%20metsapoliitika%20ja%20s%C3%A4%C3%A4stev%20areng%20metsanduses.pdf

Kaimre, P., **Teder, M**., Pärn, L., Kalbach, E. 2005. Puidu kasutamine ja eksport on suurenenud. Eesti Mets, 3: 20−22.

Muiste, P., Kaimre, P., **Teder, M**. 2001. Priorities of forest industry in Estonia. Baltic Timber Journal, 1(4): 12–14.

Muiste, P., Kaimre, P., **Teder, M**. 2001. Ressursikasutusest Eesti metsatööstuses. Eesti Mets, 4−6: 29−32.

Teder, M. 1995. Kuidas õpetada puidukaubandust. Eesti Mets, 2: 17−18.

VIIS VIIMAST KAITSMIST

URMAS SANNIK
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15. detsember 2016

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16. detsember 2016

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17. jaanuar 2017

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2. veebruar 2017

KADRI JUST
BEGOMOVIRUS INFECTION IN TOMATO FRUIT
BEGOMOVIIRUSTE INFEKTSIOON TOMATI VILJAS
Professor **Leif Anders Michael Kvarnheden** (Rootsi Põllumajandusteaduste Ülikool), emeriitprofessor **Anne Luik**
3. veebruar 2017

ISSN 2382-7076
ISBN 978-9949-569-70-0 (trükis)
ISBN 978-9949-569-71-7 (pdf)

Trükitud taastoodetud paberile looduslike trükivärvidega © Kuma Print