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The European Forest Sector's Development Compared with EFSOS Predictions

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Abstract
The aim of this study is to compare the predictions of the European forest sector development that were made in the European Forest Sector Outlook Study 1960–2000–2020 (EFSOS) and the real development of different indicators defining the sector's actual state. EFSOS presented several scenarios on the European forest sector. Comparisons were carried out for these scenarios on the following attributes: forests available for wood supply, growing stock, net annual increment, fellings, sawnwood net trade, wood-based panels net trade, paper and paperboard net trade and roundwood price development. In addition, the development of the protected forest area and the forests' ownership structure were analysed. Series of data for 2000–2008 were analysed. The starting point for both analyses was 2000, which was the starting point of the EFSOS scenarios.

These studies on European forest resources were conducted more than 10 years ago. Substantial structural, organisational and policy changes have since been made not only in the forest sector but also in other sectors related to forestry, such as in agriculture, environment and energy. Changes in countries in Central and Eastern Europe and the former USSR during the transition period and the increased use of forest biomass for energy production are the most important changes. In addition, the global economic crisis in the past few years has severely affected the forest sector in Europe. Most of the data series used in the EFSOS models were collected in the 1990s. Therefore, those changes had some impact on the accuracy of the predictions, especially since 2006, when the first impact of the global financial crisis appeared. The results of this study allow us to conclude that after the recovery of the economy new models and predictions of forest sector development will be needed.

Keywords
Forest sector development, forest resources, forestry trade, timber markets

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List of acronyms and abbreviations

CIS	Commonwealth of Independent States
EFI	European Forest Institute
EFISCEN	European Forest Information Scenario Model
EFSOS	European Forest Sector Outlook Study
FAO	Food and Agriculture Organization
FAWS	Forest available for wood supply
FRA	Forest Resources Assessment
MCPFE	Ministerial Conference on the Protection of Forests in Europe
UNECE	United Nations Economic Commission for Europe
WTO	World Trade Organization
WWF	World Wide Fund for Nature
o.b.	Over bark

Preface

This study has been carried out as part of a project analysing the development of the forest sector in Central and Eastern Europe. The project was led by Dr. Jan Ilavsky. Marika Makkonen worked in Metla in 2007–2008 during the elaboration of her Master's thesis at the University of Helsinki. She processed the data until 2006. Dr. Daniel Halaj, a researcher from the Technical University in Zvolen, Slovakia, stayed in Metla in 2008 during his scholarship granted by CIMO, The Finnish Centre for International Mobility and the Ministry of Education of the Slovak Republic. He processed the data for 2007–2008 and the data on wood prices. Jan Ilavsky and Daniel Halaj compiled the study. Since his retirement in June 2009, Dr. Ilavsky has worked as an external researcher for Metla.

1 Introduction

The European forest sector is facing radical changes, and decisions have to be made in order to maintain the forest sector's viability in the future. Reliable and up-to-date information on current forest resources and other forestry-related subjects have to be available for decision makers to make appropriate decisions. Studies on European forest resources with predictions of their development were conducted several years ago. Substantial structural, organisational and policy changes have since been made not only in the forest sector but also in other sectors related to forestry, such as agriculture, environment, energy and other sectors. Changes in countries in Central and Eastern Europe and in the countries of the former USSR during the transition period and the increased use of forest biomass for energy production are the most important changes. In addition, the global economic crisis in the past few years has severely affected the forest sector in Europe. Therefore, it is important to ensure that the parties' decisions are based on correct knowledge and information.

The aim of this study is to draw a comparison between the predictions of the European forest sector development in the European Forest Sector Outlook Study 1960–2000–2020 (EFSOS) and the real development of different indicators defining the sector's actual state. EFSOS presented several scenarios concerning the European forest sector. The principal goal of the study was to assess whether the EFSOS scenarios of forest resources, forest ownership structures and wood removals and trade in Europe made more than a decade ago were still valid. EFSOS was carried out by the Food and Agriculture Organization (FAO) of the United Nations and the United Nations Economic Commission for Europe (UNECE).

The global economy has grown sequentially since the beginning of 2000s and, therefore, some scientists have compared that period to the period before the first oil shock in 1973 (Shelburne et al. 2007). Economic growth was strong all over Europe, which enhanced the consumption of and demand for raw wood material, and furthermore accelerated the trade of forestry products within and outside Europe (Pepke 2007). Concurrently, partly because of increased fossil fuel prices, the political environment has changed towards promoting the use of wood energy (Bowyer 2007). This has naturally increased the demand for wood for energy and added even more pressure to wood procurement in Europe (Bowyer 2007). As a consequence of increased wood demand and competition for raw wood material, wood reserves decreased in 2006, which caused record high wood prices in Europe in 2007 (Pepke 2007).

Background of the study

In the current operational environment, the European forest industry has faced difficulties in purchasing enough wood for processing. This has been the case even though over several decades, the total forest area has increased steadily all over Europe, leading to growing stock (EFSOS 2005). This means extensive unutilised wood resources for the European forest industry and energy use, and therefore it would seem to be relatively easy to provide an adequate volume of raw wood for the European forest industry. However, the situation is not simple in the current operational environment in Europe, where, for example, different political and economic aspects in different countries affect largely the level of wood supply and demand.

Rising export tariffs for Russian roundwood certainly brought additional pressure to wood procurement in Europe, when introduced in June 2006. The last raises in the customs tariffs, which would have eventually stopped export of roundwood from Russia, have not been implemented. If Russia will join the World Trade Organization (WTO), these last raises will not be realised. Nevertheless, export duties have influenced to Finland, Sweden and to some extent also the Baltic

States which have been the most important importers of Russian roundwood in Northern Europe (Viitanen & Karvinen 2010). Roundwood from Russia have also been traded to Central Europe and Norway, but in these countries their role and importance with respect to national removals and consumption have been only marginal.

Based on EFSOS estimates, increased harvests would be possible in the long-term. This statement is essential for the vitality of the European forest sector and, therefore, it is an urgent requirement to examine the real raw wood potential, felling possibilities and other components affecting the European forest sector under the changed operational environment. In particular, the countries in Central and Eastern Europe are of interest, since there is large unused wood potential and many of these countries have opened their forestry products markets as a result of their economic reforms. Market liberalisation in these Central and Eastern European countries would open remarkable sources of wood to European and global markets.

Previous studies

A considerable number of studies on European forest sector development has been carried out. The major proportion of these studies has been executed by UNECE and FAO, but European Forest Institutes and several universities all over Europe have also carried out related research. EFSOS is the principal publisher of previous studies. However, since EFSOS is so wide ranging and constitutes a major part of the study background, it is discussed separately in section four.

Two years after EFSOS was published, Schulmeyer (2006) analysed EFSOS scenarios comparing GDP growth rates, main forestry product prices, consumption, production and net trade with the actual development for the period 2000–2005. The main conclusion in Schulmeyer's study was that the EFSOS scenarios were mostly in line with the actual trends in prices, production and consumption and that EFSOS was still a reliable basis for policy discussion. The largest difference between the actual trend and projections was found in net trade. This was explained by the fact that net trade was sensitive to the background assumptions of the other projections, as it was calculated by subtracting import and export projections from each other.

In 2007, the Ministerial Conference on the Protection of Forests in Europe (MCPFE) published a report "State of Europe's Forests 2007" (MCPFE 2007a). It emphasised sustainable forest management, and it was the most recent and up-to-date study on European forests, related policies and institutions in the forest sector. The findings of the study supported the general opinion of Europe's growing forest area and growing stock, but also expressed a concern about declining forest health.

Gold et al. (2006) examined the development of the forest area and growing stock in 18 European countries between 1950 and 2000. Their aim was to examine the impact of exogenous factors (policies and markets) on forest resources and identify the long-term driving forces in key forest resource parameters. In addition, they posed an issue about the consistency and comparability of the data that was collected by UNECE and FAO for their studies. Although several studies on European forest resources have been published since 1947, the terms and definitions have varied between publications. This means that reliable time series data are impossible to attain. Gold et al. (2006) compiled and analysed all the terms and definitions used in various Forest Resources Assessment (FRA) publications from 1947 to 2000 and reclassified them. Although the study still left uncertainties, they concluded that an increase in the forest available for wood supply (FAWS) was affected by two major components. The first was afforestation volume and the second was infrastructure development that enabled access to previously inaccessible areas.

Schelhaas et al. (2004) examined the possible future development of forests in the Czech Republic, Hungary, Poland and Ukraine. Their approach was similar to EFSOS (2005), since they estimated different scenarios for future forest resources by using the same European Forest Information Scenario model (EFISCEN) that was used in EFSOS. In brief, the main findings were that almost in all countries the share of old forests increased, which induced a decrease in average net annual increment in the long-term. As a consequence of ageing, forests were expected to become more vulnerable to biotic and abiotic elements. However, they saw it as a good development option from an ecological perspective. The felling potential in those four countries was large, although increased interest in nature conservation was expected to affect felling possibilities. In addition, fellings were observed to depend on changes in forest ownership structure and in the agricultural sector.

Tilli and Skutin (2004) examined the Baltic Sea area forest resources, their ownership structure and utilisation. In addition, in the same study they examined roundwood markets, trade and the forest industry. They concluded that Northwest Russia had the most extensive unused forest resources in the Baltic Sea region and that the possibilities of increasing logging in Germany were small. The main reasons for this were high raw wood prices and a strong emphasis on nature conservation in Western Europe. Another important finding in their study was that the forest's private ownership was expected to increase remarkably in the Baltic Sea states because of the ongoing forest land restitution process in former Soviet states.

2 EFSOS – its purpose and content

This study investigates the EFSOS (2005) scenarios on forest resources, forest ownership structure, wood removals and trade. Because EFSOS (2005) constitutes a major part of the study background, it is discussed in detail in this chapter.

EFSOS in brief

EFSOS (2005) was jointly prepared by UNECE and FAO and by 2007, it was the most important study on Europe's forest sector and its future development. EFSOS was the sixth in the outlook study series and was based on a significant amount of scientific research. Precursors of EFSOS were the series of European Timber Trends Studies, of which the first was undertaken in 1952 (Schelhaas et al. 2003). Compared with previous studies, EFSOS (2005) focused more closely on analysing the outlooks of countries with economies in transition.

An objective of EFSOS was to analyse the outlook of the European forest sector and provide guidance to all stakeholders. The study covered all areas of the forest sector, including forest resources, forestry-related production and the trade and consumption of forest products and services. EFSOS presented the then current state of the European forest sector based on an historical analysis of the period 1961 to 2000 as well as two or three alternative scenarios for the period 2000 to 2020. EFSOS included all of the major countries in Europe and seven countries in the former USSR.

The methods and data used in the EFSOS (2005) scenarios are presented in two separate large-scale studies. Schelhaas et al. (2003) projected baseline and integration scenarios for the period 2000 to 2040 on the forest resources in Europe. They used the EFISCEN in their projections. Kangas and Baudin (2003), in turn, projected baseline, conservation and integration scenarios on the demand, supply and trade of forest products in Europe for the period 2000 to 2020.

Although some scenarios ranged up to 2040, EFSOS (2005) presented scenarios only until 2020. The longer time horizon would have increased the uncertainty of its projections (EFSOS 2005). More detailed methodologies and assumptions about the models are presented in Schelhaas et al. (2003) and Kangas and Baudin (2003).

Countries in EFSOS

EFSOS (2005) covered 38 countries in Europe that were considered to be relevant from a forestry point of view. Because the socioeconomic variation between these countries was wide, they were grouped into three categories based on their forest resources, economic development and market structure. The country grouping can be seen in Fig. 1 and each group is explained in more detailed below. In Fig. 1, countries marked as white are Western Europe, light grey is the CIS sub-region and dark grey is Eastern Europe.

– *Western Europe*: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom
– *Eastern Europe*: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Serbia and Montenegro, Slovakia, Slovenia, The Former Yugoslav Republic (FYR) of Macedonia, Turkey
– *CIS sub-region*: Belarus, Republic of Moldova, Russian Federation, Ukraine

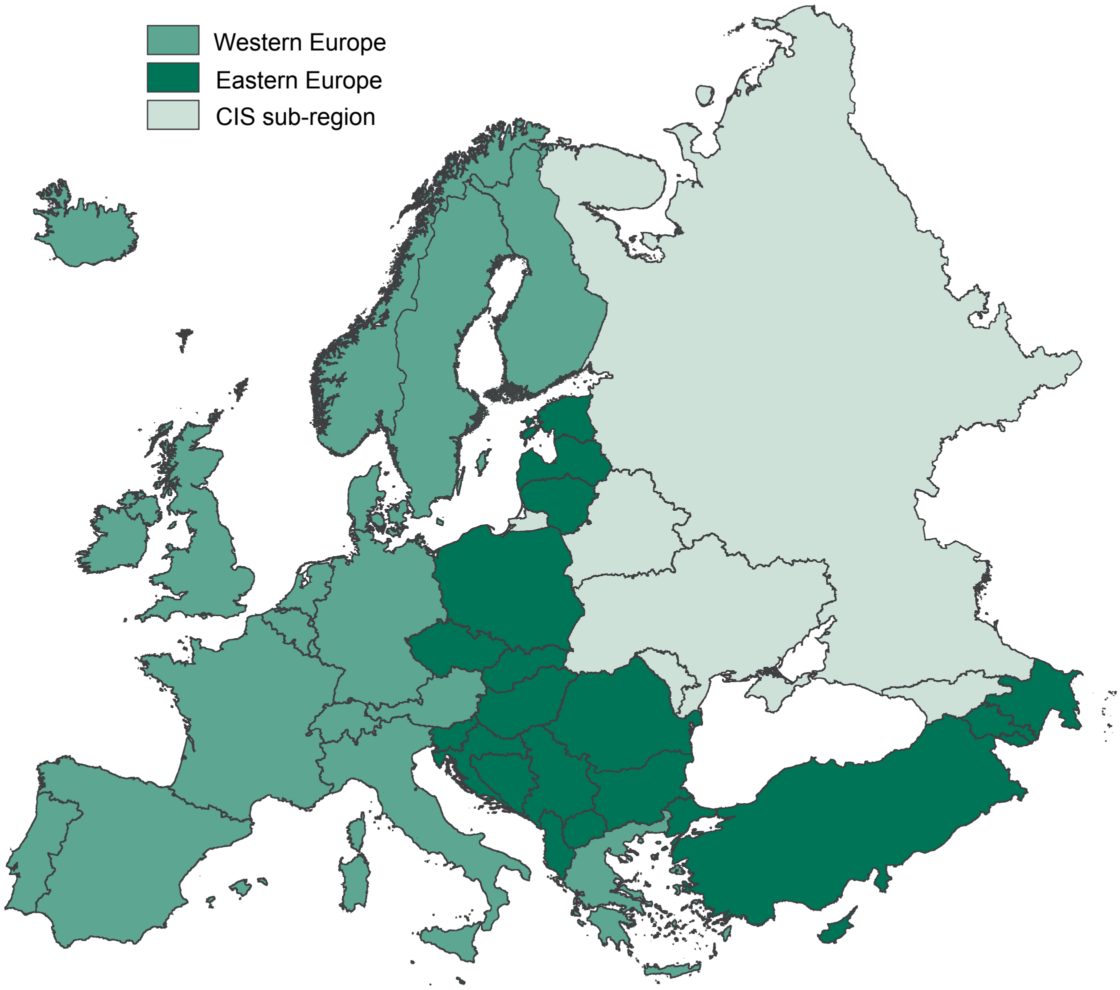

Figure 1. Country groups in EFSOS (Source: EFSOS 2005).

EFISCEN

The EFISCEN was used to simulate the long-term development of forest resources in Europe. It was considered purely a forest resources model. This was because the model did not consider price elasticises, supply, demand or any other market factors that would enable the model to adjust to different market conditions (Schelhaas et al. 2003). The model was chosen for EFSOS (2005), because it was suitable especially for regional- or country-level projections (Schelhaas et al. 2004, p. 5).

By using the EFISCEN, it was possible to show the sensitivity of the future growth and development of European forest resources to changes in future felling volumes (EFSOS 2005). These felling volumes were determined by the timber market model. The background assumptions of the EFISCEN were the state of the forests, assumed growth in the forests, approximately 400 different management regimes and assumptions concerning the policy framework. As a basis for the growth assumption, the EFISCEN applied an age-dependent growth function to all projections that simulated net annual increment. Growth was determined by a probability of the area moving to a higher age class. The EFISCEN took into account regeneration, afforestation and deforestation. All of these factors were determined separately country by country. Since the model was not able to simulate market conditions (such as forest owner behaviour), the level of thinning and final felling were assumed to be constant throughout the period (Schelhaas et al. 2003).

The starting point of the EFISCEN modelling was the FAWS area, and therefore it was important that the data reported by each country represented the FAWS area. For this purpose, a scaling method was used to achieve conformity between the current data and the data reported earlier (Schelhaas et al. 2003).

The data used in the EFISCEN modelling was based on the most recent forest inventory data. An update enquiry was sent to all countries included in the study, but on average one-third of all studied countries reported inventory data for 2000. Therefore, projections are based on the inventory data that was collected between 1980 and 2001. This is the reason why the forecasted values for 2000 did not correspond to the actual 2000 value, even though EFSOS (2005) was completed after 2000. The amount of up-to-date data varied significantly, particularly between Eastern and Western Europe. Approximately 10% of Western European countries reported inventory data for 2000 or 2001, whereas the corresponding figure for Eastern Europe was approximately 60%. In the CIS sub-region, only Belarus reported the data for 2001.

It is important to note that the scenarios in Kangas and Baudin (2003) concern the European part of Russia, whereas they calculated the scenarios for the whole Russian region. In addition, no data were available for Bosnia and Herzegovina and Greece and, therefore, simple forward calculations for increment, fellings and mortality were executed for those countries.

Timber market model

Kangas and Baudin (2003) developed an econometric model, or the so-called timber market model, in order to produce future projections of the demand, supply and trade for forest products in Europe. The demand for forest products means the quantity of forest products that consumers in the economy are willing to consume at different price levels, whereas supply indicates the level of forest products that all suppliers in the economy are willing to supply at different price levels (Pekkarinen and Sutela 2002).

Kangas and Baudin (2003) prepared the projections for the three main forest product categories: sawnwood, wood-based panels and paper and paperboard. The data used in the modelling were extracted mainly from the UNECE/FAO timber statistical database and from the UNECE and OECD databases. The required steps, such as currency conversions and price deflations, were carried out to attain data comparability. In addition, when the data were not reported for a certain year, either inter- or extrapolation was used in order to achieve full time series data. The underlying assumption of the models was a long-term growth rate of GDP and various forest sector policy and market scenarios (Kangas and Baudin 2003).

Kangas and Baudin (2003) grouped selected European countries into three different main categories based on data availability in each country as well as their economic status and size of their forestry product markets. Group I consisted of countries that were major forest product producers and/or consumers in Europe and provided sufficient long-term time series data. Countries in group II were traditional market economies, but with minor production and/or minor consumption of forest products. Group III consisted of countries that had recently become market economies. For each country group, an ordinary least squares approach was used for all projections (Kangas and Baudin 2003).

As a basis of the timber market model, Kangas and Baudin (2003) used an econometric modelling approach, which was developed by Brooks et al. (1995). The modelling used two different methodologies depending on the country group. The first modelling approach, a *multiple equation model* for demand and supply, was used for the countries in group I. The clear advantage of the multiple equation model over the other estimation methods was that it allowed us to examine a substitution effect between alternative sources on the supply and on the demand side. The second advantage was that the model provided more information on differences in the supply and demand elasticises between the countries.

The second modelling approach, *a time series cross-sectional model* for consumption, was used in groups II and III.

For each country and product, apparent consumption was calculated by adding together import demand and domestic demand. In turn, total production volume was calculated by adding domestic demand and export supply. By subtracting apparent consumption from production, the net trade for each product and country was calculated (Kangas and Baudin 2003).

EFSOS scenarios

Three scenarios were presented in EFSOS (2005) in order to take into account the uncertainty caused by the assumptions of the EFISCEN and the timber market model. These scenarios were the baseline scenario, increasing conservation, environmental regulation and the public awareness scenario (so-called conservation scenario) and European integration and market liberalisation scenario (so-called integration scenario). From this point onwards, only the terms baseline, conservation and integration are used. All three scenarios concerned only the area of FAWS. This was because the area of FAWS is defined as the area that was available for the use of the forest industry, and such information was expected to benefit the forest industry the most (Kangas and Baudin 2003).

The scenarios were based on the current economic and political states in UNECE member countries and on the expectations of their future development (EFSOS 2005). An underlying assumption of the baseline scenario was that the economy would remain stable and that currently visible trends in the FAWS area development, felling volumes, raw material costs and forest product prices would continue at the current level until 2040 (Schelhaas et al. 2003). Thus, the integration and conservation scenarios were based on the assumption that the changes in the operational environment, such as market size, production location, size of the different products' market shares and competitiveness of the forest products, would have a strong influence on the forest sector in the future (Kangas and Baudin 2003).

Differing from the integration scenario, the conservation scenario presumed an increase in the environmental enhancement, slower economic growth and increased raw material costs and real forest product prices in Europe (Kangas and Baudin 2003). The conservation scenario was expected to lead to the decreased consumption and production of forest products in all forest product areas in Europe (Schelhaas et al. 2003). The integration scenario, in turn, presumed economic growth in Europe, increased international competition, specialisation and a decline in real prices because of regional integration and reductions in customs tariffs (Schelhaas et al. 2003). Economic integration between European countries was expected to be rapid according to the integration scenario, which furthermore was expected to increase the use of forests via fast economic growth (Kangas and Baudin 2003). One significant factor contributing to the integration in Europe was expected to be an economic improvement in the formerly planned economies that were moving towards market economies (Schelhaas et al. 2003). These economies are located in East and Central Europe and in the CIS sub-region, and expected GDP to grow yearly by 3 to 9% (Schelhaas et al. 2003).

3 Objectives and scope of the study

The main objective of this study is to analyse the actual development of some of the forest sector's characteristics in 2000 to 2008 and compare them with predictions made by the EFSOS scenarios. The study also aims to provide up-to-date knowledge on the European forest resources, ownership structure, wood removals, volume of the trade of forestry products and roundwood price development.

The covered variables represent only a part of the variables studied in EFSOS. The scope of EFSOS is large, and analysing it in entirety was not considered possible taking into account the available resources for the present study. The studied variables were selected from the wood mobilisation perspective, namely those variables that were considered to be the most important factors determining the available wood potential for increased wood removals in the future.

Comparisons focused on the following areas:
- Total forest area and area of FAWS
- Area of protected forests
- Growing stock
- Net annual increment
- Forest ownership structure
- Fellings
- Forest products trade

Owing to the current rapid changes in forest product prices, a chapter on the development of roundwood prices in the Baltic Sea region was also included in the study.

EFSOS (2005) focused on the development of FAWS instead of total forest area. This was explained by the fact that the forestry information in FAWS would reflect better the productive capacity of forest resources, and thereby be more informative. Examining growing stock and net annual increment was important, because together with forest area these factors are important components determining the state of forest resources (Gold 2003). Analysing forest ownership structure was considered important, as changes in private forest ownership structure are found to affect logging volume, which furthermore is found to affect the possibilities of increasing fellings, wood mobilising and forestry products trade (MCPFE 2007a).

The covered period for forest resources and forest ownership structure was 2000–2005, and for forest products trade and removals 2000–2008. These two different time periods were determined by data availability. The starting point for both analyses was 2000, which was also the starting point for the EFSOS scenarios. However, the publicly available data for forest resources and ownership structure were available only until 2005. For trade, the data were available until 2008. Therefore, comparisons between the actual and projected development of forest resources and ownership structure extend to 2005 and comparisons on forest products trade extend to 2008.

To assure that comparisons between this study and EFSOS were valid, it was essential to include the same countries in this study as were included in EFSOS (2005). In some cases, however, complete country data were not available or their validity was considered weak. Therefore, when making comparisons between the EFSOS scenarios and the actual development, the coverage of the study was limited to UNECE countries where adequate data were available. If countries were excluded from the analysis, the respective data were excluded from both sets of data, i.e. from the set of EFSOS as well as from the set of actual development.

Forest sector in Europe

According to EFSOS (2005), the European forest sector consists of forestry, forest industry and forest products markets. Historically, long-term trends in the European forest sector were relatively stable until 1991, when the former Soviet Union collapsed and many countries in Eastern Europe declared their independence. This event significantly affected the European forest sector. In 1991, political and economic reforms started in many countries in the CIS sub-region (EFSOS 2005). In addition, many Eastern European countries were experiencing economic reforms, which had started few years earlier because of the collapse of the Iron Curtain.

The European forest sector had to adapt to a new situation, as many of the new independent countries began to adopt the principles of the market economy and enter wood markets (EFSOS 2005). The emergence of these new market economies in Eastern Europe may have influenced the way in which the European forest sector was structured on a regional basis. It has been stated that the forest sector in Western European countries is influenced more by the factors concerning the laws and economic instruments, whereas in Eastern Europe and the CIS sub-region the markets are the main driving force (Thoroe et al. 2004).

Although the basic structures of the forest sector institutions in different countries in Europe are similar, these institutions are organised differently (Rametsteiner, 2005). The scopes of the different institutions affecting the European forest sector in the intergovernmental, governmental, non-governmental and private sectors is wide and, therefore, only major agents are mentioned in this context (Bauer and Guarin Corredor 2006). At the country level, the Ministry of Agriculture and Forestry is usually the most important decision-making body. The main international institutions affecting the European forest sector are the EU, United Nations and its sub-units, MCPFE and several other organisations and programmes, e.g. the WTO, WWF and European Forest Institute (EFI) (Bauer and Guarin Corredor 2006). Other international institutions, such as several research institutes and the Montréal Process, also developed and implemented criteria for sustainable forest management and conservation in boreal and temperate forests (Bauer and Guarin Corredor, 2006).

In general, the forest sector is affected by the political and demographic environment and innovations. Changes in demand and supply and changing attitudes towards non-wood production also affects the forest sector (Schelhaas et al. 2004). In addition, consumers are more and more interested in the ethical side of forestry, which may either increase or decrease the demand for forest products (EFSOS 2005). Currently, however, the greatest issue affecting the forest sector is the increasing concern of climate change, which is expected to increase protective measures in forests (Pepke 2007). Increased protection in forest management areas would aggravate already difficult wood procurement in Europe.

There are many factors in the economy that affects the forest sector, but which the forest sector itself cannot affect. Usually, such factors affect the forest by changing the demand for forest products. The first of these factors is market size, which affects the demand for forest products. The second is the political, economic and social environment, which determines the framework in which the forest industry and the whole sector can operate. The third is the transition countries' ability to develop their own economies (Thoroe et al. 2004; UNECE/FAO 2006), which will be reviewed in more detail in the following section.

Economic systems and economies in transition

Approximately half of the countries studied in EFSOS are so-called countries with economies in transition[1]. These countries are characterised by the fact that they have moved, or they are still moving, from centrally planned economies towards market economies. These countries have a large wood potential. The development of transition countries is interesting from the European forest sector's point of view, because if their wood potential enters European wood markets, it would inevitably affect wood trade flows in Europe. Therefore, it is important to understand the background of the transition process in order to evaluate the future logging possibilities in the countries of Central and Eastern Europe and the former Soviet Union and the impact of the increased marketed wood on the European forest sector.

Owing to different administrative structures, values, practices and political objectives, each country in transition has followed its own path, creating its own political system towards democracy (Herrschel 2001). The economic change, however, has not been straightforward, and several drawbacks have occurred in many countries. Many countries have moved into recession, leading to decreased demand for wood and felling volumes (Schelhaas et al. 2004). Other drawbacks have also occurred along the way. For example, in Poland, approximately 10 years after the start of the transition, it was estimated that one-third of the households lived under the poverty line, increasing to nearly 50% in rural areas (Musial 2003). After the initial shock, however, transition countries started to recover slowly.

[1]Economic transition means an economic and political process from a formerly centrally planned economy towards a free market economy (Salminen and Temmes 2000).

A substantial share of private ownership is a major feature of a market economy (Salminen and Temmes 2000). Therefore, because of the economic transition process, governments in some countries started a land restitution process by assigning formerly nationalised land to their former owners or their heirs (Simula 2003; Schelhaas et al. 2004; Salminen and Temmes 2000). The restitution process, however, has had some remarkable drawbacks because these are fragmented and small-sized proprietorships and there is a lack of bond to the land and a lack of experience of how to manage the forest (Schelhaas et al. 2004). All of these factors have made it difficult to predict the new forest owners' reactions to changes in the economy and this has had a substantial impact on the predictions of forest sector development.

Forest products markets and trade in Europe

The demand for forest products determines the state of the forest products markets, which furthermore determines the overall state of the forestry sector (Klemperer, 2003). European forest products markets have undergone radical changes during recent decades. One of them was the political and economic reforms in Central and Eastern Europe that caused the collapse of the production and consumption of forest products in the early 1990s. In most of those countries, production and consumption recovered relatively quickly to their initial levels. Recovery was the fastest in the Baltic Sea region and slowest in Russia (EFSOS 2005).

Another remarkable change in the European forest products markets has been changes in the solid wood markets that have affected significantly the structure of raw wood demand (EFSOS 2005). In addition, changes from export-oriented low value-added forestry products towards more profitable value-added products have been observed especially in Baltic countries (Pepke, 2007)

Even though the economies all over the Europe have strengthened and the forest products markets have grown almost in all main product categories, the forest sector's contribution to national GDP has decreased all over the Europe (MCPFE 2007a). This indicates other sectors' relatively higher growth compared to forestry sector's growth. Strong economic growth has led to the increased forest products consumption and production all over the Europe, being strongest in Eastern Europe (MCPFE 2007a). Nonetheless, rapid growth especially in the new EU member countries brought upward pressure on forestry product prices because of the increased demand (Shelburne et al. 2007).

In addition to economic growth, also the maturity of the forestry products affects forestry product's consumption and further to the forestry product's markets. Currently, majority of the forestry products are regarded to be at the top of the curve and therefore no growth is expected in these product categories. The main competitors of forestry products are their substitutes. Since the needs of the markets change rapidly, constant product development becomes crucial for the forestry products competitiveness. Another important tool is price competition, which is consequential especially for industries producing low value-added products. This is because these products are relatively easy to replace with substitutes (Kangas and Baudin 2003).

Roundwood markets have expanded or remained steady almost all over Europe. Only in Italy and in countries in North Western Europe have roundwood markets fallen sharply because of the large-scale fellings in 2000 as a result of the windblown in the late 1990s (MCPFE 2007a). Energy wood markets have grown and they are expected to continue growing as a result of political goals to increase the use of renewable energy (UNECE 2007).

Sawnwood markets have been strong during recent years in Europe, and Europe has remained a net exporter of sawnwood (Pepke 2007). High sawnwood demand has increased prices, which have been, however, compensated by higher log and energy costs (Pepke 2007). In addition, production, consumption and exports in European panel markets have increased, boosting their markets and trade (Pepke 2007). In addition, growth in the European paper and paperboard markets has been strong, which in turn, has increased the already high demand for small-sized wood (EFSOS 2005).

Forest products' imports and exports have increased within and outside Europe (Bowyer et al. 2007). Increase in trade has occurred in all major wood product categories, including paper and paperboard, sawnwood, wood pulp and wood-based panels (EFSOS 2005). At a global level, Europe has been a net exporter in all forestry product categories comprising approximately a half of the total exported forestry products by value (EFSOS 2005). This trend was strengthened by the impact of economic changes, as after 1990 imports and exports from the CIS sub-region and Eastern Europe increased significantly (EFSOS 2005).

4 Methodology and data

This study is based on an empirical analysis of European forest resources, forest ownership structure, felling volumes and trade in the three main forest product categories. The following section introduces the used method in this study and provides a precise description of the used data and data sources.

Methodology

This study followed the country grouping used in EFSOS (2005). This was necessary in order to obtain comparability between the EFSOS projections and the results of this study. First, individual country data for each selected variable were collected. Publicly available data varied by country, the selected variable and year. Therefore, in some cases, the data matrix had missing values. There was a lack of data, especially in the case of forest area and growing stock. On average, half of the countries provided data only for 2000 and 2005, whereas some countries provided full time series data. In some cases, data were available erratically for 2000–2005.

In those cases, all data were considered to be important in order to increase the reliability of the results. Therefore, in order to avoid a loss of important information and to achieve full time series data, a linear interpolation was used. When most country data were available only for 2000 and 2005, a linear interpolation was not considered to add value to the results. This was the case with ownership, net annual increment and felling volumes. In these cases, the accuracy of the scenarios was evaluated based on the two observations in 2000 and 2005. For forest products trade, the data were available for all years between 2000 and 2008.

The countries were grouped following the country grouping in EFSOS (Eastern Europe, Western Europe and the CIS sub-region) and data were summed by each region. The sum represented the whole group. The value of net trade was obtained by following the method used by Schulmeyer (2006), where the volume of forest products import was deducted from their export volume. In order to obtain a benchmark value for the actual development, projected values for each individual country were collected from Kangas and Baudin (2003) and Schelhaas et al. (2003). The scenarios on forest products net trade were calculated by subtracting consumption from production (Kangas and Baudin 2003). Again, the projected values for each group of countries were summed and these values were compared with the actual values. In those cases, where the data availability of the selected variables was limited or non-existent, the country in question was excluded from all calculations. Such a procedure ensured that the trends indicating the actual and projected development took into account the same number of countries to that the results would be comparable.

Besides a graphic evaluation, it was difficult to find other suitable methods for verifying the accuracy of the forecasts. Because the forecasts were calculated for 2000 and 2010, and the values of the actual development were available for 2000 and 2005, one reliable method was to compare the rates of the average annual change in the studied variables. The average annual growth rates of the actual and projected development were calculated for forest area, growing stock, net annual increment and felling volumes. For the forest product net trade these calculations were not necessary because of better data availability. In addition, the fluctuation in these variables was strong and, therefore, it was questionable whether the average annual growth rates would be the best possible method to evaluate the accuracy of the trade projections. Thus, a graphic evaluation was sufficient in order to verify the accuracy of the net trade forecasts.

In the scenarios on forest products trade, Kangas and Baudin (2003) included Malta in their calculations. However, Malta was not included in the EFSOS (2005) scenarios and, therefore, it was also excluded from this study. In addition, Kangas and Baudin (2003) excluded Bosnia and Herzegovina and Serbia and Montenegro from their trade scenarios, which Schelhaas et al. (2003), in turn, included into their scenarios on forest resources. Therefore, in this study, Bosnia and Herzegovina and Serbia and Montenegro were excluded from the trade scenarios, but included in the other scenarios.

Data and data sources

One of the most important objectives of this study is to use the most recent and best available data. To guarantee that the data were comparable with those used in the EFSOS (2005) projections, it was important to use the same data sources and definitions for each studied variable. However, efforts to achieve this objective brought along some problems. The most significant problem was the variation in terms and definitions between the different studies, even though they were executed by FAO or UNECE. This was particularly problematic in the case of forest resources, of which it was difficult to find comparable time series data.

In general, data on forest resources were extracted mainly from the UNECE/FAO database, which is based on national forest inventories. Another important data source was the State of Europe's forests 2007 (MCPFE 2007a). In a few cases, when adequate data were not available elsewhere, data from country reports (FRA 2005b) were used. These reports included forest inventory data that national correspondents (FRA 2005a). However, in those cases where the inventory data were not available for a certain year, national correspondents reported inter- or extrapolated values. These values were not used in this study, because they were assumed to increase the inaccuracy of the results. The forecasted data on forest products trade were extracted from the country tables for EFSOS (UN 2005a, 2005b, 2005c). In turn, the forecasted data on forest resources were extracted from Kangas and Baudin (2003).

Because the data sources varied slightly depending on the studied variable, a detailed description of data collection and processing was needed. This description is presented in the following section for each studied variable.

FAWS and protected forests: Table 1 illustrates the structure of the forest area data matrix. The total forest area was divided into FAWS and protected forests. Protected forests were further divided into soil and water protection, and biodiversity conservation. These three categories were not exclusive and, therefore, when combined they comprised in some cases a larger area than the total forest area. However, the purpose of this study was to examine each variable separately to see the direction of development in different types of protection and FAWS areas.

The data on forest area were collected from each studied country for 2000–2005. Linear interpolating was used for the data when needed. The principal data sources of FAWS were the MCPFE main report (MCPFE 2007a) and the country reports for FRA (FRA 2005b). In addition, some data were provided by the Czech Republic government (Information… 2006) and official database of Slovakia (Statistical… 2007). The values from these sources corresponded with MCPFE (2007a) and UNECE/FAO (FRA 2005a, 2005b) data, and they were thereby regarded as reliable data. An advantage of using the data from these sources was that they also provided data for 2001–2004 that was not available elsewhere. Data interpolating was avoided in the case of the Czech Republic and Slovakia, which was considered to increase the reliability of the results.

All data on protected forest areas were collected from the MCPFE (2007a) main report. This caused certain problems, as the used definitions for the soil and water protection in MCPFE (2007a) were not fully congruent with EFSOS (2005). The definition used by EFSOS (2005) was soil, water and infrastructure protection, whereas the corresponding definition used by MCPFE (2007a) was soil, water and other protection of other forest ecosystems. Since better data were not available, the data from these sources were used and compared. The results were still considered to be indicative, because the difference between the definitions was not believed to be significant. In turn, the definitions for biodiversity conservation between EFSOS (2005) and MCPFE (2007a) were fully comparable.

Growing stock: The data on growing stock were collected by the total growing stock on forests and by the growing stock in FAWS. Growing stock was measured as cubic metres over bark. Again, the data were structured as a matrix, which assorted the data by country and year. The data sources for growing stock were the country reports for FRA (FRA 2005b) and the MCPFE (2007a) main report. Additional data were provided by the market statement of Hungary (Market… 2005). The data quality of this source was revised by comparing reported values to FRA 2005 and its country reports (FRA 2005a, 2005b). As the values corresponded well between the different studies, the market statement of Hungary (Market... 2005) was considered a reliable source for use in this study.

Table 1. Structure of the forest area data matrix.

Country	Year	Forest area, 1000 ha			
		Forest area designated for:	Protected forest area designated for:		Total forest area
		Wood supply (FAWS)	Soil and water protection	Biodiversity conservation	
Austria	2000	3341	663	117	3838
	2005	3354	682	117	3862
Belgium	2000	663	148.9	8.3	667.3

Net annual increment: The only data source for net annual increment was MCPFE (2007a). All values were measured as cubic metres over bark. The data on net annual increment was available only for 2000 and 2005. Linear interpolating was not used for the data.

Ownership structure: The data on forest ownership structure were difficult to find from publicly available sources. The used sources were FRA 2005 and its country reports (FRA 2005a, 2005b), MCPFE and the country enquiry tables for MCPFE (MCPFE 2007a, 2007b). With some exceptions, the former provided the data mainly for 2000 and in some cases for 2005. The latter provided the data mainly for 2005. However, the major problem with these sources was that they used different definitions for private and public forest ownership. Depending on the study, the values represented either the forest land, or the forest and other wooded land. Therefore, it was not possible to create extensive time series data within the frame of this study. In order to achieve reliable results, the values reported for forest land were used in this study. This definition was chosen, because the results were believed to be more relevant to the purpose of this study. However, the results are only indicative because of the paucity of data.

Fellings: The data for felling volumes were extracted from MCPFE (2007a). All values were measured as cubic metres over bark. Values were available only for 2000 and 2005 and thus linear interpolating was not used.

Trade: Values for forest product imports and exports were extracted from the UNECE timber databases 1964–2008 (UN 2005a, 2005b, 2005c). These databases were comprehensive in all studied product categories and countries for 2000–2008. Therefore, 2008 was also included in the trade analysis. Import and export values were extracted in three main categories: sawnwood, wood-based panels and paper and paperboard. Kangas and Baudin (2003) included only plywood, particleboard and fibreboard in their category of wood-based panels. Therefore, in order to achieve comparability between the projections and collected data, the value for veneer sheets was subtracted from the total value reported for wood-based panels in the UNECE timber database 1964–2008.

Roundwood prices in the Baltic Sea region: Values for roundwood prices in the Baltic Sea region were taken from the statistical database of the Finnish Forest Research Institute (Finnish Forest… 2008).

5 Analysis of the European forest sector's development trends in comparison with EFSOS predictions

This chapter presents and discusses the results for each studied variable. When evaluating the development of European forest resources or the logging potential in Europe, it is good to exercise certain caution. Firstly, especially in Central and Eastern Europe, exists various uncertainties concerning the logging potential. The potential may seem large, but the conditions of those forests can vary largely between different regions. Secondly, unclear goals of new forest owners, especially in the countries with economies in transition at the beginning of the transition period, could not be captured by any model. This caused a lot of uncertainty to the projections. Thirdly, the development of the overall economy and the policy environment caused uncertainty to the projections, because these variables, in each scenario, are constant throughout the projection period. Fourthly, the forest sector is sensitive to the changes in the other sector's policies, such as agricultural, environmental and energy policies, which could not be projected by the models, too.

The following results are presented in the same order in which they have been covered earlier in this study. Thus, the results concerning the forest resources are presented at first, followed by the results concerning the forest products trade. The results of each studied variables are presented in the following order: firstly on the European level and then by each of the three sub-regions.

5.1 Total forest area and FAWS area

Forest area in Europe: Only the baseline scenario is presented for Europe, as the forecasts of the integration scenario were not available. As a consequence of forests' natural expansion and planting, the total forest area in Europe has increased by nearly 13 million hectares during the past 15 years (MCPFE 2007a). This trend was also observable in the results, as the total forest area and FAWS in Europe increased in 2000–2005 (Table 2).

The total forest area in all studied countries in 2005 was 161.57 million hectares, of which FAWS accounted for 134.12 million hectares. Both the total forest area and FAWS increased by 1.44% and 0.45% in five years, respectively. As can be seen, FAWS did not increase at the same rate as did the total forest area. In fact, the difference was remarkable, as the annual average growth rate for the total forest area was 0.29% and the corresponding rate for FAWS was only 0.09%. This means that FAWS increased annually relatively less than one-third of the total forest area increase when measured at the European level. This result indicates that an increasing proportion of European forests are directed to something other than commercial purposes. Bosnia and Herzegovina, Romania, Germany, Iceland, Portugal, Spain and Luxembourg were excluded from all calculations because of a lack of data.

Actual growth in FAWS in 2000 coincided well with the projected baseline scenario in Europe, even though the forecast underestimated the actual development of FAWS by more than 2.5 million hectares. This underestimation, however, was only 1.9% of the actual considered value, which was not significant. However, the actual growth in FAWS was faster after 2000 than was projected. The actual growth of FAWS was more than twice as fast in the five years (on average, 0.09% annually) compared with the forecast (on average, 0.04% annually).

The possible reasons for the biased projections of the EFISCEN are numerous. Firstly, the model is not flexible enough to adjust to different market conditions, which may change remarkably over five years. This makes it difficult to make projections for the variables that the political environment and markets (forest products demand) affect. Secondly, changes in the policy framework are difficult to foresee, because forest policy is largely affected by the policies of other sectors. Thirdly, the effect of assumed felling volumes is remarkable in the EFISCEN projections. However, as felling volumes

Table 2. Total forest area and FAWS in all studied countries.

Year	Actual forest area, mill. ha		Scenarios (in FAWS), mill. ha
	Total	FAWS	Baseline
2000	159.27	133.52	130.97
2005	161.57	134.12	
2010			131.48
Change-%	1.44	0.45	0.39
Average growth/year, %	0.29	0.09	0.04

are determined by the timber market model, these estimates are sensitive to the biases in that model. Fourthly, the EFISCEN was meant for the long-term projections, which for five years may not be long enough for evaluating the model. Finally, the level of thinnings and final fellings were assumed to remain constant during the projection period, which may be an unrealistic assumption in the current market environment. This means that because of the improvement in the economy, especially in transition countries, raw wood demand was growing and forest management was likely to improve. This would lead to changes in the thinning and felling volumes in Europe.

The following subsections present the actual development of FAWS in each of the three sub-regions separately and compare the development to the forecasts.

Forest area in Western Europe: In 2005, Western Europe accounted for 83.78 million hectares (18%) of the total FAWS area in Europe (Table 3, Fig. 2). During the period 2000–2005, the increase in the area of FAWS was 0.52 million hectares (0.62%). This accounts for 102.900 hectares (0.12%) of average annual growth in FAWS. The growth in the FAWS area was only 42.8% of the total forest area growth, which indicates that more than half of the forest increase was allocated to something other than commercial purposes.

Table 3. Observed and projected total forest area and FAWS in Western Europe (excluding Germany, Luxembourg, Iceland, Portugal and Spain).

	Forest area, mill. ha		EFSOS scenarios in FAWS, mill. ha	
	Total	FAWS	Baseline	Integration
2000	97.6	83.26	80.02	80.07
2001	97.842	83.404		
2002	98.084	83.508		
2003	98.326	83.612		
2004	98.568	83.716		
2005	98.81	83.78		
2010			80.23	80.89

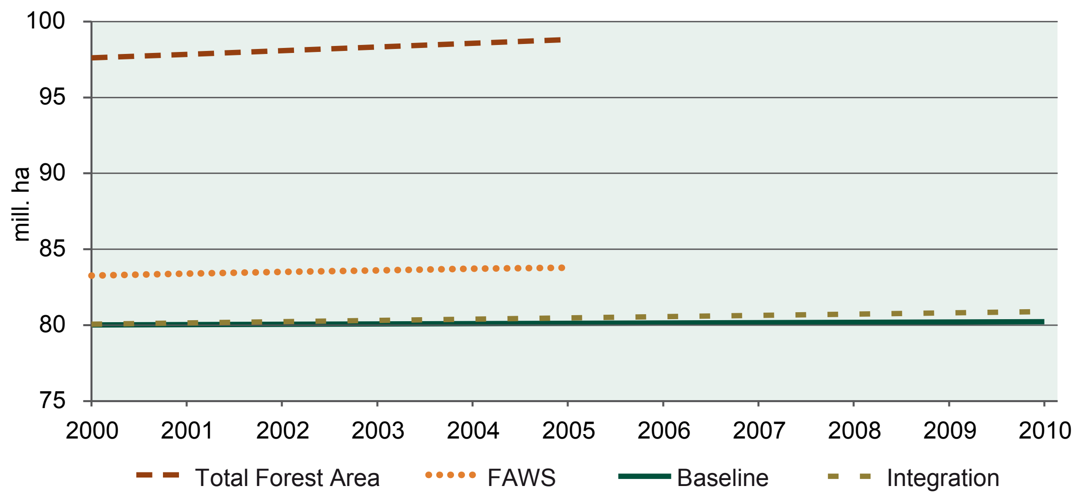

Figure 2. Total, actual and forecasted growth in forests in Western Europe.

Germany, Iceland, Luxembourg, Portugal and Spain were excluded from all calculations, because sufficient actual data were not available for those countries. Those countries accounted together for approximately 15% of total FAWS in Western Europe, which was considerable, but as they were also excluded from the data set on projections, it did not cause a comparability problem between the observed and projected trend.

Fig. 2 shows the difference between the actual and projected (both baseline and integration) values for FAWS in 2000, which differed by approximately 3.2 million hectares. This was most likely caused by the EFISCEN's ability to project short-term forecasts. Another reason may have been data quality problems, as the majority of the used data were based on the forest inventories executed in 1990s.

The FAWS area in the baseline scenario was projected to increase annually on average by 20,900 hectares (0.03%) and by 81.600 hectares (0.10%) according to the integration scenario. Both the baseline and integration scenarios underestimated the actual FAWS area development in Western Europe, although the integration scenario projected successfully the actual average annual growth rate of FAWS (0.12%) in 2000–2005. The majority of the differences between the actual and projected values in individual countries occurred in Italy (2.43 million ha) and Greece (0.71 million ha). In other countries, the corresponding differences were only marginal, varying between 0.01 million ha and 0.21 million ha. The fastest growth in FAWS in 2000–2005 was observed in Iceland (21.3%), Ireland (9.9%) and Italy (5.6%), whereas the slowest, or even negative, growth rate was observed in Finland (–2,5%), Norway (–0.3%) and Austria (0.4%).

Forest area in Eastern Europe: Eastern Europe accounted for 38.44 million hectares (8.5%) of the total FAWS area in Europe. The total growth of FAWS in 2000–2005 was 0.55 million hectares, which accounted annually on average for 108.900 (0.29%) hectares. Schelhaas et al. (2003) estimated 32.000 (0.08%) hectares of average annual growth of FAWS under the baseline scenario, and 39.800 (0.10%) hectares of growth under the integration scenario. Both projections underestimated actual development. Table 4 and Fig. 3 illustrate the actual trend in relation to the baseline and integration scenarios. Romania and Bosnia and Herzegovina were excluded from all calculations because of deficient data. Those two countries comprised approximately 16% of total FAWS in Eastern Europe. Again, those excluded countries did not affect the comparability between the projections and observed trends because they were excluded from all calculations.

Based on the results, FAWS declined in Eastern Europe in 2001, and thereafter it started to increase towards the projected level (Table 4, Fig. 3). It is likely that this decrease resulted rather from an error in the definitions of FAWS in year-on-year or measurement errors than from a real decline in the area of FAWS. Therefore, if a linear trend were drawn between 2000 and 2005, the average annual growth rate would have been 0.29%, which would have exceeded the projected growth rates in the baseline and integration scenarios. The fastest growth of FAWS during the study period was observed in Bulgaria (13.4%), Lithuania (4.5%) and Hungary (3.8%), whereas its area decreased in the Czech Republic (–1.7%), Albania (–1.4%) and Estonia (–0.6%).

The actual trend of FAWS development remained below the projected level throughout the study period. The actual and projected trends in 2000 differed by 0.98 million hectares. The difference between the actual and projected values in 2000 was likely caused by the same reasons as was the case in Western Europe, although it should be noted that the gap is much smaller than the corresponding difference in Western Europe. This is explained by the inventory data used in EFISCEN projections, which was more up-to-date in Eastern Europe compared with Western

Table 4. Observed and projected total forest area and FAWS in Eastern Europe (excluding Romania and Bosnia and Herzegovina).

	Forest area, mill. ha		EFSOS scenarios in FAWS, mill. ha	
	Total	FAWS	Baseline	Integration
2000	43.560	37.900	38.88	38.88
2001	43.772	38.008		
2002	43.944	38.116		
2003	44.116	38.224		
2004	44.288	38.332		
2005	44.42	38.44		
2010			39.2	39.28

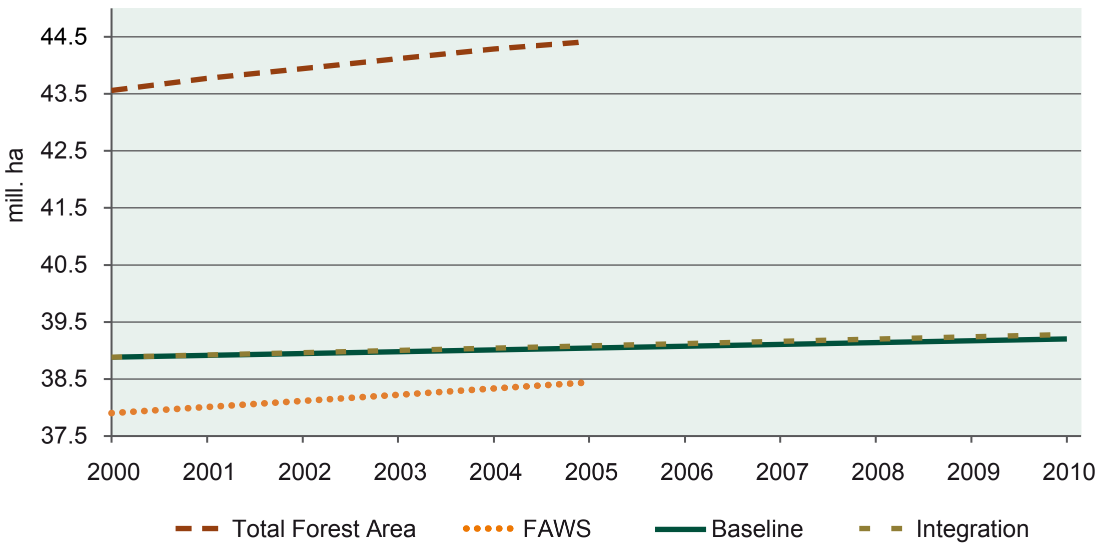

Figure 3. Expected and actual development in forest area in Eastern Europe.

Europe. However, because of the biased projection for 2000, neither of the projections succeeded in explaining the development of FAWS in Eastern Europe. If all trends had had the same starting point in 2000, the actual trend would have exceeded both projections during the first five years because of the higher average annual growth rate.

Forest area in the CIS sub-region: Based on the results, the CIS sub-region differed from the other two regions in that the total forest area actually declined in 2000–2005 (Table 5, Fig. 4). This result indicates that a larger relative share of forests was transferred to something other than commercial purposes in the CIS sub-region during the study period. This might be in line with the assumption presented in EFSOS (2005), which expected most of the decline in FAWS to occur in the CIS sub-region.

In the studied countries, the FAWS area in the CIS sub-region decreased annually on average by 94.000 hectares (–0.76%). This decrease was much greater than that projected, as both the baseline and integration scenarios projected the FAWS area to decline annually on average by 2.000 hectares

Table 5. Observed and projected total forest area and FAWS in the CIS sub-region (excluding Russia).

	Forest area, mill. ha		EFSOS scenarios in FAWS, mill. ha	
	Total	FAWS	Baseline	Integration
2000	18.11	12.36	12.07	12.07
2001	18.156	12.208		
2002	18.202	12.116		
2003	18.248	12.024		
2004	18.294	11.932		
2005	18.34	11.9		
2010			12.05	12.2

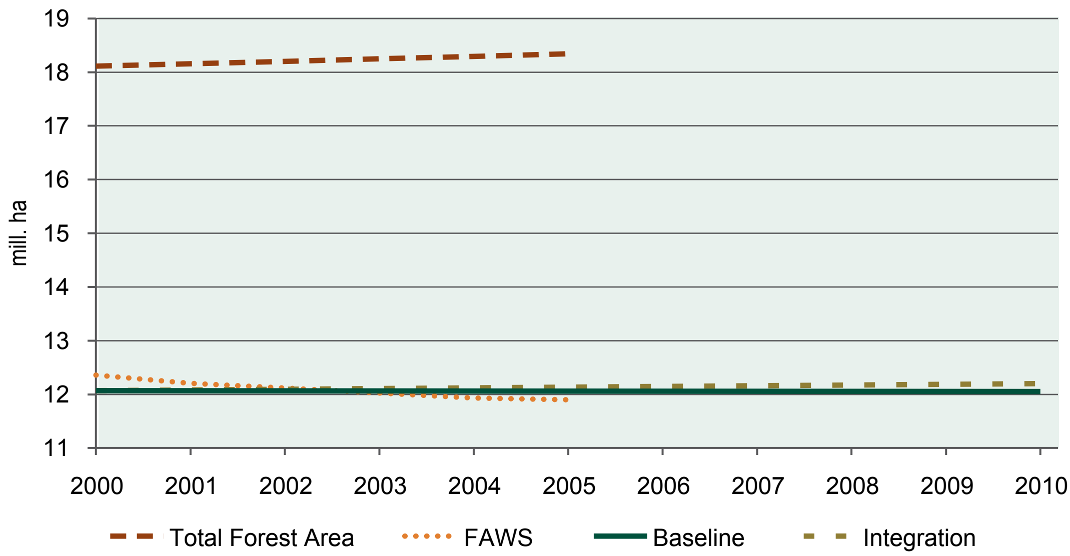

Figure 4. Expected and observed development in forest area in the CIS sub-region (excluding Russia).

(–0.02%). The difference between the actual and projected trends is notable. While the results show clearly that FAWS in the CIS sub-region decreased, the decrease of FAWS might also be caused by changing definitions for FAWS between the different inventory years.

The difference between the actual and projected values for 2000 was 0.29 million hectares, which was insignificant. However, because the average annual decrease between the actual trend and both projections was notable, it can be said that the EFISCEN projections did not accurately project the outlook of FAWS in the CIS sub-region. The reason for these overly optimistic scenarios may have been a lack of comparable data, because the definition of FAWS was not exactly the same in all countries in the CIS sub-region (EFSOS 2005).

The impact of Russia's large forest resources on the total value of FAWS in the CIS sub-region is predominant, and thus changes in Russia affect the development of the whole region. Based on the collected data on forest resources in Russia, it was found that the FAWS area declined by 1.67 million hectares in 2000–2005. This decline exceeded the increase of FAWS in Eastern and Western

Europe during the same period (1.06 million hectares in total). This explains the decline in FAWS in Europe. In other words, even if FAWS increased nearly in all studied countries, excluding Finland (–0.5 million ha), Norway (–0.02 million ha), Albania (–0.01 million ha), Estonia (–0.01 million ha) and Slovakia (–0.02 million ha), the decline in Russia was sufficient to cover the growth in other countries. However, it is worth exercising caution when making comparisons between these three sub-regions because three significant forestry countries (Germany, Portugal and Spain) were excluded because of a lack of data.

5.2 Area of protected forests

Schelhaas et al. (2003) did not project scenarios for forest protection and conservation. However, EFSOS (2005) made some assumptions on the development of protective functions in Europe. According to EFSOS (2005), the level of soil, water and infrastructure protection was low and the level was expected to remain unchanged in the future. In the same study, biodiversity conservation was expected to increase in all countries. The strong growth of protective functions was explained by the recent political actions and increasing public interest in biodiversity conservation. The fastest growth in biodiversity conservation was assumed to occur in regions with high economic growth, such as countries in Eastern Europe and the CIS sub-region (EFSOS 2005).

Some caution is needed when drawing any conclusions according to the results of protected forests. All of the used data were extracted from MCPFE (2007a), which reported some comparability problems between the different years. This was caused by the changing definitions of the studied variables. Therefore, the results for forest protection and conservation are only indicative. In addition, some countries were excluded from the analysis since they did not provide sufficient data. These countries were Bosnia and Herzegovina, Bulgaria, Romania, Serbia and Montenegro, Macedonian and Turkey from Eastern Europe. In Western Europe, data were not available for Greece, Portugal and Spain. It is clear that missing data caused a certain amount of error in the results, although the overall trend is believed to remain indicative.

Fig. 5 illustrates the development of the areas for biodiversity conservation and soil and water protection in the three sub-regions. The total area for soil and water protection in 2005 was 90.9 million hectares in all studied countries, whereas the corresponding figure for biodiversity conservation was 28.9 million hectares. If the three sub-regions are compared, the largest area for biodiversity conservation and soil and water protection in 2005 was in the CIS countries, which accounted for 91.2 million hectares of protected forests. The corresponding figure for Western Europe was 22.7 million hectares and for Eastern Europe only 5.9 million hectares. However, in relation to total forest area, Western Europe comprised the largest share of protected areas in Europe, as shown in Fig. 6.

Over 2000–2005, the total area of biodiversity conservation, soil and water protection in Europe increased by 2.8%. The level of soil, water and other forest ecosystem protection was remarkably higher in all sub-regions compared with biodiversity conservation, but a signal of the growing interest in biodiversity conservation was seen. The level of biodiversity conservation increased relatively faster (5.4%) compared with soil and water protection (2.0%) during the study period.

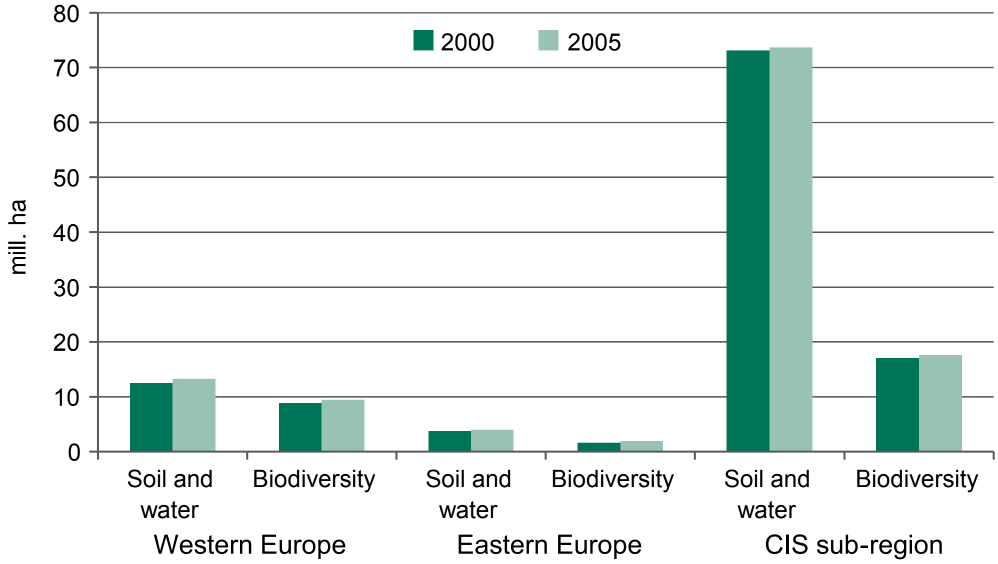

Figure 5. Level of soil, water and biodiversity conservation in Europe by sub-region in 2000–2005.

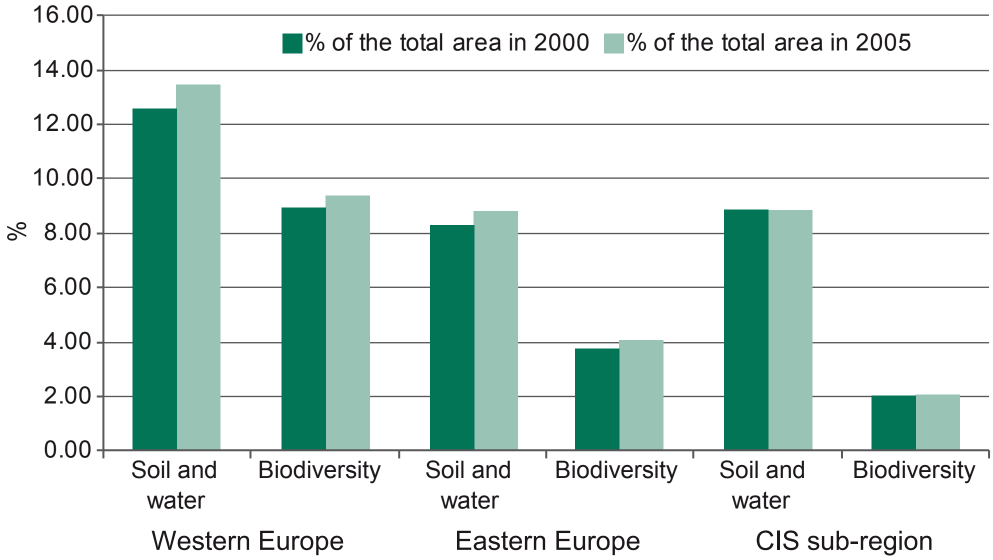

Figure 6. Soil and water protection and biodiversity conservation in Europe as a percentage of the total forest area in the sub-regions.

5.3 Growing stock

Growing stock in Europe: A wide variety of factors affects the growing stock of the forests, such as felling volume, natural mortality, storms, fires and insects (Gold 2003). According to EFSOS (2005), growing stock in FAWS was expected to increase slightly in all three sub-regions under the baseline and integration scenarios. Table 6 illustrates the aggregated growing stock in the studied countries in Europe, excluding Germany, Iceland, Luxembourg, Bosnia and Herzegovina, Romania and Russia. These countries, except Russia, were excluded because of a lack of data. Russia was excluded because the collected data in this study comprised the area of Russia in total, whereas Schelhaas et al. (2003) made projections only for the European part of Russia. Therefore, the data were not comparable and could not be used.

Table 6. Growing stock in Europe (excluding Russia).

Year	Actual, million m³ (o.b.)		Scenarios, million m³ (o.b.)	
	Total	FAWS	Baseline	Integration
2000	23.70	20.59	22.65	22.64
2005	25.63	21.87		
2010			24.79	24.65
Change-%	8.1	6.2	9.4	8.9
Average growth/year, %	1.57	1.22	0.91	0.85

The total growing stock in Europe (including the areas that were not intended for commercial purposes) was 23.7 million m^3 over bark (o.b.) in 2000, of which growing stock in FAWS comprised nearly 87%. In 2005, the total growing stock in all studied countries was 25.6 million m^3 o.b., of which FAWS comprised 85%. This result is in line with the assumption that the relative share of FAWS is declining in comparison to the total forest area in Europe. Although the overall area of FAWS has declined in Europe, the growing stock in FAWS has still increased. This indicates that a substantial share of European forests is relatively young, fast-growing forests. Moreover, the area of FAWS is managed more efficiently, which has led to better growth.

In Europe, the actual growing stock in FAWS increased comparatively faster compared with the baseline and integration scenarios. The actual average annual increase in the growing stock in FAWS was 256 million m^3 (1.22%), whereas according to the baseline scenario it was 214 million m^3 (0.91%) and the integration scenario 201 million m^3 (0.85%). Therefore, both scenarios underestimated actual development. The reason for such an underestimation is most likely the same as in the case of the FAWS scenarios.

Growing stock in Western Europe: EFSOS (2005) expected that the growing stock volume in FAWS in Western Europe would increase slightly by 2010 (Table 7, Fig. 7). In 2005, the total growing stock in FAWS was 12.4 million m^3 o.b. Germany, Iceland and Luxembourg were excluded from all calculations because of a lack of data for 2005. The exclusion of Germany is especially notable, because its share in growing stock in FAWS was approximately 29% in 2000.

Table 7. Observed and projected growing stock in Western Europe (excluding Germany, Iceland and Luxembourg).

Year	Growing stock, mill. m³ (o.b.)			
	Observed growing stock		EFSOS scenarios in FAWS	
	Total	FAWS	Baseline	Integration
2000	12 891.85	11 544.82	13 053.75	13 041.80
2001	13 126.81	11 708.13		
2002	13 361.77	11 871.43		
2003	13 596.73	12 034.74		
2004	13 831.69	12 198.05		
2005	14 057.90	12 349.85		
2010			14 336.44	14 110.73

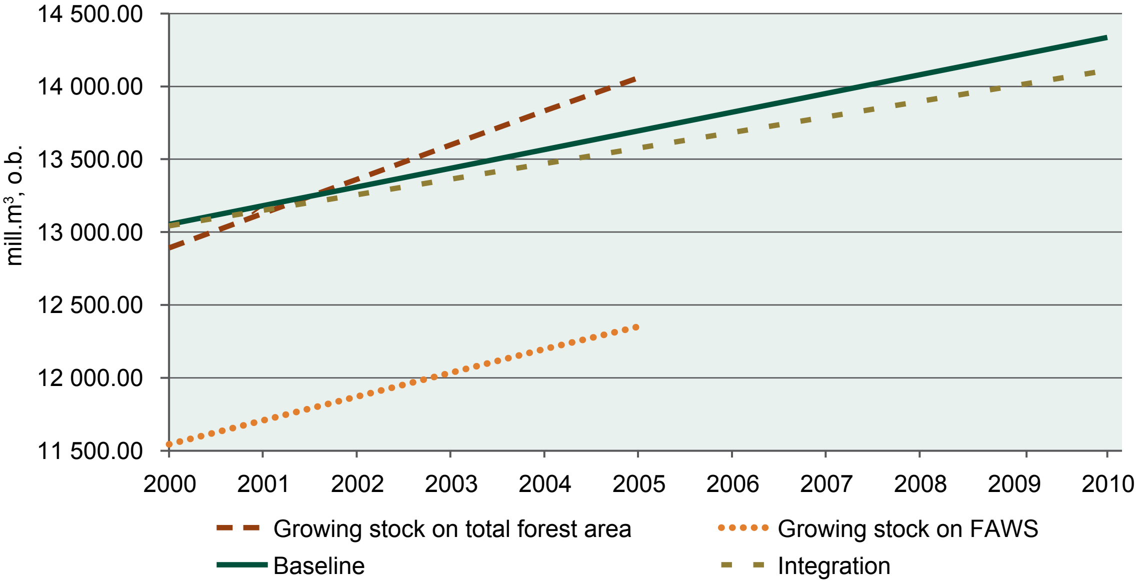

Figure 7. Growing stock in Western Europe.

During the period 2000–2005, forest growth in Western Europe increased by 0.81 million m^3 o.b. The average increase in growing stock volume was faster than Schelhaas et al. (2003) projected. The actual average annual growth in FAWS was 1.36%, whereas the corresponding figure according to the baseline scenario was only 0.94%, and even lower according to the integration scenario (0.79%). Therefore, both the baseline and integration scenarios underestimated the actual growing stock development in Western Europe.

It should be noted that Schelhaas et al. (2003) referred to the forecasts in FAWS. This means that scenarios presented in Fig. 10 should reflect the growing stock volume in FAWS, not in the total forest area. This is somewhat confusing, because the projections seem to reflect the growing stock development in the total forest area. The actual growing stock in FAWS in 2000 differed from both scenarios by approximately 1.5 million m^3, whereas the difference between scenarios and the growing stock in the total forest area in 2000 was approximately 0.65 million m^3 o.b. The difference between the actual and projected values in 2000 is more likely to be caused by the old data that was used in the modelling. As stated before, Western European countries provided the oldest inventory data for the EFISCEN modelling, which for the values for 2000 were estimated.

Growing stock in Eastern Europe: Only a slight increase in growing stock volume in FAWS was expected to occur in Eastern Europe in 2000–2010 (EFSOS 2005). The actual growing stock in FAWS in 2005 was 7.02 million m^3 o.b. and the growth in 2000–2005 totalled 0.34 million m^3 o.b. Table 8 and Fig. 8 illustrate the actual and projected growing stock volume in FAWS in Eastern Europe. Romania and Bosnia and Herzegovina were excluded from calculations because of a lack of data. Again, the difference between the projected and actual values for 2000 was obvious, although the difference was not as remarkable as it was in Western Europe.

Based on these results, the actual increase in growing stock in FAWS was much faster than it projected in Eastern Europe. The actual average annual growth rate in FAWS (1.01%) exceeded the projected annual average growth rates in the integration scenario (0.46%) and baseline scenario (0.59%). Even if this difference may seem unsubstantial, it resulted in total growing stock volume in FAWS exceeding the growth volume projected by the integration scenario for 10 years, and nearly reached the corresponding level of the baseline scenario.

Table 8. Observed and projected growing stock in Eastern Europe (excluding Romania and Bosnia and Herzegovina).

Year	Growing stock, mill. m³ (o.b.)			
	Observed growing stock		EFSOS scenarios in FAWS	
	Total	FAWS	Baseline	Integration
2000	7546.68	6675.25	7070.98	7070.98
2001	7627.99	6770.65		
2002	7710.65	6860.52		
2003	7802.54	6901.79		
2004	7883.86	6961.15		
2005	7968.72	7020.41		
2010			7501.80	7400.93

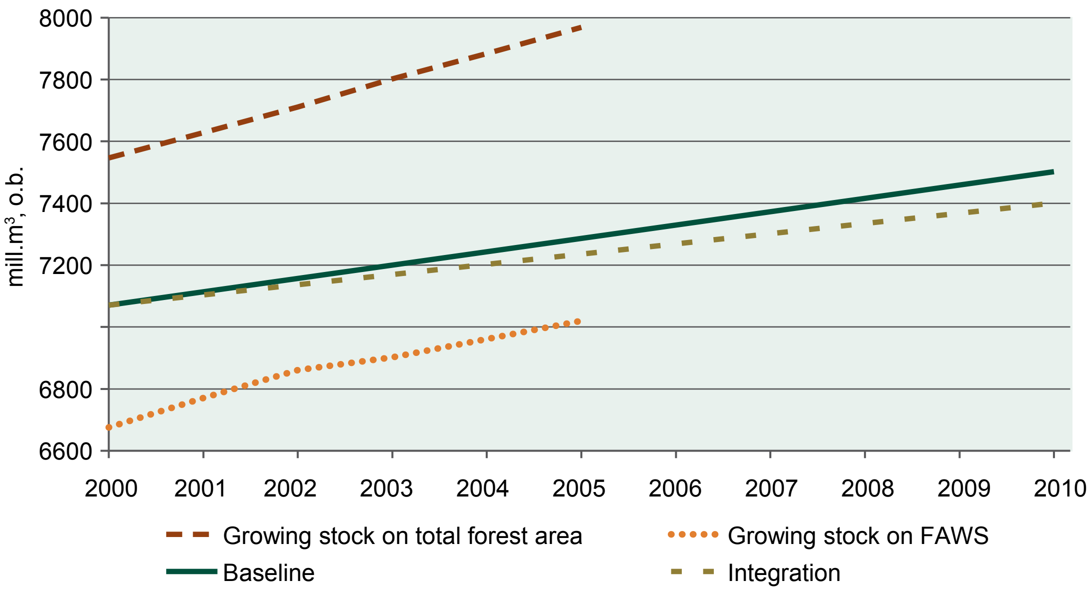

Figure 8. Growing stock in Eastern Europe.

Growing stock in the CIS sub-region: Table 9 and Fig. 9 illustrate the actual and projected development in growing stock volume in the CIS sub-region. In reference to EFSOS (2005), the majority of European forest growth was projected to occur in the CIS sub-region. Not even the projected decline in the area of FAWS was expected to affect the strong growth of forests in the region. However, the available data for the study do not allow us to make such an assumption with total certainty. This is because Russia was excluded from all calculations, as the projected values for Russia were inconsistent with the related data. A possible reason may be caused by territorial demarcation, for which the figures were calculated, because some figures might be reported for the European part of Russia, whereas some might be reported for the whole country. However, these differences were difficult to trace. The comparability problems were obvious; therefore, Russia was excluded from the calculation.

Table 9. Observed and projected growing stock in the CIS sub-region (excluding Russia).

Year	Growing stock, mill. m³ (o.b.)			
	Observed growing stock		EFSOS scenarios in FAWS	
	Total	FAWS	Baseline	Integration
2000	3266.20	2367.77	2526.40	2526.40
2001	3328.30	2393.88		
2002	3390.40	2419.99		
2003	3452.50	2446.09		
2004	3526.40	2474.73		
2005	3600.31	2503.36		
2010			2952.95	3134.60

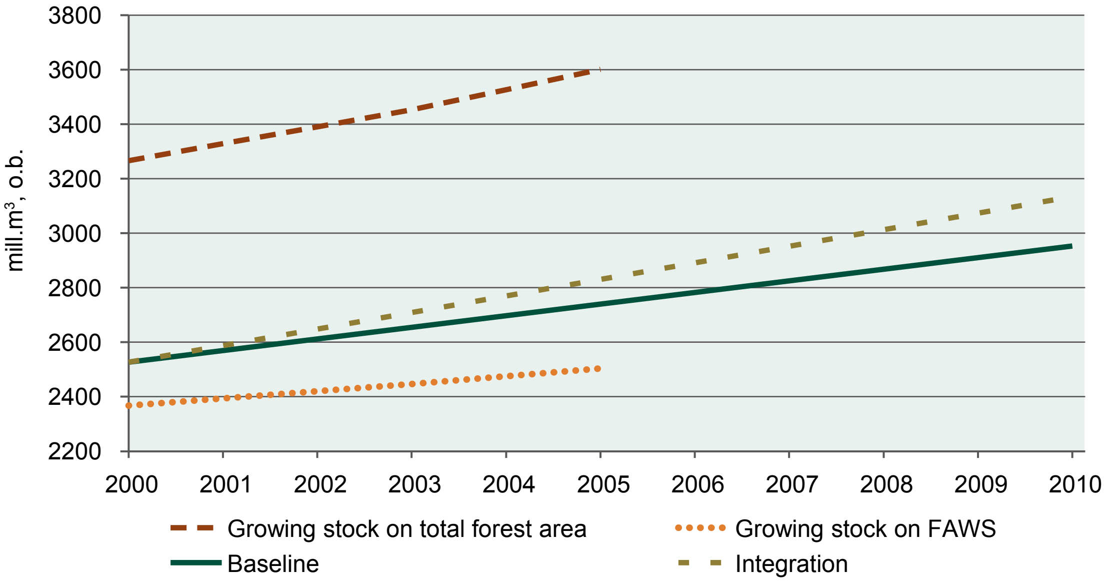

Figure 9. Growing stock in the CIS sub-region.

Based on these results, total growing stock in FAWS in Belarus, Ukraine and the Republic of Moldova was 2.5 million m^3 o.b in 2005. In these three countries, growing stock increased by 0.13 million m^3 o.b. in five years. Both the baseline and integration scenarios projected higher growing stock in FAWS compared with the actual development. The observed annual average growth was 1.12%, whereas the corresponding figure according to the baseline scenario was 1.57% and the integration scenario 2.18%. Both scenarios overestimated slightly the actual growing stock volume in 2000. This may have been caused by the old inventory data provided by the Republic of Moldova and Ukraine.

5.4 Net annual increment

Net annual increment in Europe: Table 10 presents the actual and projected development of net annual increment in FAWS in the studied European countries. The following 13 countries were excluded because of a lack of data: Austria, Greece, Iceland, Ireland, Luxembourg, Portugal,

Table 10. Observed and projected net annual increment in Europe.

Year	Observed, mill. m³ (o.b.) in FAWS	Scenarios in FAWS, mill. m³ (o.b.) Baseline	Integration
2000	1252.58	1581.04	1580.93
2005	1282.13		
2010		1476.55	1490.95
Change-%	2.4	-6.6	-5.7
Average growth/year,%	0.47	-0.68	-0.58

Spain, Switzerland, Bosnia and Herzegovina, Poland, Croatia, FYR Macedonia and the Republic of Moldova.

The overall growth of forests in Europe in 2005 was 1282.13 million m^3 o.b. By 2010, however, Schelhaas et al. (2003) projected a fall in net annual increment in FAWS under both scenarios. This fall was considerable, varying on average from 9.0 million m^3 (0.58%) to 10.5 million m^3 (0.68%) annual decline. Based on the results, however, the total net annual increment in FAWS actually increased by 29.55 million m^3 o.b. (2.4%) in five years, which accounted for an approximately 6.0 million m^3 (0.47%) average annual increase.

In the studied countries, a decline in net annual increment in FAWS was expected to occur in all sub-regions. However, in five years the decline occurred only in the CIS sub-region, whereas growing stock increased in Eastern and Western Europe. Regional differences are discussed in more detail in the following sections.

Net annual increment in Western Europe: Table 11 and Fig. 10 illustrate the development of net annual increment in Western Europe. It should be noted that a relatively large number of countries were excluded from the review because of missing data. These countries were Austria, Greece, Iceland, Ireland, Luxembourg, Portugal, Spain and Switzerland. Together, these countries accounted for approximately 16% of the total increment in FAWS in Western Europe.

Table 11. Observed and projected net annual increment in Western Europe (excluding Austria, Greece, Iceland, Luxembourg, Portugal, Spain, Switzerland and Ireland).

Year	Net Annual Increment, mill. m³ (o.b.) Observed	Baseline	Integration
2000	477.24	423.52	423.41
2001	482.42		
2002	487.84		
2003	493.26		
2004	498.68		
2005	504.34		
2010		413.91	414.05

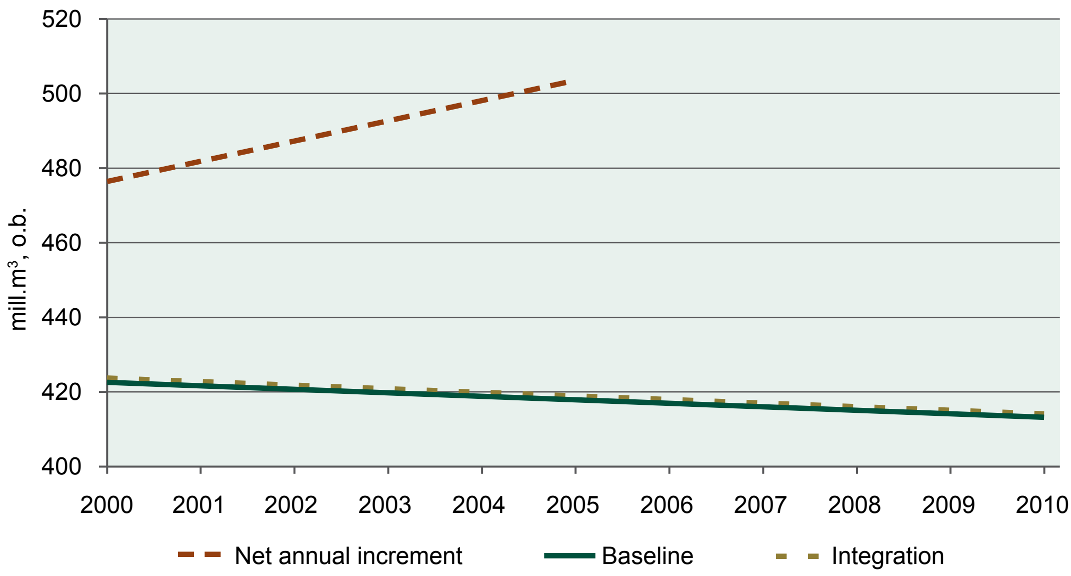

Figure 10. Observed and projected net annual increment in Western Europe.

The net annual increment in FAWS in Western Europe accounted for 504.34 million m^3 o.b., which makes the region the second largest in Europe after the CIS sub-region. According to Fig. 13, Schelhaas et al. (2003) projected a slight decrease in the level of annual growth in reference to both scenarios. The average annual decline was projected to be approximately 936,000 m^3 o.b. (0.22%). However, the results show that the actual trend was opposite. The forests grew annually on average by 1.11%, which resulted in a 5.42 million m^3 o.b. average annual growth in 2000–2005. The reason for such a significant difference between the observed and projected trends is most likely the level of projected felling volume that had been expected to be clearly higher than it actually was. In addition, some bias may have been in the EFISCEN input data on the current state of forests that partly determined the scenarios. Fellings are discussed in more detail in the following section.

Net annual increment in Eastern Europe: Table 12 and Fig. 11 show the actual and projected trend in net annual increment in FAWS in Eastern Europe. The total annual growth in FAWS in Eastern European forests in 2005 was 181.09 million m^3 o.b., which was regarded as the smallest region in Europe in reference to net annual increment. Again, some countries were excluded from all calculations because of data unavailability. Those countries were Bosnia and Herzegovina, Poland, Croatia and FYR Macedonia. Together, these countries accounted for approximately 27% of total net annual increment in Eastern Europe. This large proportion was mainly caused by Poland, which solely accounted for 22% of the total increment.

The difference between the actual and projected trends was even larger than it was in Western Europe. Schelhaas et al. (2003) projected a faster decline in the level of net annual increment in FAWS compared with Western Europe. The average annual decline was projected to be approximately 771.000 m^3 o.b. (–0.46%) according to the baseline and 780.000 m^3 o.b (–0.47%) according to the integration scenario. However, in 2000–2005, net annual increment actually increased by 5.16 million m^3 o.b. (0.58%) in the studied Eastern European countries.

Table 12. Observed and projected net annual increment in Eastern Europe (excluding Bosnia and Herzegovina, Poland, Croatia and FYR Macedonia).

Year	Net Annual Increment, mill. m^3 (o.b.)		
	Observed	Baseline	Integration
2000	175.930	169.69	169.69
2001	177.032		
2002	178.064		
2003	179.096		
2004	180.128		
2005	181.090		
2010		161.98	161.98

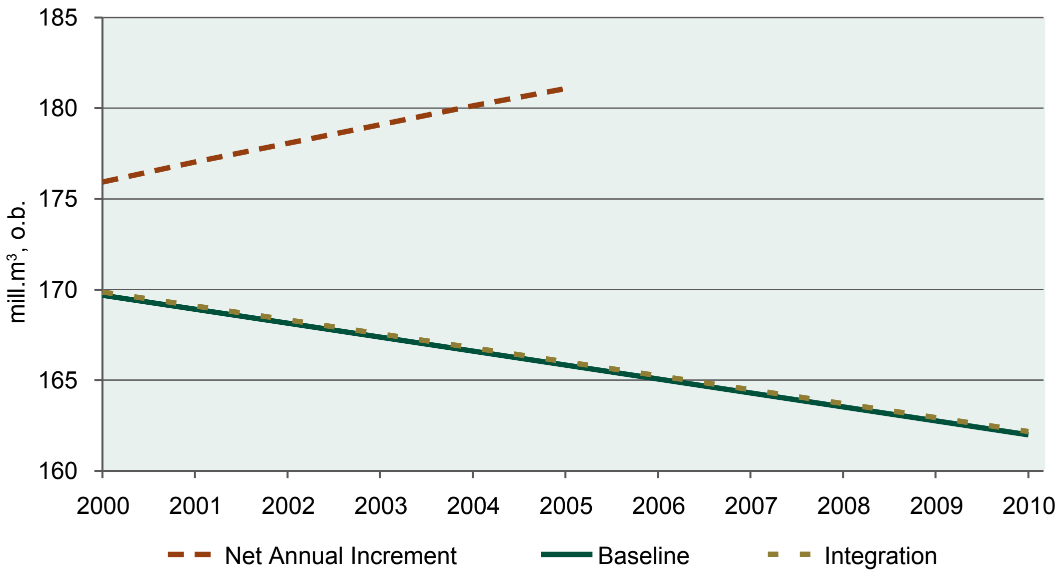

Figure 11. Observed and projected net annual increment in Eastern Europe.

Net annual increment in the CIS sub-region: Fig. 12 illustrates the actual and projected development of net annual increment in FAWS in the CIS sub-region. The Republic of Moldova was excluded from all calculations because of a lack of data. Total net annual increment in the CIS countries was 596.7 million m^3 o.b. in 2005, which makes the region the largest in terms of net annual increment in Europe.

The difference between the actual and projected values for 2000 was significant. This was caused by the data reported in Russia, which was approximately only a half of the projected values in 2000 and 2005. This was somewhat confusing. The most likely reason for such a large difference between the actual and projected values may be in the regional division, which means that some values were calculated for the total area of Russia and some only for the European part. However, these regional differences were difficult to track. As a result of this difference, it was not sensible to compare the actual development with the projections.

Table 13. Observed and projected net annual increment in the CIS sub-region (excluding the Republic of Moldova).

Year	Net Annual Increment, mill. m^3 (o.b.)		
	Observed	Baseline	Integration
2000	599.41	987.83	987.83
2001	598.458		
2002	597.916		
2003	597.374		
2004	596.832		
2005	596.7		
2010		900.66	915.01

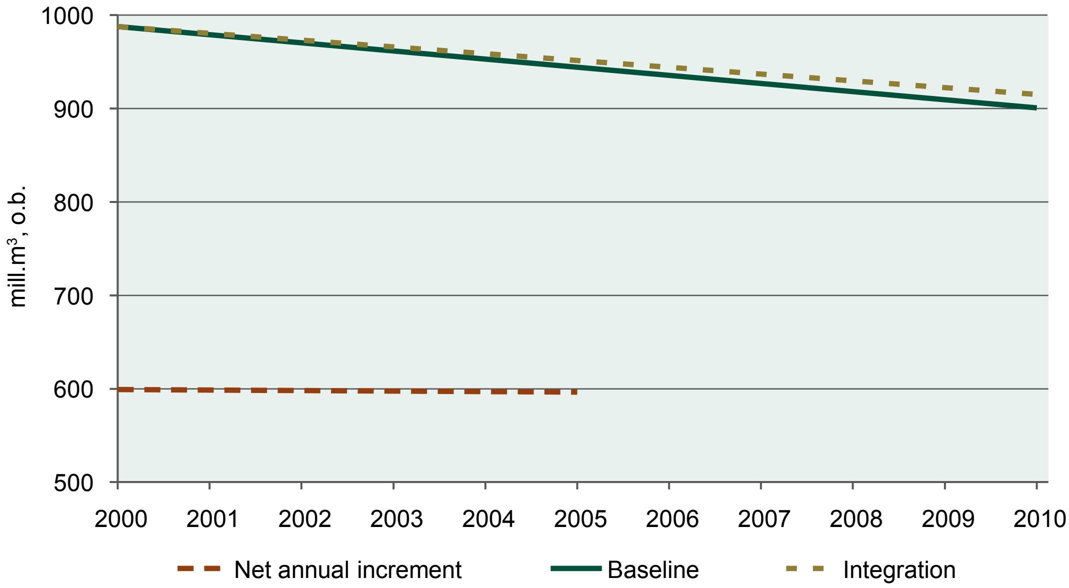

Figure 12. Observed and projected net annual increment in the CIS sub-region.

5.5 Ownership structure

Schelhaas et al. (2003) did not prepare scenarios for ownership structure, but EFSOS (2005) made some approximations concerning its development. Over the past two decades, public forest ownership declined or remained constant in Western Europe, excluding Luxembourg and the Netherlands, where public ownership seemed to increase. In Eastern Europe, the development of the ownership structure was similar, but the change towards privately owned forests occurred in just a fraction of the time that it took in Western Europe. The land restitution process in Eastern Europe accelerated the growth of private ownership, but as a side effect, it created a large number of small forest estates. The share of private ownership was still expected to increase because of the economic transition process in Eastern Europe. The CIS sub-region differed from Eastern and Western Europe in that its forest land remained mostly under public ownership (EFSOS 2005).

The data on forest ownership structure contained certain comparability problems. In order to prevent this problem, only the countries that provided comparable data were included in this study. This led to a substantial number of excluded countries, which were Albania, Bosnia and Herzegovina, Croatia, Estonia, Slovenia, FYR Macedonia, Turkey, Denmark, France, Germany, Greece, Italy, Luxembourg, Portugal, Spain and Sweden. Although only 22 of the 38 studied countries were included in this study, it was possible to present some estimates of the trend in ownership structure development in Europe. However, when reviewing the results, these facts should be taken into account.

Fig. 13 illustrates the development of forest ownership structure in the three sub-regions in 2000–2005. Based on these results, it seems that in Eastern Europe the share of private forest ownership increased by 3% in five years. This resulted largely from the land restitution process. However, nearly 20 years after launching the transition process, the share of public forest ownership in Eastern Europe was still high compared with Western Europe. In Western Europe, private forest ownership seemed to stabilise at the level of 60%, whereas the share of the public ownership was approximately 40%. In the CIS sub-region, no attempts were made towards increasing the share of private forest ownership. The only exception was Ukraine with a 0.1% increase in the share of privatively owned forests in 2000–2005. This value is marginal, but it is good to be noted that Ukraine started its restitution process in 2001 (Schelhaas et al. 2004), which was more than 10 years after the other Eastern European transition countries started their economic transition processes.

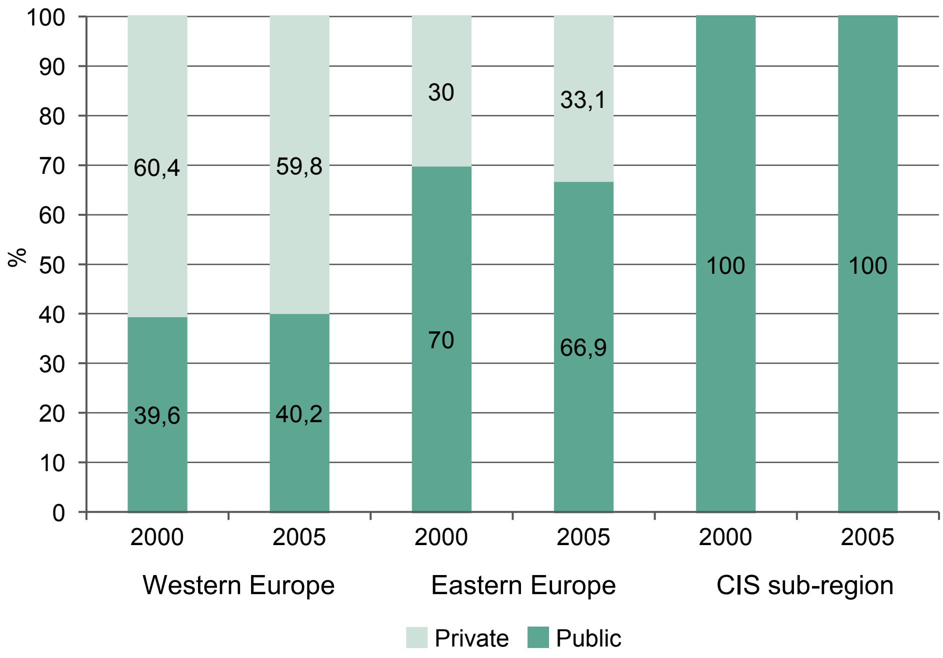

Figure 13. Development of ownership structure in the three regions in 2000–2005.

5.6 Fellings

The most important long-term factor affecting forest resources is the level of fellings over time (Schelhaas et al. 2003). The level of fellings was also one of the major determinants when projecting different scenarios with the EFISCEN. Therefore, a bias in expected felling level has caused a bias to all other projections. According to EFSOS, the felling level in FAWS was expected to increase in Western and Eastern Europe, but not to exceed the annual increment within the next 20 years. In those regions, continuously increasing fellings were expected to lead to a raw wood shortage by 2025. If this were to happen, raw wood would become a scarce resource in certain regions in Europe, which would have implications on trade flows and the forest owner behaviour (EFSOS 2005).

By contrast, Schelhaas et al. (2004) stated that if the felling volume were to remain constantly too low, a long-term consequence would be the decreasing net annual increment because of the higher average age of forests. This would not necessarily be a bad development trend, because as the forests get older, their diversity increases. From an economic point of view, however, this is not desirable because the risk of various biotic and abiotic agents, such as root fungi, insects and storms, might increase. This would furthermore lower the economic value of the forests.

Fellings in Europe: Wood harvesting volumes have increased steadily over the past 10 years in Europe (MCPFE 2007a). This trend can also be seen in Table 14, where actual and projected felling levels in FAWS are shown in Europe. In 2000–2005, fellings in FAWS increased by 44.8 million m^3 o.b., accounting to 685.7 million m^3 o.b. in 2005. In addition, all three scenarios projected an increase in fellings in FAWS in Europe. According to the results, it seems that the actual development followed the baseline scenario well, where expected average annual growth in fellings was 11.1 million m^3 o.b. (1.42%) and observed growth 8.97 million m^3 o.b. (1.36%). Regional differences in the felling level development are shown in Annex V, where it can be seen that most of the felling volume increase occurred in the CIS sub-region. Trends in each sub-region are discussed in more detail in the following sections.

Fellings in Western Europe: Table 15 and Fig. 14 illustrate the actual and projected development in felling volumes in FAWS in Western Europe. Austria, Ireland and Switzerland were excluded from all calculations because of a lack of data. Those countries represented approximately 8% of the total fellings in FAWS in the region and, therefore, the exclusion of those countries was not considered to be significant. In 2005, the total felling volume in FAWS was 333.5 million m^3 o.b. In five years, it increased by 11.24 million m^3 o.b, which accounted for a 0.69% average annual increment in fellings in FAWS. The actual growth in felling volume was significantly higher compared with the conservation scenario, as in five years it exceeded the total growth projected by the conservation scenario for 10 years. Based on the results, the baseline scenario was able to project the felling volume in Western Europe the best.

Table 14. Observed and projected level of fellings in all studied countries in Europe.

Year	Observed, mill. m^3 (o.b.)	Scenarios, mill. m^3 (o.b.)		
	in FAWS	Baseline	Conservation	Integration
2000	640.87	731.98	731.98	731.98
2005	685.70			
2010		842.92	763.93	921.74
Change-%	7.0	15.2	4.4	25.9
Average growth/year,%	1.36	1.42	0.43	2.33

Table 15. Observed and projected fellings in Western Europe (excluding Austria, Ireland and Switzerland).

Year	Felling in FAWS, million m^3 (o.b.)			
	Observed	Baseline	Conservation	Integration
2000	322.26	328.19	328.19	328.19
2001	325.248			
2002	327.496			
2003	329.744			
2004	331.992			
2005	333.5			
2010		357	339.38	361.94

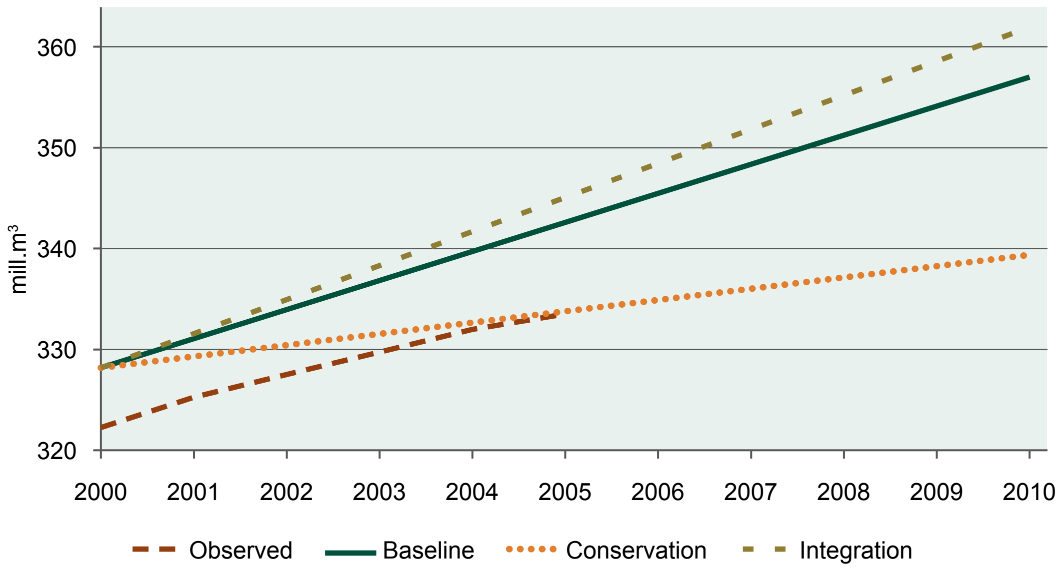

Figure 14. Observed and projected felling volume (in million m^3 o.b.) in Western Europe.

Fellings in Western Europe: Table 16 and Fig. 15 illustrate the actual and projected felling volumes in FAWS in Eastern Europe. Bosnia and Herzegovina, Croatia and FYR Macedonia were excluded from all calculations because of a lack of data. Those countries represented less than 4% of all fellings in the studied region and, therefore, their influence on the aggregated trend was not expected to be significant.

In 2005, the total felling volume in FAWS in Eastern Europe was 138.78 million m^3 o.b. The actual growth in felling volume in 2000–2005 was 5.71 million m^3 o.b., which accounted for a 0.84% average annual growth rate. Both the baseline and integration scenarios projected an increase in felling volumes as well, whereas the conservation scenario expected the level of fellings to decline. According to these results, the actual increase in felling volume in FAWS during the study period (1.14 million m^3 o.b. annually on average) exceeded the projected level according to the baseline scenario (0.85 million m^3 o.b. annually on average), but did not reach the level of the integration scenario (1.79 million m^3 o.b. annually on average).

Table 16. Observed and projected fellings in Eastern Europe (excluding Bosnia and Herzegovina, Croatia and FYR Macedonia).

Year	Felling in FAWS, million m^3 (o.b.)			
	Observed	Baseline	Conservation	Integration
2000	133.07	159.58	159.58	159.58
2001	135.142			
2002	136.284			
2003	137.426			
2004	138.568			
2005	138.78			
2010		168.08	157.26	177.48

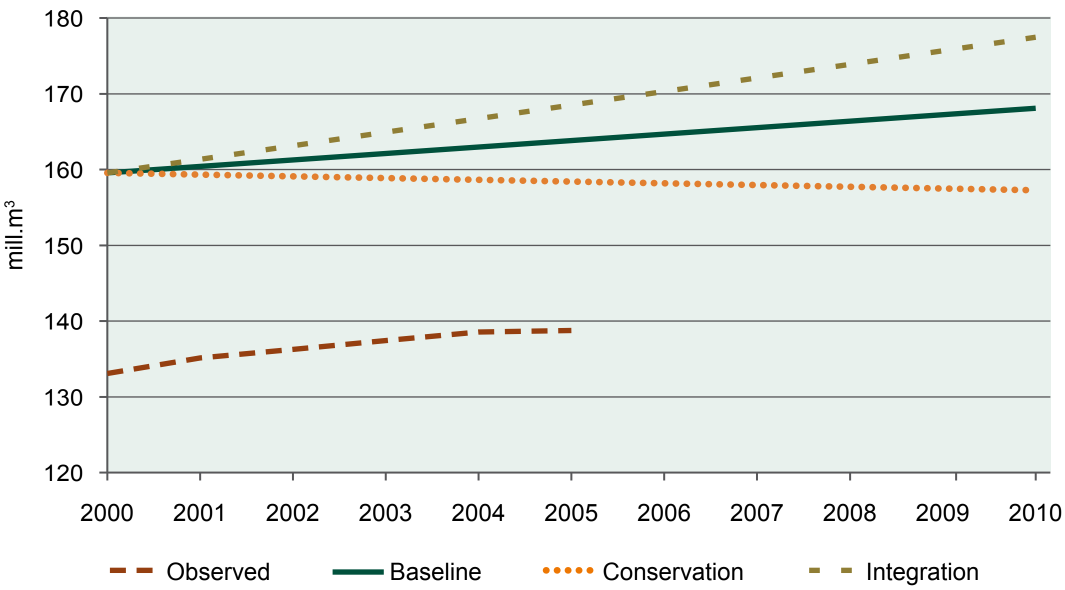

Figure 15. Observed and projected felling volume (million m^3 o.b.) in Eastern Europe.

When examining the results, it should be noted that the actual and projected values in 2000 differed by 26.5 million m^3 o.b. This difference is significant. A reason for this difference may be in the data conversion, which was executed for the historical, under bark measured, data. The data were measured as over bark values by using conversion factors (Schelhaas et al. 2003). However, in Western Europe the difference between the actual and projected trends for 2000 was much smaller, only 5.93 million m^3 o.b., although the same conversion was executed for these countries as well. Therefore, it is most likely that the quality of the original data used in the felling projections in Eastern Europe was low.

Fellings in the CIS sub-region: Compared with the other two regions, the most rapid increase in felling volume in FAWS was expected to occur in the CIS sub-region (EFSOS 2005). In reference to EFSOS, required fellings in the CIS sub-region were expected to be met without difficulties until 2035 according to the integration scenario, or until 2040 according to the baseline scenario. If this expectation were to hold, it would mean that the CIS sub-region would provide the majority of the wood supply to the other two regions in the future (Schelhaas et al. 2003). This statement was supported by the finding that even though over 70% of the total forest area in Europe was located in Russia, only 31% of all fellings in Europe occurred there. This means a remarkable unused wood potential in Russia.

Table 17 and Fig. 16 illustrate the actual and projected development in fellings in FAWS in the CIS sub-region. The Republic of Moldova was excluded from calculations because of a lack of data. Since the Russian Federation constitutes the major part of the CIS sub-region, the share of the Republic of Moldova was only marginal (0.28%).

Again, the difference between the actual and projected values in 2000 differed. Of all three sub-regions, this gap was the widest in the CIS sub-region, being nearly 57 million m^3 o.b. In 2000, the scenarios for Belarus underestimated real felling volume by nearly 22%, whereas the scenarios for Russia overestimated real development by 31%. This indicates low data quality either in the projections or in the MCPFE report (2007a). However, based on the results, the total felling volume

Table 17. Observed and projected fellings in the CIS sub-region (excluding the Republic of Moldova).

Year	Felling in FAWS, million m^3 (o.b.)			
	Observed	Baseline	Conservation	Integration
2000	185.54	244.21	244.21	244.21
2001	191.574			
2002	197.148			
2003	202.722			
2004	208.296			
2005	213.41			
2010		317.84	267.29	382.32

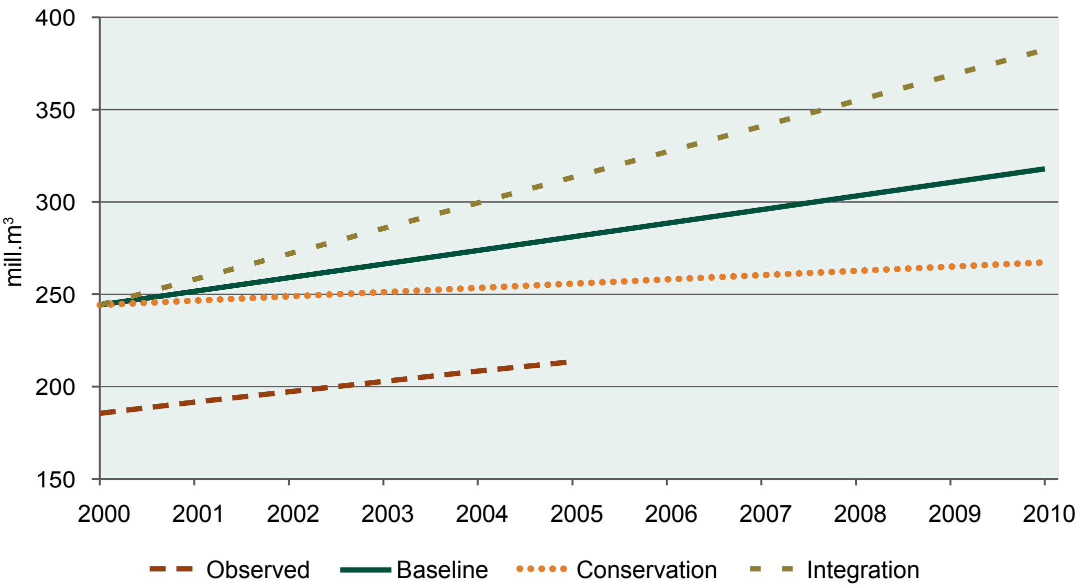

Figure 16. Observed and projected felling volume (million m^3 o.b.) in the CIS sub-region.

in the CIS sub-region in 2005 was 213.41 million m^3 o.b., accounting on average for only 31% of the total commercial forest fellings in Europe. Again, this result shows a remarkable unused felling potential in the CIS sub-region, especially in Russia. The increase in fellings in 2000–2005 was 27.87 million m^3 o.b., which meant a 2.85% average annual growth rate over five years. The actual felling level exceeded the projected level according to the conservation (0.91%) and baseline (2.84%) scenarios. However, the average annual growth did not reach the level projected by the integration scenario (4.58%).

5.7 Fellings to increment ratio

Fellings to increment ratio in the three sub-regions: Finding an optimal felling level is crucial for Europe's forest sector. If the annual felling level increases above the annual increment for a long period, the sustainability of forest ecosystems would be endangered and long-run shortages of wood would be expected. In turn, if the felling level is too low, the risk of various forest damage increases.

According to EFSOS, the reason for the relatively low increase in growing stock volume in Eastern and Western Europe is the expected increase in annual fellings in relation to the annual increment in those regions. Fig. 17 illustrates the fellings to increment ratio in Europe and in the three sub-regions. The percentage value in the figure stands for the share of annual felling volume and of annual increment volume.

Based on these results, felling volume was approximately 67% of annual forest increment in Europe, which was nearly 10% lower compared with 2000. However, when reviewing each of the sub-regions separately in 2000 and 2005, the results show that the majority of fellings occurred in Eastern Europe and in the CIS sub-region. In Western Europe, on the contrary, the level of fellings actually decreased slightly.

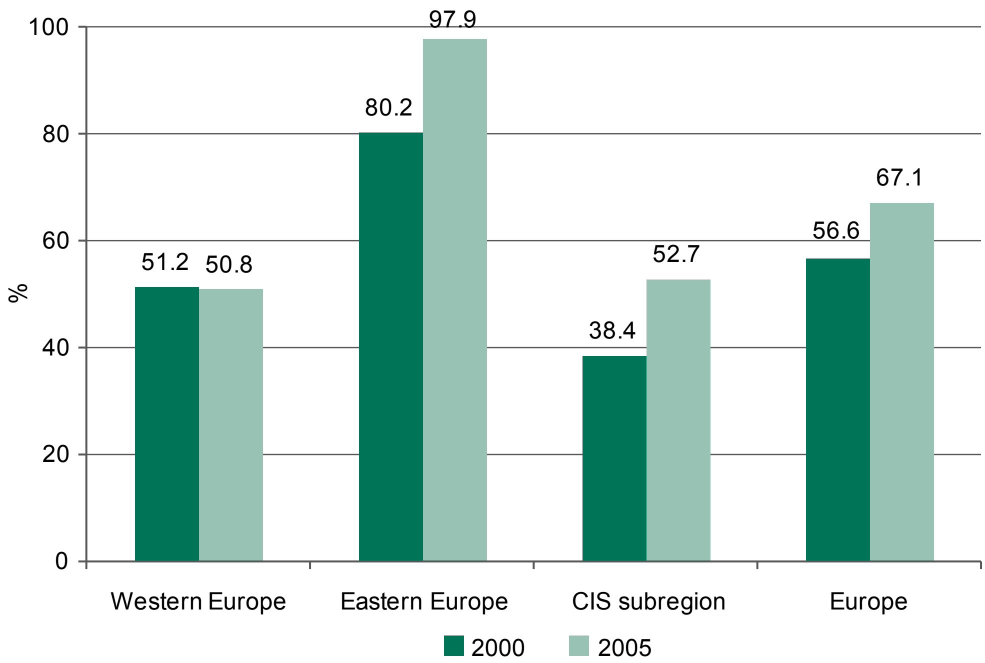

Figure 17. Fellings to increment ratio in Europe and in the three sub-regions in 2000 and 2005.

5.8 Trade with wood products

By volume, Western Europe has traditionally been the largest exporter of forest products in all the main categories in Europe. Therefore, changes in the import and/or export volumes in Western Europe reflect largely the trade patterns across Europe (EFSOS 2005). According to EFSOS, consumption in all studied forest product categories in Europe was expected to increase, indicating growth in forest products trade. However, the majority of forest products on the European markets during the analysed period were regarded as mature, and new products were not expected to enter the markets in the near future (Kangas and Baudin 2003).

The level of forest products exports by volume from Eastern Europe showed an increasing trend after 1990 to the level of Western Europe. Nevertheless, it was expected that the export volume from Eastern Europe would start to return to its initial level, as the economic growth, especially in transition countries, was expected to increase domestic forest product consumption (EFSOS 2005). Therefore, a shortage of raw wood in Western Europe was expected. Some analysts predicted that if the EU continued its expansion East, those new EU member countries would be an important source of low-cost wood to European markets (Schelhaas et al. 2003).

The following three sections present the actual and projected net trade development of those forest product categories that were assigned to this study. The categories are sawnwood, wood-based panels and paper and paperboard. Net trade refers to exports minus imports. In terms of net exports, the exported volume of forest products exceeds the imported volume, whereas net imports mean that a higher volume is imported in relation to exports.

5.8.1 Sawnwood

Sawnwood net trade in Europe: In reference to EFSOS, all three scenarios projected increasing sawnwood net exports from Europe, which was confirmed by actual data (Fig. 19). The most notable trend in sawnwood export growth was expected to occur in the CIS sub-region, where it was boosted by the expected increase in sawnwood production (Kangas and Baudin 2003). The results confirm the projected view of a higher rate of sawnwood exports in relation to their imports in Europe, which led to net exports in all analysed regions except Western Europe. Fig. 18 illustrates the observed trend in coniferous and broadleaved sawnwood net trade in Europe and in the three sub-regions in 2000–2008.

Although Europe was a net exporter of sawnwood during the analysed period, there were differences between the sub-regions. Western Europe was a net importer of sawnwood until 2007. It became a net exporter for the first time in 2008. Sawnwood imports amounted to 37.6 million m^3 (86.45%) and exports to 40.15 million m^3 (58.43%). Eastern Europe was also a net exporter of sawnwood with 5.6 (12.87%) million m^3 of imports and 10.63 million m^3 (15.47%) of exports. The biggest net exporter of sawnwood in Europe in 2008 was the CIS sub-region with 17.93 million m^3 (26%) of exported and only 0.29 (0.66%) million m^3 of imported sawnwood.

Sawnwood net trade in Western Europe: In Western Europe, only a slight change in trade patterns was expected in reference to the baseline, integration and conservation scenarios (Fig. 20). The conservation scenario projected a growth in sawnwood export volume, whereas the integration scenario projected exports would decrease slightly. As can be seen from the upward sloping trend, actual sawnwood exports from Western Europe grew at a significantly higher rate. This rapid increase in sawnwood exports may have been caused by the prolonged higher volume of sawnwood

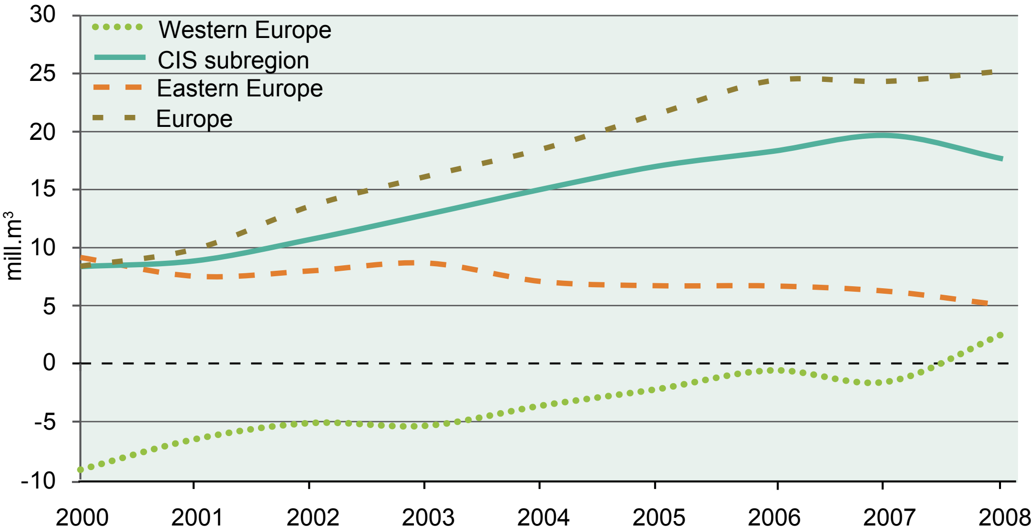

Figure 18. Actual sawnwood net trade in Europe and in the three sub-regions in 2000–2008.

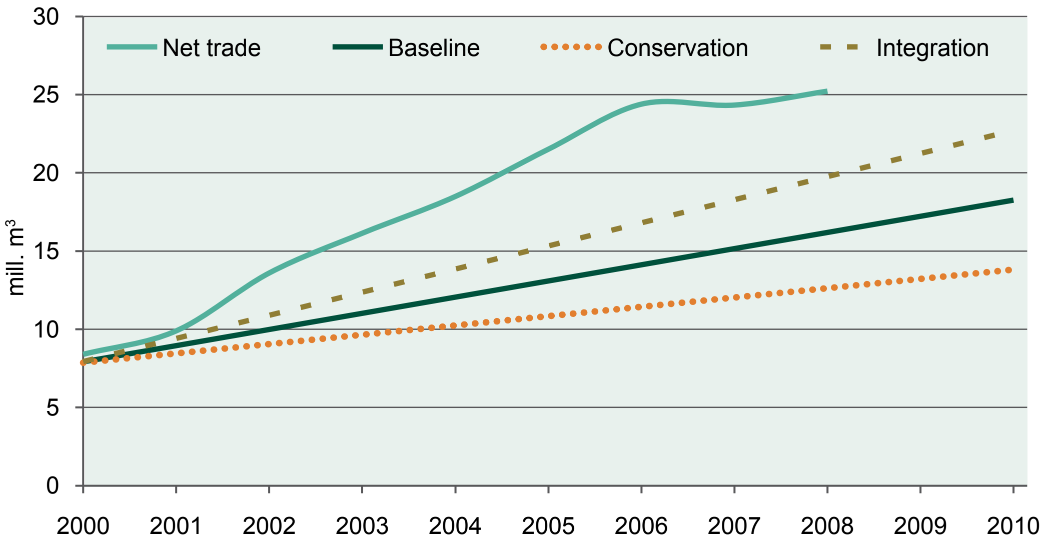

Figure 19. Actual net trade of sawnwood in Europe in comparison with EFSOS projections.

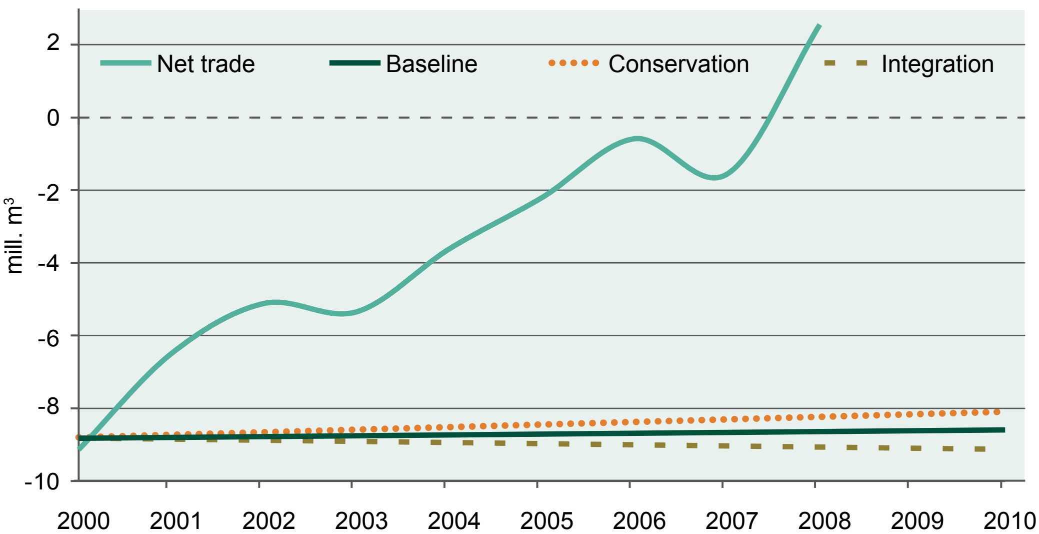

Figure 20. Actual and projected net trade of sawnwood in Western Europe.

production compared with its consumption in Western Europe (EFSOS 2005). However, the observed trend does not imply only increased exports but also decreased imports. While sawnwood exports from Western Europe grew by approximately 16% in 2000–2008, imports of sawnwood decreased by 14%. Thus, increased sawnwood exports and decreased imports caused a sharp increase in the observed trend.

Based on these results, the model used for EFSOS predictions was not well suited to the estimation of sawnwood net trade in Western Europe. The difference between the actual and projected trends can be explained partly by data quality, although data interpolation probably brought some inaccuracy to the projections. However, the major part of the difference was probably caused by the underlying assumptions of the timber market model, which the model was not able to reflect well enough for each country.

Sawnwood net trade in Eastern Europe: In Eastern Europe, the actual and projected trends in sawnwood net trade differed as well. However, the difference was the opposite compared with Western Europe, as all scenarios projected an increasing trend in net trade, although net trade actually declined (Fig. 21). According to the results, the volume of sawnwood net trade was estimated to increase annually on average by 1.4–2.8%, depending on the scenario. Based on the results, however, the observed trend in net trade actually declined by 54.03% over eight years, an annual average of 6.75%.

Although the share of sawnwood exports from Eastern Europe declined by 15.71% in eight years, Eastern Europe remained a net exporter of sawnwood. However, the increase in sawnwood imports to Eastern Europe was much faster compared with that of exports, which caused the declining trend in actual net exports. In fact, sawnwood imports nearly doubled over six years. This finding supports the view presented in EFSOS that economic growth in the transition countries decreased the export volume of forest products.

Based on these results, it can be said again that the timber market model did not reflect the actual sawnwood net trade well enough in Eastern Europe. The reasons for this are most likely the same as they were in the case of Western Europe.

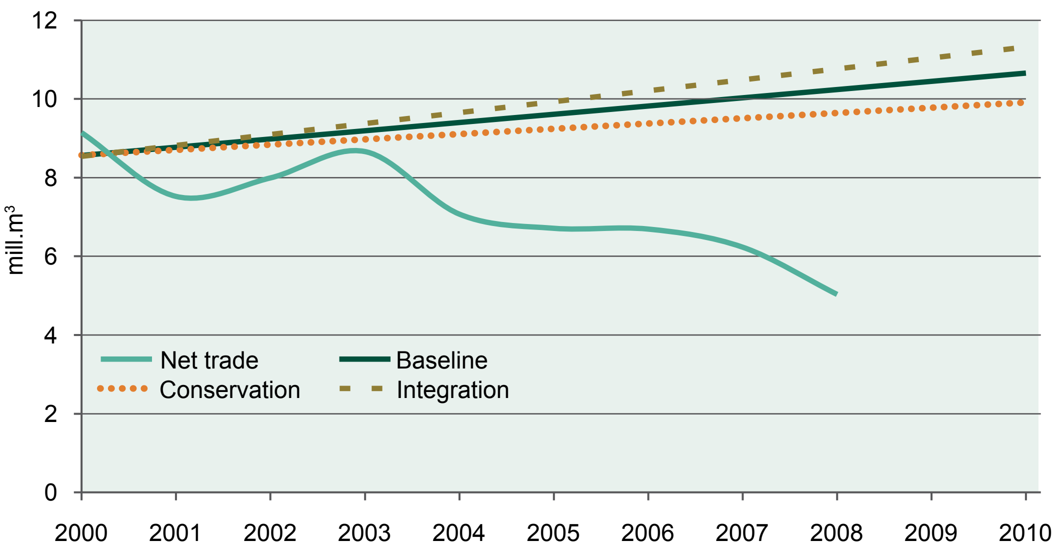

Figure 21. Sawnwood net trade in Eastern Europe.

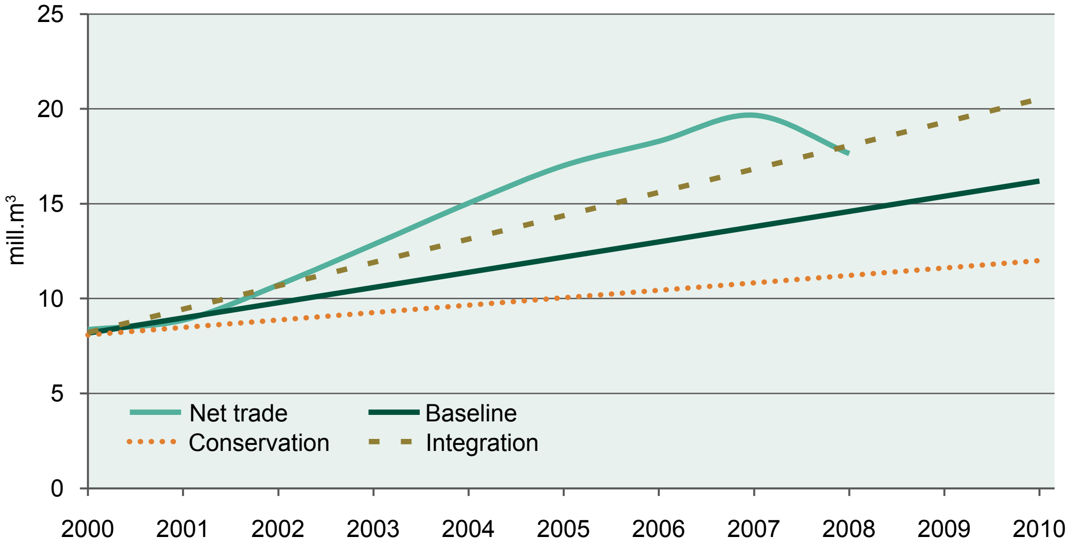

Figure 22. Sawnwood net trade in the CIS sub-region.

Sawnwood net trade in the CIS sub-region: The CIS sub-region has traditionally been a net exporter of sawnwood and this trend was expected to continue, boosting sawnwood trading volume from the region (EFSOS 2005). This expectation was shown to be correct. In 2000–2008, sawnwood exports from the CIS sub-region increased by 203%. Concurrently, sawnwood imports to the CIS sub-region declined by 35.56%. These changes resulted in a strong upward sloping trend in sawnwood net trade. In the CIS sub-region, the projections of the actual development of sawnwood net trade were accurate, although all scenarios underestimated the growth level (Fig. 22).

5.8.2 Wood-based panels

Wood-based panels net trade in Europe: The consumption and production of wood-based panels have declined in Europe since 2006, indicating a strong decrease in the international trade of wood-based panels. Western Europe has traditionally been the largest producer of wood-based panels (Kangas and Baudin 2003), but a remarkable decrease in production volumes has been reflected in all sub-regions except Eastern Europe.

Fig. 23 shows the actual decrease in net trade volumes of wood-based panels coming mostly in Western Europe and slightly in the CIS sub-region. As can be seen, the level of imports and exports has fluctuated strongly in Europe since 2006. The value of exports increased by 61.28% however, imports increased by 79.44%. Europe became a net importer of wood-based panels with 38.74 million m^3 of exports and 39.73 million m^3 of imports in 2008. In 2008, the net trade of wood-based panels in Eastern Europe and the CIS sub-region was almost at the same level.

In reference to EFSOS, all three scenarios projected increases in net exports of wood-based panels in Europe by 2010. The prediction was not confirmed by actual data from 2004–2008 (Fig. 24). A remarkable decrease in net trade can be seen from 2006 to 2007 when the amount of exports increased by 2.35 million m^3 but the amount of imports also increased by more than 6 million m^3. Therefore, the net trade of wood-based panels decreased by nearly 4 million m^3. Therefore, the trend of the net trade of wood-based panels in the past four years was opposite to projected scenarios by EFSOS.

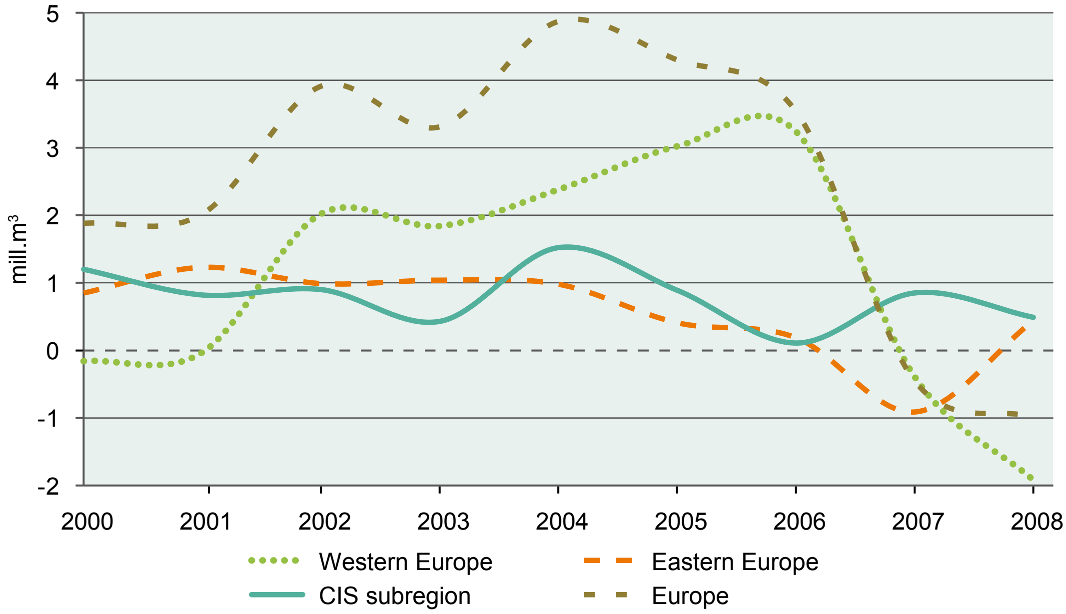

Figure 23. Net trade in wood-based panels in Europe and in the three sub-regions in 2000–2008.

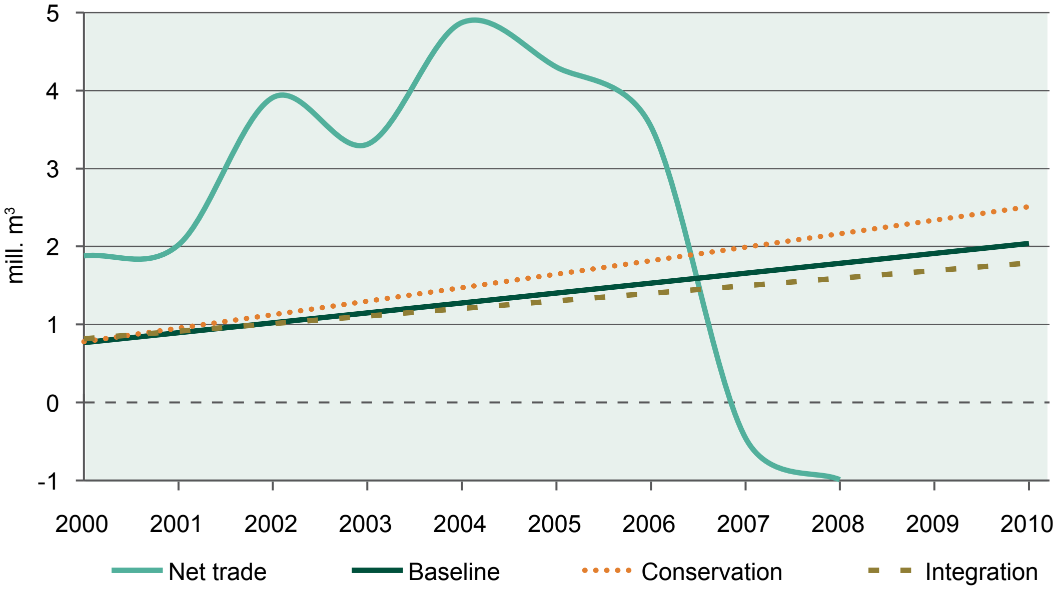

Figure 24. Comparison of the actual net trade of wood-based panels in Europe with predictions by all three scenarios.

Wood-based panels net trade in Western Europe: According to the results, Western Europe was a net importer of wood-based panels with 70.4% (27.97 million m^3) of all imports and 67.24% (26.05 million m^3) of all exports in 2008. In Western Europe, imported and exported volumes were balanced in 2006–2007, as wood-based panels exports increased by only 1.2% and imports by nearly 18% (Fig. 25). This strong fall in export volume caused a sharp downward sloping trend in the net trade of wood-based panels in Western Europe.

As can be seen in Fig. 25, all three scenarios did not predict wood-based panels net trade in Western Europe well in 2006, as the net trade increased significantly faster than was expected. According to the scenarios, Western Europe was actually expected to be a net importer of wood-based panels,

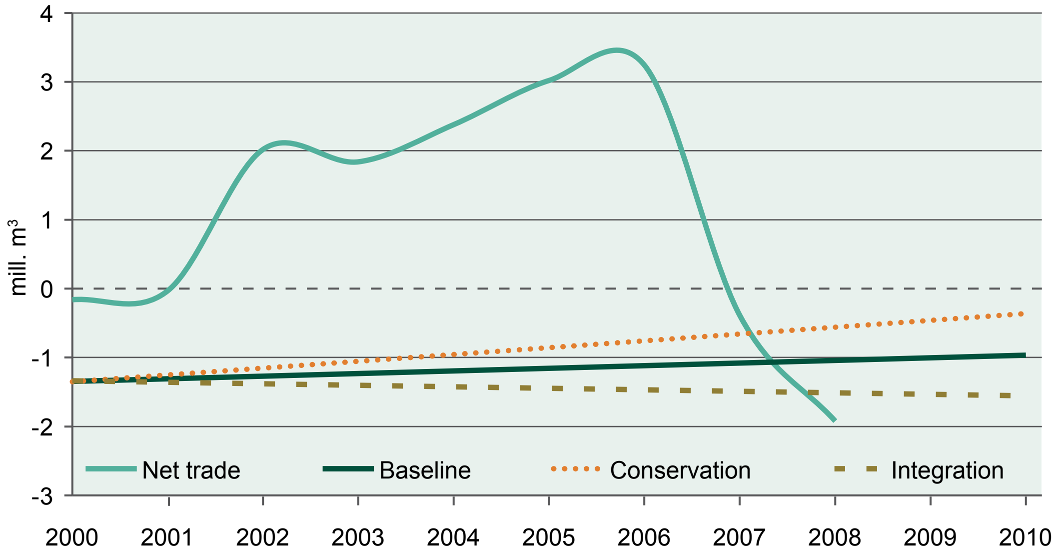

Figure 25. Wood-based panels in Western Europe.

although the export volume from the region was expected to increase according to the baseline and conservation scenarios. The strongest increase in the trade of wood-based panels was projected by the conservation scenario. In 2007–2008, the situation changed so significantly that the net trade became in line with the EFSOS prediction.

Wood-based panels net trade in Eastern Europe: Eastern Europe was the second largest region in wood-based panels imports and exports with 22.98% (9.13 million m^3) and 24.7% (9.57 million m^3), respectively. A decreasing trend of net exports can be seen since 2004, with a deep fall in 2006–2007. After the recession in 2007, caused by the global economic crisis, the trade in wood-based panels in Eastern Europe recovered in 2008 and the sub-region became a net exporter. In Eastern Europe, exports of wood-based panels increased by more than 14% in 2008.

The volume of wood-based panels trading in Eastern Europe fluctuated strongly, as can be seen in Fig. 26. By 2001, the exports of wood-based panels was growing faster than its imports, which caused a sharp upward trend. Afterwards, the situation was opposite, as the imported volume increased, achieving the level of exports. Although Eastern Europe remained a net exporter until 2007, the overall tend was decreasing. This indicated strongly that Eastern Europe was becoming a net importer of wood-based panels, which happened in 2007. This finding supports the theory of increasing domestic consumption because of economic improvements in Eastern Europe.

The EFSOS scenarios reflected well the actual development of the net trade in wood-based panels in Eastern Europe until 2005. Afterwards, the model was not able to reflect the strong fluctuations in trade volumes caused by the global economic crisis.

Wood-based panels net trade in the CIS sub-region: The CIS sub-region was a net exporter of wood-based panels as well, although its share in overall European imports and exports was the lowest, only 6.61% (2.63 million m^3) and 8% (3.12 million m^3), respectively. Although the total volume of exported panels from the CIS sub-region was low, the growth of exports during the study period was remarkable, achieving more than 75%. However, this increase was not sufficient to compensate for their imports, which achieved a 453% growth rate in eight years. Fig. 27 shows

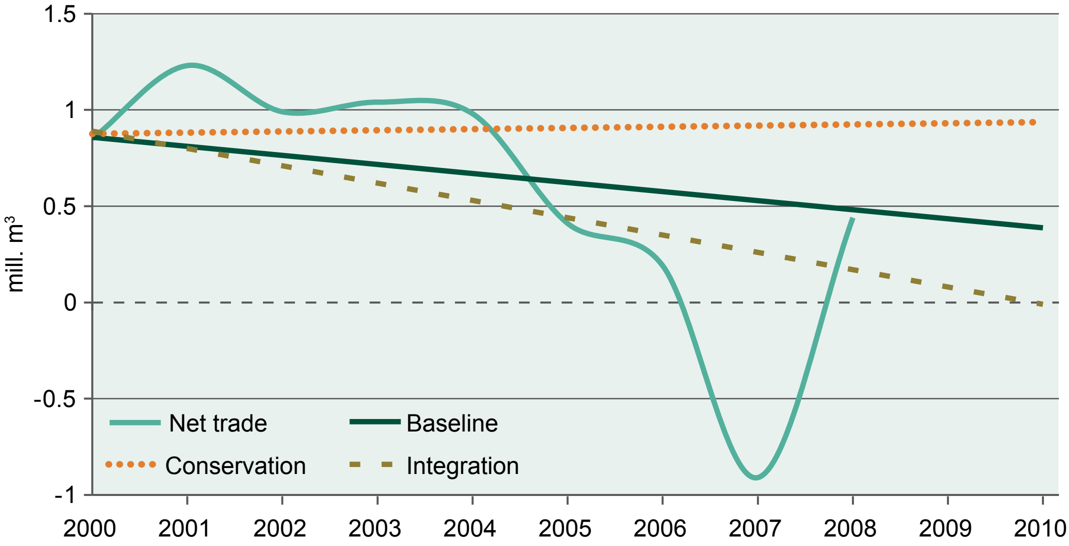

Figure 26. Wood-based panels net trade in Eastern Europe.

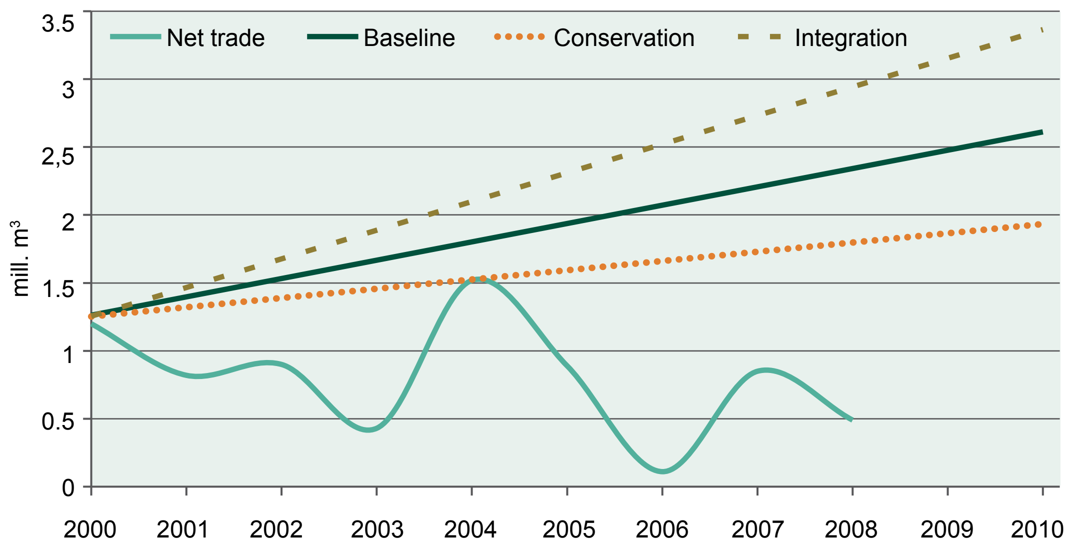

Figure 27. Net trade of wood-based panels in the CIS sub-region.

the trend of the net trade in wood-based panels in 2000–2008. As can be seen, trade fluctuations were as strong as in Western and Eastern Europe.

The overall trend in the net trade of wood-based panels in the CIS sub-region was declining, which caused a downward sloping curve. All three scenarios projected higher exports than imports. As Fig. 27 shows, the scenarios did not project the development in the net trade of wood-based panels in the CIS sub-region well. The reason might be that the model did not take into account the strong growth in domestic demand for wood-based panels in the CIS sub-region.

5.8.3 Paper and paperboard

Paper and paperboard net trade in Europe: Paper and paperboard has been the major exported forest product by value from Europe during recent decades (EFSOS 2005). Regional differences in paper and paperboard trading activity in Europe exist, as a major share of its trade has traditionally occurred in Western Europe (Kangas and Baudin 2003). Eastern Europe was the net importer of paper and paperboard, whereas the other two regions were net exporters. The development of paper and paperboard net trade in Europe and in the sub-regions is demonstrated in Fig. 28.

In reference to EFSOS, the baseline and integration scenarios projected a decrease in paper and paperboard net exports from Europe by 2010. The conservation scenario projected a slight increase in exports. The actual data did not confirm the EFSOS scenarios during the studied period (Fig. 29), which was characterised by significant fluctuations. A remarkable decrease in net trade can be seen from 2004 to 2007 where the amount of exports increased by 6.78 million tons but the amount of imports increased by more than 10.72 million tons. Paper and paperboard net trade decreased by nearly 4 million tons. The year 2008 was characterised by a slight increase in net trade (0.61 million tons).

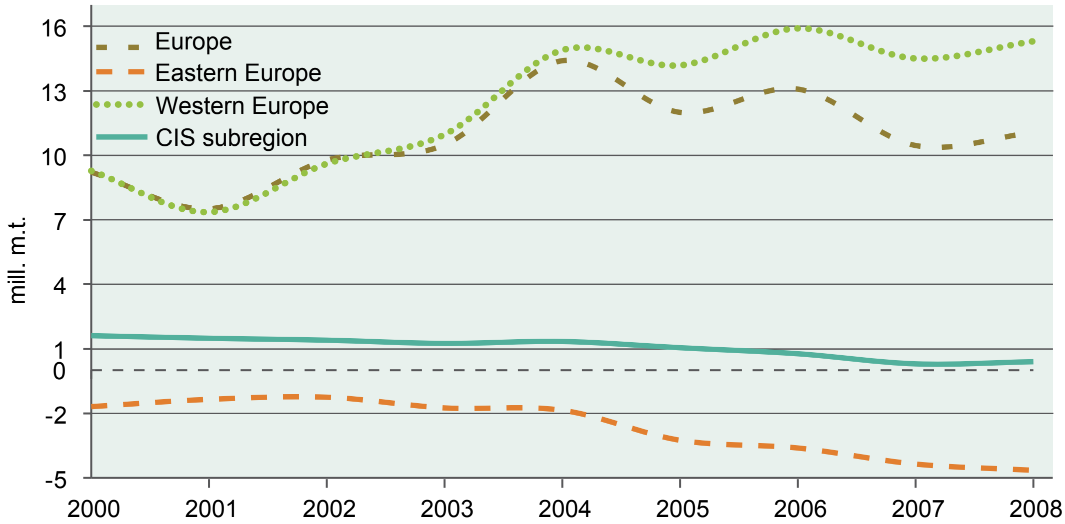

Figure 28. Paper and paperboard net trade in Europe and in the three sub-regions in 2000–2008.

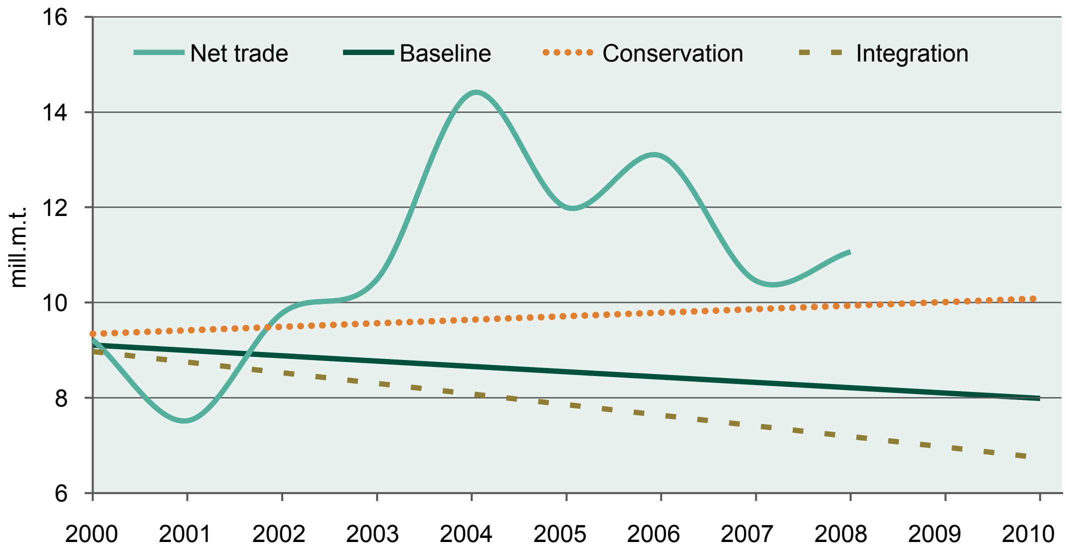

Figure 29. Comparison of actual net trade of paper and paperboard in Europe under all three scenarios.

Paper and paperboard net trade in Western Europe: According to the results, Western Europe remained the largest paper and paperboard importer and exporter during the reference period (Fig. 30). In 2008, Western Europe accounted for 79.92% (47.11 million m.t.) of all paper and paperboard imports and 89.15% (62.42 million m.t.) of exports in Europe.

Paper and paperboard export in Western Europe increased by 17.92% in 2000–2008. Imports increased as well, but their growth (7.9%) reached approximately only half that of exports. Strong growth in exported volumes caused the upward sloping trend in paper and paperboard net exports, which can be seen in Fig. 30.

Paper and paperboard net trade in Western Europe increased at a higher rate than that projected by all three scenarios (Fig. 30). The baseline and integration scenarios even projected a decline in paper and paperboard net trade, whereas the conservation scenario projected a slight growth. The actual and projected development differed significantly from each other, which may be partially explained by the impact of the growth rates in paper and paperboard consumption and production in Western Europe, which were expected to remain at a constant level in the future (EFSOS 2005). Therefore, the strong growth in paper and paperboard exports was not projected.

Paper and paperboard net trade in Eastern Europe: Eastern Europe was the second largest importer and exporter of paper and paperboard in Europe with 15.81% (9.32 million m.t.) and 6.67% (4.67 million m.t.), respectively. Export volume of paper and paperboard increased by 66.19% in 2000–2008. However, the growth in the paper and paperboard imported volume was remarkably higher (207.57%) compared with the exported volume during the reference period. As a consequence of this high import volume, Eastern Europe remained a net importer of paper and paperboard throughout the analysed period. The results also indicated a high domestic consumption of paper and paperboard in Eastern Europe, because the imported volume well exceeded the level of exports. This high domestic consumption was in line with EFSOS's overall assumption of increasing domestic demand for forest products in Eastern Europe.

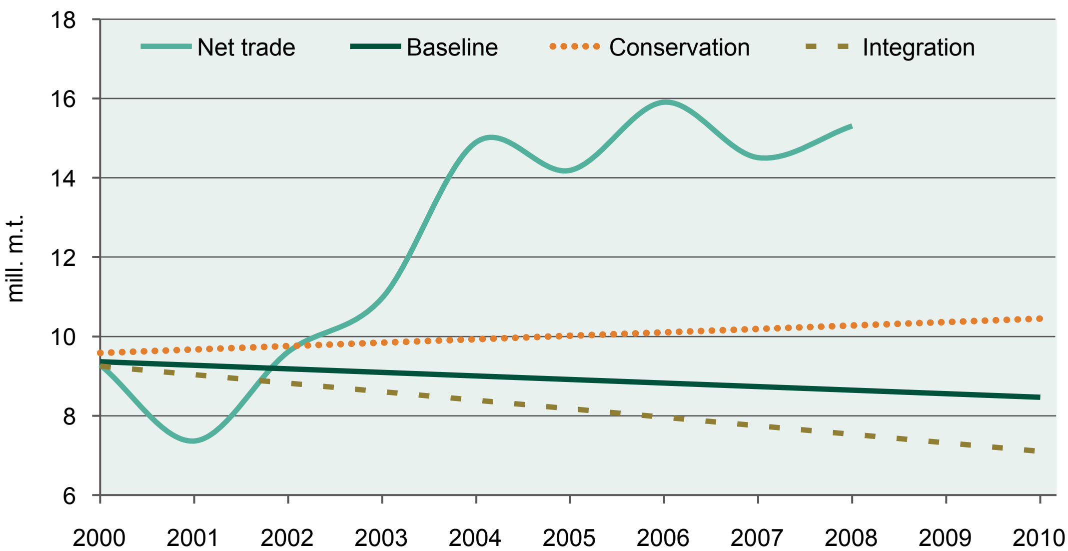

Figure 30. Paper and paperboard net trade in Western Europe.

The domestic consumption of paper and paperboard in Eastern Europe was expected to increase at a higher growth rate compared with the production growth rate (Fig. 31). This caused downward sloping projections according to all three scenarios. However, the actual trend was relatively well in line with the integration scenario, although the average annual growth rate was still higher compared with the integration scenario. The corresponding values according to the baseline and conservation scenarios were much lower.

Paper and paperboard net trade in the CIS sub-region: The CIS sub-region accounted for only 4.25% (2.51 million m.t.) of all imports and 4.17% (2.92 million m.t.) of all exports in Europe. However, the import volume growth during the study period was the fastest compared with the other two regions (325.97%). The export growth rate was much lower (22.17%). The CIS sub-region remained a paper and paperboard net exporter throughout the reference period, although the downward sloping trend indicated rapidly increasing domestic paper and paperboard consumption (Fig. 32). Again, this finding supports the view of increasing domestic consumption along with economic growth in the CIS sub-region (EFSOS 2005).

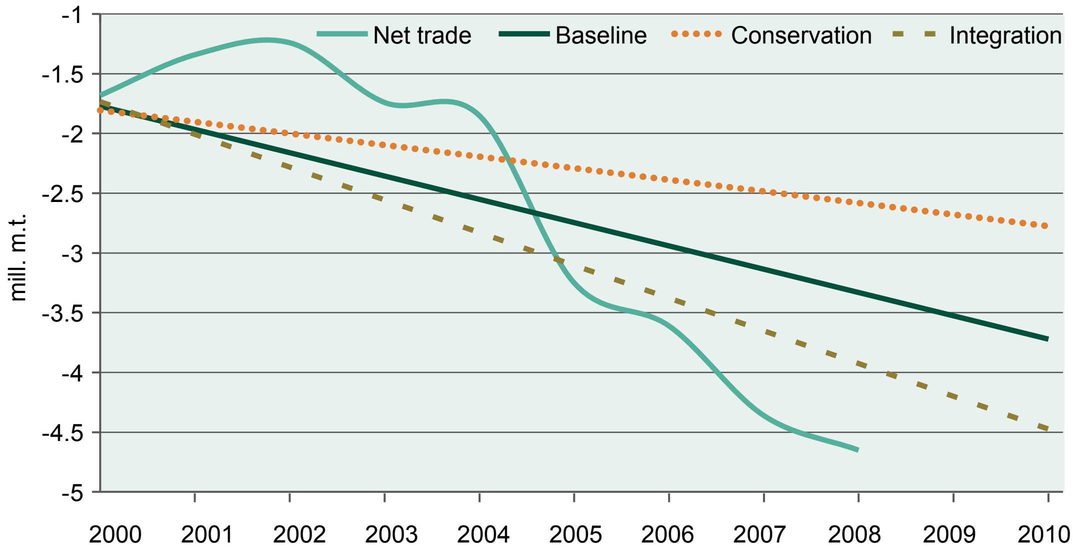

Figure 31. Paper and paperboard net trade in Eastern Europe.

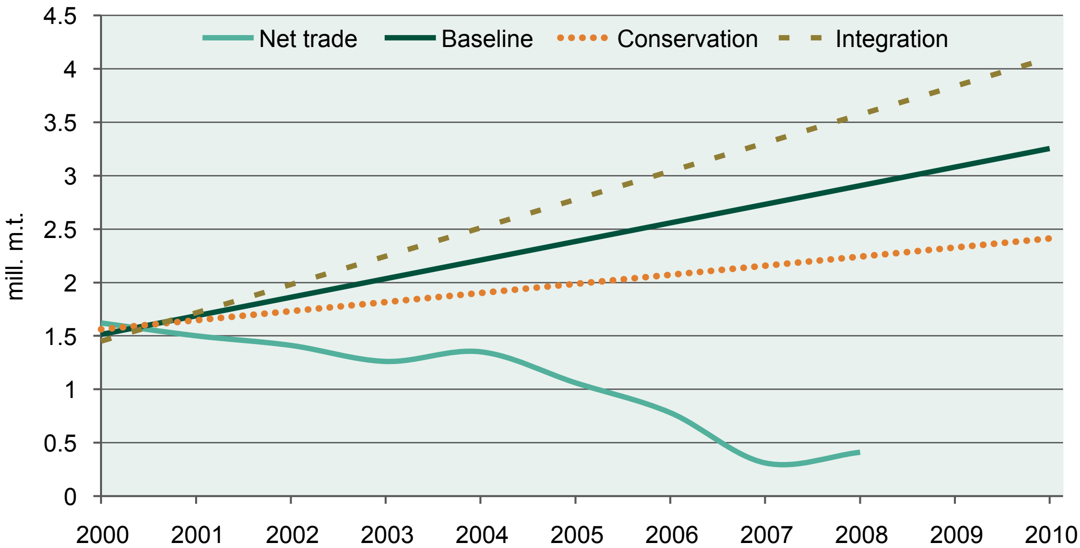

Figure 32. Paper and paperboard net trade in the CIS sub-region.

According to the results, the majority of the increase in paper and paperboard imports during the study period occurred in Russia (280.6%) and Ukraine (215.9%). The growth in paper and paperboard exports was not sufficient to compensate for this increase and, therefore, the trend illustrating actual development is downward sloping. All three scenarios projected increasing paper and paperboard export volumes from the CIS sub-region, which were not confirmed.

5.9 Development of roundwood prices in the Baltic Sea region

The prices of roundwood and wood products have substantially fluctuated over the past decade. It was observed in EFSOS that the availability of roundwood was limited across Europe. In addition, it was also noted that the available data were measured at a number of different points along the roundwood production chain (i.e. standing, at roadside or delivered). A conclusion was made based on the analysis of the price of standing timber (or stumpage price) that a peak in real prices was achieved in the mid-1970s, followed by a gradual decline since then until the end of the analysed period in 2000 (EFSOS 2005). Concerning the roadside prices of roundwood, EFSOS predicted them to remain constant over the projection period of 2000–2010.

Schulmeyer (2006) analysed the development of roadside prices for spruce/fir and beech logs in Austria and pine, spruce and birch logs in Finland in 1995–2005 and compared them with the prediction in EFSOS. The prices in those countries remained reasonably constant over that decade and were well in line with the predictions. However, the development of roundwood prices has been turbulent since 2005. Therefore, we analysed the development of roundwood prices in countries in the Baltic Sea region.

Suchomel and Gejdos (2009) analysed the influence of certain factors on selected prices of raw wood assortments, wood products and timber market roundwood price development in selected Central and Eastern European countries in 2004–2009. This period was selected for the high appearance of incidental fellings in Central Europe and their negative influence on trade with wood. Accordingly, the practical influence of the global economic recession on the wood industry and trade with raw wood was analysed.

The Finnish Forest Research Institute collects roundwood price data in Estonia, Finland, Lithuania, Norway and Sweden and makes them available to various user groups. The reported prices originate from official forest statistics in each country, and they are delivered by the national contacts. The monthly average prices of roundwood assortments are reported at the roadside. Only quarterly data are available for Sweden.

Two factors have to be considered carefully when making comparisons between countries. Firstly, prices are reported in local currencies. Secondly, measurement units, quality and dimensional requirements vary significantly within the region. Consequently, the statistics reflect more price developments within countries than they do price differences between particular countries (Finnish Forest…2008).

To overcome these factors, price indices of the monthly changes of different roundwood assortments in each country were calculated, using the price of the assortment in January 2006 as the reference year with the value 1. The development of the price indices of logs and pulpwood in Estonia, Finland, Lithuania, Norway and Sweden was calculated for January 2006 to October 2009 and compared in the following sections.

5.9.1 Development of the price indices of logs

The development of the price indices for pine logs is presented in Fig. 33. The highest price variations were observed in Estonia and Lithuania. There was a sharp increase in prices from December 2006 until November 2007, followed by a rapid fall in prices during 2008. An exceptionally drastic fall in prices was recorded in Lithuania and Estonia during the first quarter of 2009. More modest changes were recorded in all three Scandinavian countries, in which the price level at the end of the analysed period was about the same as it was at the beginning. There is a slight increase in prices in all studied countries in the second half of 2009.

The development of the price indices of spruce logs was similar (Fig. 34). However, peak prices lasted for a much shorter period in comparison. Again, the most significant difference between the high levels of prices and the lowest prices were observed in Estonia and Lithuania. In October 2009, the prices of spruce logs were about the same as they were at the beginning of 2006. The price level of spruce logs in Sweden remained at about the same level during the whole period, which was 20 to 40% higher than in 2006. In addition, the development of prices of spruce logs in all analysed countries indicated a slight recovery of the market.

The price indices of birch logs indicated the highest fluctuation (Fig. 35). The data for Norway were available only together for all broadleaves and data for Sweden were not available. In all studied countries, the prices of birch logs were high for a long period of time, almost 18 months, followed by a sharp fall at the beginning of 2009. The recovery in the prices of birch logs since spring 2009 was less evident though.

5.9.2 Development of pulpwood price indices

The prices of pine pulpwood in Finland, Norway and Sweden steadily grew during the whole analysed period until the end of 2008. Then, prices fell during 2009. However, they did not fall lower than in 2006. By comparison, the development of prices in Lithuania was exceptional with a rapid threefold rise during one year from September 2006 to September 2007, followed by the same sharp fall in prices (Fig. 36).

The development in the prices of spruce pulpwood was similar. An exceptional development was seen in Finland with a rapid increase in prices during 2007 and a fall during 2008. The same development was seen in Lithuania (Fig. 37).

The development of the price indices for birch pulpwood were similar to those for spruce pulpwood with a peak in Estonia and Lithuania in 2007. The prices for birch pulpwood also fluctuated in Finland and Norway in comparison with spruce pulpwood (Fig. 38).

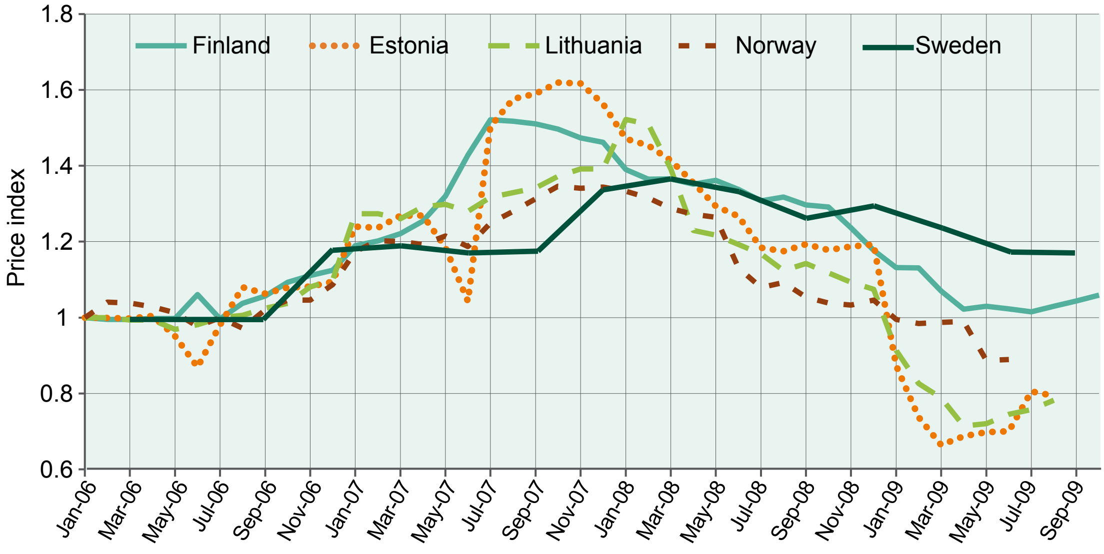

Figure 33. Development of the price indices of pine logs.

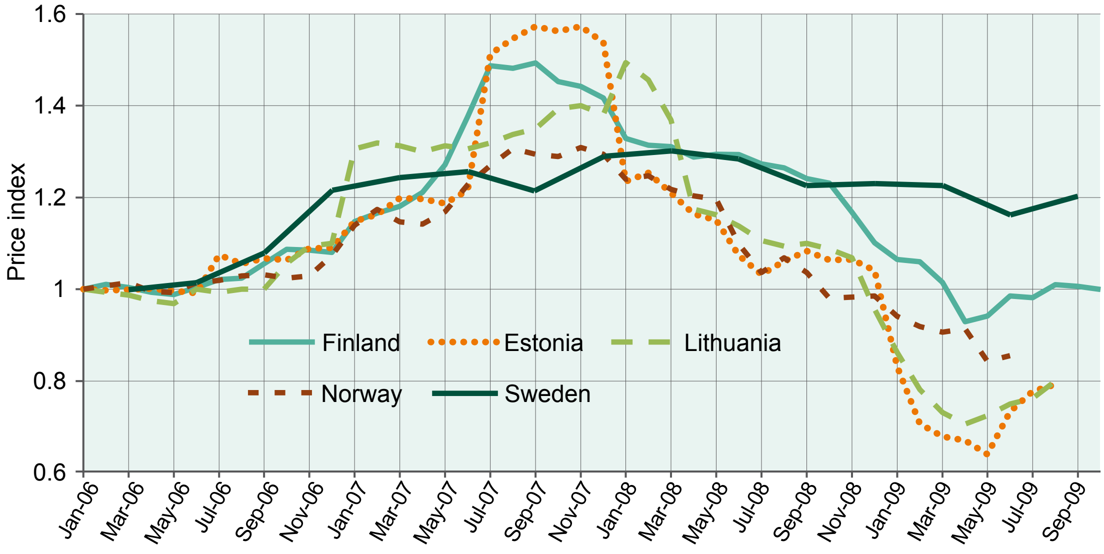

Figure 34. Development of the price indices of spruce logs.

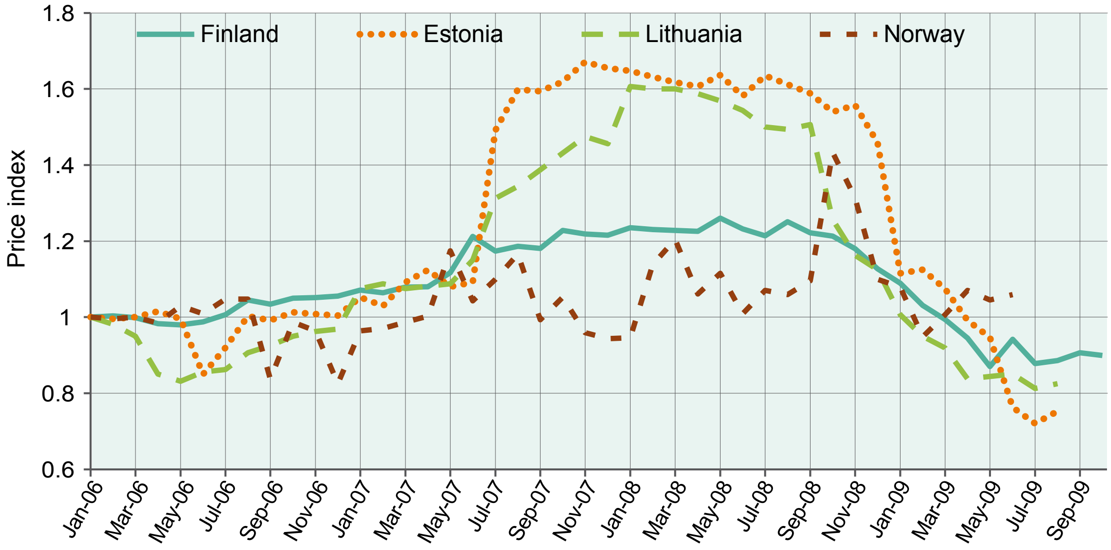

Figure 35. Development of the price indices for birch logs (for Norway only broadleaves were reported).

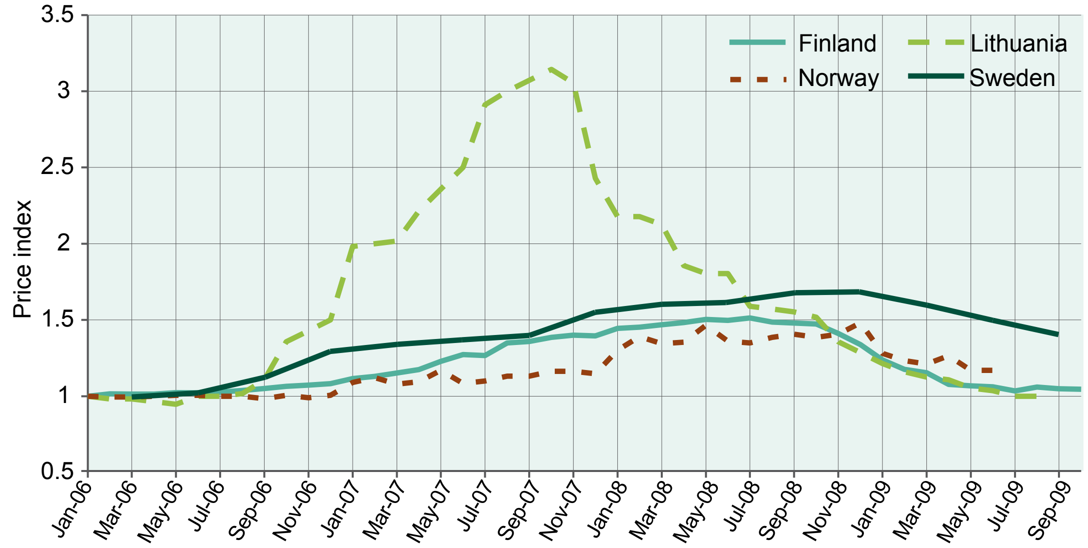

Figure 36. Development of the price indices for pine pulpwood.

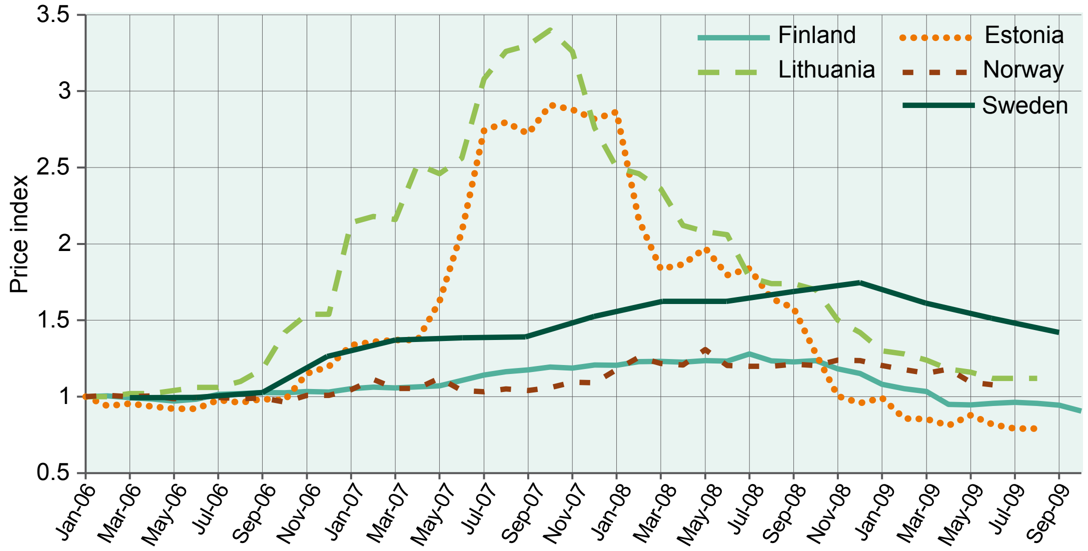

Figure 37. Development of the price indices for spruce pulpwood.

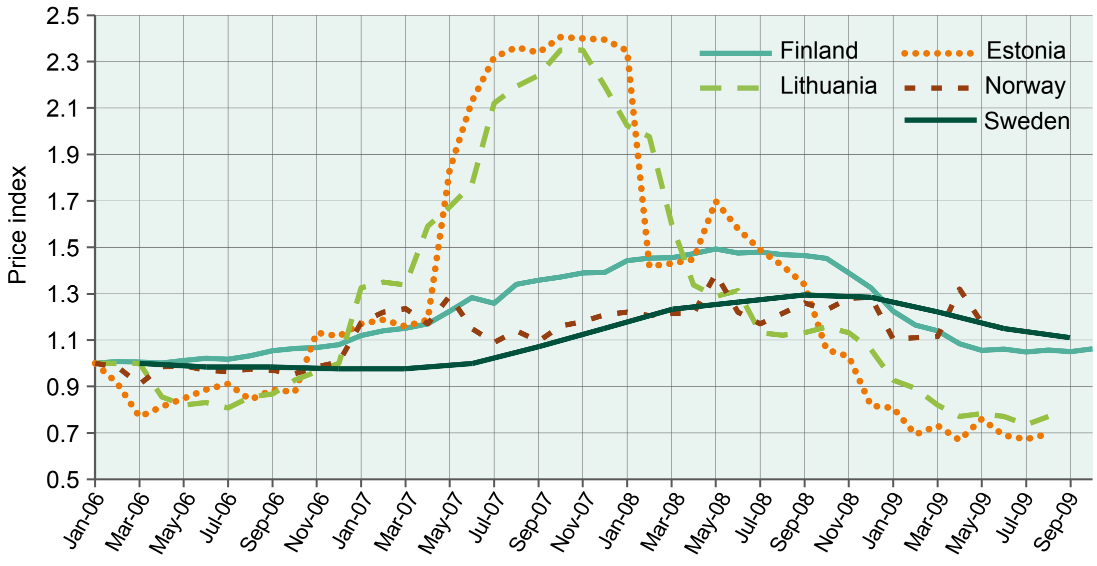

Figure 38. Development of the price indices for birch pulpwood (for Norway, only broadleaves were reported).

6 Conclusions and recommendations

These studies on European forest resources were conducted more than 10 years ago. Substantial structural, organisational and policy changes have since been made not only in the forest sector but also in other sectors related to forestry, such as in agriculture, environment and energy. Changes in countries in Central and Eastern Europe and the former USSR during the transition period and the increased use of forest biomass for energy production are the most important changes. In addition, the global economic crisis in the past few years has severely affected the forest sector in Europe. Most of the data series used in the EFSOS models were collected in the 1990s. Therefore, those changes had some impact on the accuracy of the predictions, especially since 2006, when the first impact of the global financial crisis appeared. The results of this study allow us to conclude that after the recovery of the economy new models and predictions of forest sector development will be needed.

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