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Comparison of Nordic and Central European Forests for their Socio-economic Functions and Measurement Methods

DIPLOMA THESIS

2017 Sami Ukkonen

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Abstract

Name: Sami Ukkonen

Topic of diploma thesis: Comparison of Nordic and Central European Forests for their Socio-economic Functions and Measurement Methods

Abstract: This work is focused on the collection of theoretical and internationally agreed-upon information on the range and sources of socio-economic functions and benefits provided by forests and subsequently on the comparison of these functions within set groups of Nordic and Central European countries. The countries chosen for these groups were Finland, Sweden, Norway, Czech Republic, Slovakia and Austria. Simultaneously was examined if there exists nationally or regionally different approaches on how these and other forest functions are typically measured or evaluated in general.

Through a review of literature and multiple national and international statistical compilations was obtained both quantitative and qualitative data regarding the forests, forest policies and forest industries of each country observed. This information was placed within the frames of internationally acknowledged Criteria & Indicator standards for the "Maintenance of socioeconomic functions and conditions". Afterwards these standards were then used accordingly as the basis for the comparisons made.

Overall it was found, that some of the main characteristics of the socio-economic functions and benefits of forests proved relatively similar in the two regions, particularly from the social point of view and management-related goals and objectives in each country. Main differences were more identifiable through the economic aspects of forest functions, but mostly on national and not so much on regional level. The significance and value of local forest-based industries combined with the political and historical background and cultural traditions of each country contributed strongly towards many of the observed differences. Noticeable discrepancies on the methods of measurement of the forest socio-economic functions were found relatively few and trivial among the countries studied. Significantly different, nationally individual approaches to evaluate forest functions in general could not be identified outside of the Czech Republic.

Key words: forest functions, socio-economic functions, Nordic countries, Central Europe,

Abstrakt

Jméno: Sami Ukkonen

Téma diplomové práce: Srovnání socio-ekonomických funkcí lesů severní a střední Evropy a metody měření

Abstrakt: Tato práce je zaměřena na sběr teoretických a mezinárodně uznávaných informací o socio-ekonomických funkcích a výhodách, které lesy poskytují, a následně na srovnání těchto funkcí v rámci skupin severských a středoevropských zemí. Zvolené země v těchto skupinách jsou Finsko, Švédsko, Norsko, Česká republika, Slovensko a Rakousko. Současně bylo zkoumáno, jestli existují národně nebo regionálně různé způsoby, kterými jsou tyto funkce měřeny nebo hodnoceny.

Posouzením vybrané literatury a několika národních i mezinárodních statistických výkazů byly získány kvantitativní i kvalitativní údaje o lesích, lesnické politice a dřevařském průmyslu v každé zemi. Tyto informace byly zpracovány použitím mezinárodně uznávaného nástroje "Kritéria a indikátory trvale udržitelného obhospodařování lesů". Tyto normy poté posloužily jako základ pro provedená srovnání.

Celkově bylo zjištěno, že některé z hlavních charakteristik socio-ekonomických funkcí a výhod lesů jsou relativně podobné v obou regionech, a to zejména z hlediska řízení cílů a sociálního. Hlavní rozdíly byly více viditelné skrze ekonomické aspekty funkcí lesa, ale spíše pouze na národní a ne tolik na regionální úrovni. K rozdílům přispěl především dřevařský průmysl v kombinaci s určitou politickou a historickou minulostí a take kulturní tradice každé země. Znatelných rozdílů týkajících se metod měření socio-ekonomických funkcí lesa bylo nalezeno relativně málo a byly poměrně nezávažné. Významně odlišné metody na zhodnocení daných funkcí, než které jsou použity v České republice, nebyly u ostatních zemí identifikovány.

Klíčová slova: lesní funkce, socio-ekonomické funkce, severní Evropa, střední Evropa,

List of abbreviations

C&I – Criteria & Indicators of Sustainable Forest Management

FAO – Food and Agriculture Organization of the United Nations

FRA – Global Forest Resources Assessment

FTE – Full time equivalent

GDP – Gross Domestic Product

JWEE – Joint Wood Energy Enquiry

KSLA – Kungliga Skogs- och Lantbruksakademien (Royal Swedish Academy of Agriculture and Forestry)

MCPFE – The Ministerial Conference on the Protection of Forests in Europe

MTOE – Million tons oil equivalent

NACE – Statistical classification of economic activities in the European Community

NP – National Park

NR – Nature Reserve

NCA – Nature Conservation Area

NWFP – Non-wood forest product

OEC – The Observatory of Economic Complexity

RWE – Roundwood equivalent

SFM – Sustainable forest management

TEEB - The Economics of Ecosystems and Biodiversity

TPES – Total primary energy supply

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1. Introduction

Forests have for long been recognised as multifunctional and multi-purpose resources, but a mostly mono-functional, production-oriented view of forests dominated across industrially developed countries during the 20th century. In many ways, multifunctionality has only recently re-emerged as the new rationale for forests and forest management. (Slee, 2005) Typically the idea of forest multifunctionality has also been linked with the approach of sustainable forest management, as in both concepts the forest lands are managed with the goal of receiving services and goods through more than one forest function simultaneously. (Sabogal et al. 2013) From a socio-economic perspective, it has become desirable to unpack and attempt to measure the wide range of values associated with forest multifunctionality. (Slee, 2005)

In order to measure a country's progress towards the implementation of multifunctional and sustainable forest management, it is necessary to regularly monitor changes in the outputs provided by forest management; in social and economic, as well as environmental, dimensions. The variety of social and economic benefits which forests can provide range from the relatively easily quantified, economic values associated with concrete forest products, to the less tangible services and contributions to society, such as health, well-being and recreation. (FAO, 2005b)

In 2015, the countries of the European Union encompassed more than 182 million hectares of forests and other wooded lands, corresponding to some 41 % of its total area and approximately the same proportion of land area which is used for agriculture. (Eurostat, 2016) Concurrently, forest-based industries constitute one of Europe's largest industrial sectors, accounting for around 10% of European manufacturing industry's total value of production, value-added and employment. (European Commission, 2003)

The European forest sector as a whole however is not homogenous, as major discrepancies exist between different countries and regions regarding how forests are utilized, managed and valued, and how they in return benefit the societies surrounding them. (UNECE, 2011a) The evaluation, maintenance and monitoring of these socio-economic functions has become a subject of increased international interest and attention,

leading to their inclusion in internationally used policy instruments and tools of monitoring, such as "Criteria & Indicators of Sustainable Forest Management" (C&I).

For these reasons, the main objectives and aims of this work (more specifically explained in the following chapter) are focused on the examination of socio-economic functions of forests in Europe, with a specific focus on two groups of countries from different regions. The first group, representing the Nordic countries of Europe includes Finland, Sweden and Norway, while the second group representing Central European countries includes the Czech Republic, Slovakia and Austria. Both regions have significant forest resources and in general the forest sector is relatively more important to local economies (i.e. higher percentage of GDP) in Northern Europe and Central-East Europe, than rest of Europe. (Forest Europe, 2015)

The reasoning behind choosing these six particular countries to represent their regions was based on many factors. All the countries have medium-sized populations, ranging from 5 to 10.5 million inhabitants, while regionally they have relatively same-sized, comparable land areas and overall high total forest covers. This results in at least somewhat comparable forest resources. Choosing instead for example the small and agriculture-focused Denmark to represent Nordic countries or the massive land areas and forest resources of Germany to represent Central Europe would have resulted in too much skewing of the results. Inclusion of only three countries in both groups was also done to avoid from bloating the scope of the work too wide and unmanageable.

The work begins with a review of literature, to establish a basis on the commonly agreed-upon theory and information regarding the socio-economic functions of forests. It then proceeds with the literature- and statistics-based acquisition of both quantitative and qualitative basic information regarding the forests, forest policies and forest industries of each country observed. Comparisons are conducted using appropriately selected methodology, while obtained results are analyzed and conclusions made through own and outside observations. The socio-economic functions which are evaluated from these countries cover both quantitative and qualitative factors. The main overhead topics assessed include forest ownership structures, contributions of the forest sector to national economies, employment provided by forests, consumption of forest products and the recreational and social values of forests.

2. Aims and objectives

The primary aim of this thesis is to determine through a comparison, if and how the forests of Nordic and Central European countries differ by the range of socio-economic functions and benefits that they provide for their surroundings or if there are significant similarities instead. A simultaneous, secondary aim is to observe if there are differences in how these particular functions are actually measured or evaluated in each of the countries studied. This is done especially for finding out if the differences in these methods could influence the perceived results of the primary comparison.

The main research objectives of this thesis are specific means which will help to achieve the given aims. The objectives will be divided as follows:

- Review literature to find commonly agreed-upon theory and information regarding the socio-economic functions and benefits of forests.
- Review literature and statistics to obtain sufficient information and quantitative data regarding the forests, forest policies and forest industries of each country studied for the better understanding of their socio-economic value and functions.
- Compare obtained statistical data and information between the two groups of countries and countries individually
- Obtain information and compare if the general methodologies and approaches used for the evaluation of forest functions differs in countries studied.
- Use own and outside observations to analyze the results and make conclusions.

3. Literature review

Forests and different forest products have a long history of cultural, economic and ecological importance in the Nordic countries of Europe. They provide for total national revenues through advanced forest industries, they provide places and means of recreation that are utilized by majority of inhabitants and they provide better quality environment and living possibilities. Similarly as in Nordic countries, forests of most Central European countries hold long-standing historical importance in regards to culture, ecology and economies, but perhaps in some cases to a lesser degree.

For the purposes and goals of this thesis, the first chapters of the literature review will be used to identify and explain some key-terminology regarding the concept of forest functions – how they relate to humans and activities of humans, in what ways are they important and what are the socio-economic functions of forests. The latter chapters, from 3.6 onward, are used to identify and depict the general features of forests, forestry and forest industries in the countries to be compared: Nordic countries of Finland, Sweden and Norway and the Central European countries of Czech Republic, Slovakia and Austria. Topics that are covered, such as forest resources, forest ownership structures, economic contributions of the forest sector and the social & recreational uses of forests, will be of particular importance in regards to the main objective of the thesis – comparing the forest socio-economic functions of different nations and how they are being assessed or measured.

3.1 Ecosystem services and goods

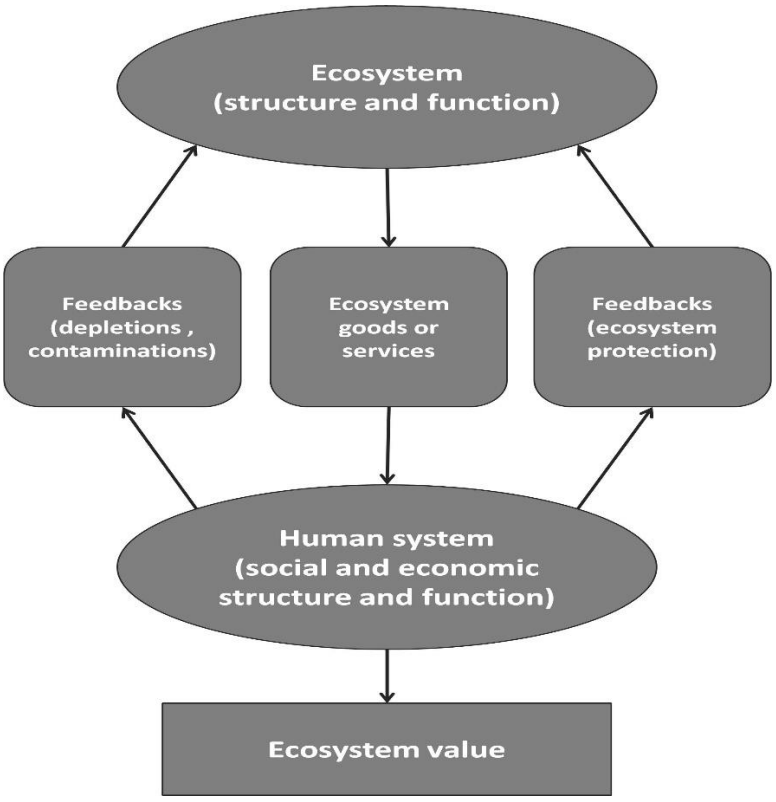
Ecosystems services as a concept, signify all the direct and indirect contributions of the world's different ecosystems to human well-being, survival and quality of life. While similar concepts have been discussed by scientists and environmentalists for decades, the currently accepted concept was especially popularized by the Millennium Ecosystem Assessment, called for by the United Nations and published in 2005. By this assessment the world's ecosystem services were grouped into four broad categories:

1. Provisioning, such as the production of food and water
2. Regulating, such as the control of climate and diseases

3. Supporting, such as nutrient cycles or crop pollination
4. Cultural, such as spiritual and recreational benefits.

(Meijaard et al., 2011)

Being a vast and general concept, ecosystem services are often all lumped together by these categories, but especially for certification reasons and simple clarity, they should be differentiated also from ecosystem goods. More precisely defined, ecosystem services are typically the processes that nature provides, such as purification of water, while the goods are the tangible outputs of these processes, for example clean water. Somewhere between ecosystem goods and services are the cultural values of ecosystems. They cannot be exactly identified as either goods or services, but are of clear importance in how we regard and value ecosystems. (Meijaard et al., 2011)



Picture No. 1 Relationships between the ecosystem and the human systems in ecosystem valuation. (Brown et al., 2006)

To help inform decision-makers, many ecosystem services and goods have been assigned economic values, but naturally valuation such as this in most cases can be a difficult and controversial task. Particularly agencies in charge of protecting and managing natural resources must often make hard decisions regarding spending that may involve tradeoffs in resource allocation. All such decisions are economic ones and as such they are based on society's set values. Therefore economic valuation can provide useful means to justify and prioritize policies, programs and actions regarding protection or restoration of ecosystems and their services. (King & Mazotta, 2000)

3.2 Forest ecosystem functions

Forest ecosystem functions are a major source in the provision of many important ecosystem services and ecosystem goods to humans. Forests perform a large number of different functions both through natural occurrences and formation, but also as a product of conscious human activity. Traditionally, the functions provided by forests have been included into three major categories – productive, protective and social functions. The total value of each such particular functions are always limited and an increase of one will often happen at the expense of the others. Simultaneously however many functions are also dependent on each other and their success may tightly be linked together. (Skurczak et al., 2014)

While in the past timber supply used to be the main focus of resource assessments, nowadays the concept of forest productive function has extended to include all types of wood and non-wood forest products. A large variety of products produced by the forests are extracted for use, ranging from timber and fuelwood to foods such as berries, mushrooms, edible plants and game meat, animal fodder and other non-wood products. By quantity however industrial roundwood and fuelwood are still today the most significant products. (FAO, 2010a)

In the earlier times the assessment of forest resources was typically focused only on the productive function. Concern for the environment and increased awareness of the public has led many countries to also acknowledge the importance of also the protective functions and environmental services provided by forests. The world's forests provide many protective functions, on both local and global scale - with their influence on climate being the most important one. Globally they have a very significant role within the carbon

cycle, acting as carbon sinks and significantly slowing down and lessening the effects of global warming. Locally they provide shade and absorb heat-energy during warm seasons, while during cold they obstruct and deflect wind. Other than the climatic influence, the protective functions also include for example protection from wind erosion, air-pollution filtering and protection of water resources from pollutants, erosion and such. (FAO, 2005a)

Forests create an environment that is favorable to human health, recreation, inspiration and one that can have both spiritual and cultural values. With the help of their productive functions they also enhance local labor markets, providing employment and income. These are some of the social functions of forests. The values and occurrences of different forest social benefits vary greatly among countries, mostly depending on their traditions and development level. (FAO, 2005b)

In general it is extremely difficult to measure the total economic values of such non-productive forest functions and this is very much reflected by major variations among given estimates. It is however nowadays commonly agreed that the aggregate value of these functions far exceeds that of the productive functions. (Skurczak et al., 2014)

3.3 Sustainable forest management and multifunctional forestry

Related terms such as ‘sustainability’, ‘sustainable development’ and ‘sustainable use’ are commonly used in literature regarding modern forest management and conservation, but often they are used without specific definition. One such definition for sustainable forest management was developed by the Ministerial Conference on the Protection of Forests of Europe, held in Helsinki, Finland in 1993. Sustainable forest management was then defined as:

“*The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems*.” (MCPFE, 1993)

This definition was later also adopted as official by the international Food and Agriculture Organization. More simply conveyed, the concept can be seen as the

search for balance between society's demands for forest products and benefits while also preserving the health and diversity of the forests now and in the future.

Typically the concept of sustainable forestry is also strongly linked with the idea of multifunctional or multi-use forestry as in both concepts the forest lands are utilized in ways that they should contribute with many services or goods through more than one forest function simultaneously. Via successful planning of multifunctional forestry and sustainable management principles, the integrated benefits of multiple forest functions can simultaneously be relayed to surrounding localities and their inhabitants. (Sabogal et al. 2013)

3.4 Concept of socio-economic functions of forests

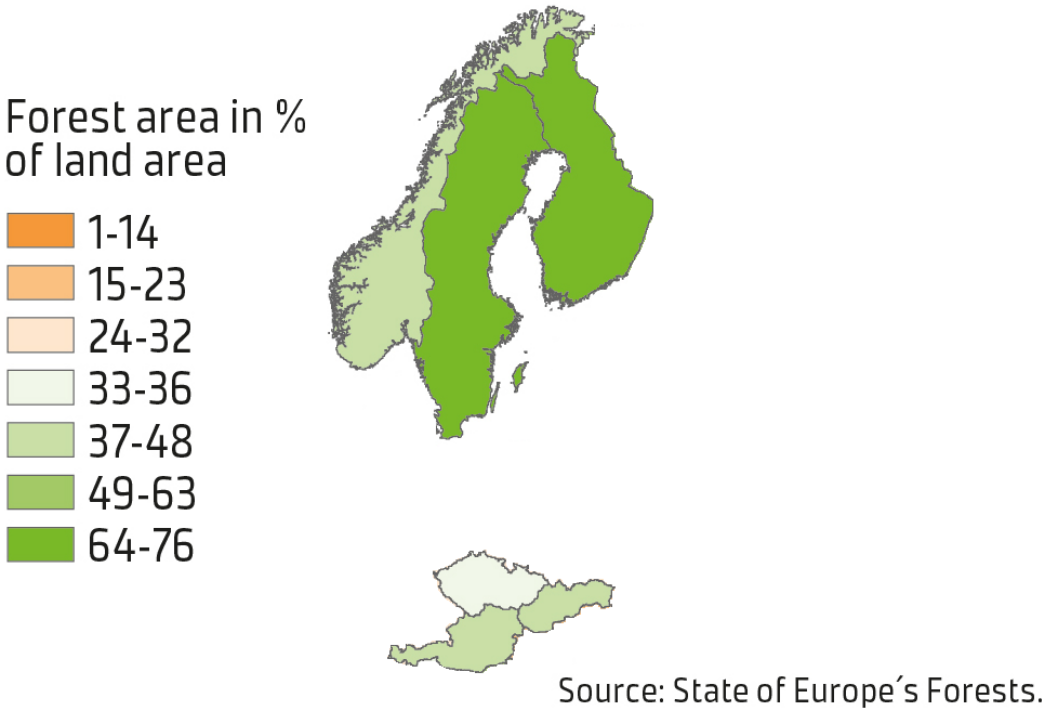
Through their aforementioned, varied productive and social functions, forests provide a large range of both social and economic benefits to societies and people. These benefits vary from quantifiable economic contributions of forests, such as revenues, processing and trade of forest products and energy, to the much less measurable social values, such as contributions and services to society and protection of sites with high cultural, spiritual or recreational value. (FAO, 2005b) Economic aspects are usually measured in monetary terms and information is routinely collected about them, but measuring of social or socio-economic benefits is more challenging - data is often scarce and there is often no clear definition of what exactly should be measured.

Despite frequent referral to socio-economic benefits or functions of forests in many publications of today, a clear and common agreement of what exactly is their definition is lacking. The combination of the words social and economic into a single word 'socio-economic' essentially acknowledges the inter-relatedness of social and economic values. (Slee, 2005) One simplified definition given by FAO is "the benefits to society of economic activity". (FAO, 2014b)

The economic activity is the production of all goods and services in a country and is usually measured as the gross domestic product (GDP). But when referring to "socio-economic benefits", it is required to reverse the perspective; rather than production, the consumption of the goods and services becomes the main focus of interest and the contribution of a sector to socio-economic function can be very different than its share of

GDP. Agriculture provides perhaps a clearer example of this difference than forestry. Agriculture often accounts only for small proportions of GDP, but delivers significant benefits to society by feeding local populations and sustaining often less developed rural areas. (FAO, 2014b) This does not however exclude an industry's share of GDP from also being a potential indicator of its socio-economic value.

3.5 Forest cover and resources



Picture No. 2: Forest area in percent of land area from countries observed. (Natural Resources Institute Finland, 2012)

3.5.1 Nordic countries

From industrialized countries with notable populations, Sweden and Finland are the ones with the most extensive forest covers in the whole world. (World Atlas, 2016a) As such, Finland is Europe's most forested country, with a forest cover of more than 73% of its land area and totaling approximately 23 million hectares. By Finland's own land usage classification, even up to 86% of all land areas are designated for forestry usage, while the rest include built areas, agricultural areas etc. These figures include also poorly

productive areas, where the annual growth is between 0.1 and 1 cubic meters (m^3), but a majority of Finnish forests still grow on productive forest land which amount to a total area of 20.3 million hectares. (Ylitalo, 2012)

In the year 2015, the entire growing stock volume on Finnish forest lands (including the poorly productive forest lands) was estimated at 2356 million m^3. (Ylitalo, 2015) The annual increment of growing stock on these same areas is approximately 105.5 million m^3, while the entire annual drain amounts to approximately 79 million m^3. As the growth consistently exceeds drain, Finland's forest resources are growing rapidly and all the time. (Väkevä, 2015)

Sweden, as mentioned, has similarly vast forest resources. Approximately 69% of the country's land area, a total of 28.2 million hectares is considered forested land by international definitions. 23.2 million hectares of these lands are considered productive forest lands similarly as in Finland. (Christiansen, 2014) According to a country report on Sweden, commissioned by FAO regarding forest genetic resources, in 2011 the total standing volume of Sweden's growing stock was roughly 3400 million m^3 and approximately 2900 million m^3 of that was within productive forest lands. The total annual increment within productive forest lands was estimated approximately 111 million m^3 and 117 million m^3 within all land areas, while the annual fellings amount to between 80 and 90 million m^3. (Black-Samuelsson, 2011)

Compared to its neighboring countries, Norway's forest cover and resources are slightly lesser, however still significant. The total area covered by forests or otherwise wooded land constitutes approximately 39% of the country's entire land area, totaling around 13.4 million hectares. From this, roughly 8.3 million hectares are on productive forest land. (Skrøppa, 2011)

In the National Forest Inventory of 2011-2015, the total growing stock of Norway's forests was estimated to be around 942 million m^3, with a yearly increment of 26 million m^3. (Steinset, 2016) According to the Norwegian Forest and Landscape Institute, the annual increment has already for many decades considerably exceeded the annual harvest, resulting in a massive increase of forest growing stock over time. (Skrøppa, 2011) The annual drain amounts only to around 10 million m^3. (Amundsen, 2014)

The substantially lesser forest cover and growing stock of Norway, in comparison to Sweden and Finland, is mainly a result of the geographic and topographic features of the country. The vast mountainous and non-arable areas of the Scandinavian Mountains make up the majority of all Norway's land area and as such, the higher altitudes and rougher climate conditions significantly reduce the growth potential of forests. (Skrøppa, 2011)

3.5.2 Central European countries

If compared to Nordic countries, smaller land areas and much more active transformation of forests into agricultural areas over centuries has significantly reduced the forest covers and standing stocks of these Central European countries. However, similarly as in Nordic countries, development and growth of forest resources within recent decades has been very positive due to changed attitudes and better, more knowledgeable and sustainable management. It is also to be noted that while the resources overall seem considerably smaller, the forests of Central Europe grow significantly larger and faster, often resulting in shorter cycles and larger volumes per hectare.

According to the Czech Ministry of Agriculture, in 2015 the Czech Republic had a forest area of 2.67 million hectares, a third of the country's total land area, and an estimated 692 million m^3 of growing stock. The total area has been annually in constant increase thanks to active afforestation efforts of new land, but also simply due to improvements on precision of Land Register data. In 2015 the raw timber harvest totaled approximately 16.16 million m^3, which was even 0.68 million m^3 more than the previous year total due to a substantial amount of salvage fellings. The total annual increment in recent years has been consistently well above 21 million m^3. (Krejzar, 2015)

The area of forests in Slovakia has also steadily increased over the last few decades and forested stands covered a total area of approximately 1.94 million hectares in 2011, which equals 41% of all land areas in the country. The total growing stock was 466 million m^3 with an annual increment of 12 million m^3, while felling amounts fluctuated between 9 and 10 million m^3 in recent years. Although the amount of increment has been consistently above 10 million m^3 since 1990, the amount of fellings have more than doubled since then, which implies an increased value of forestry as an industry. (Ambrušová et al., 2013)

Of the three Central European countries addressed, the most forested one is Austria. Austria is covered by 3.92 million hectares of forest, representing more than 47% of the country's surface area. (Angelstam et al., 2005) According to the latest conducted Austrian National Inventory (2007/09), the entire growing stock of Austrian forests was 1135 million m^3. The incremental growth totaled to 30.4 million m^3 while the timber utilization rate in the same inventory was estimated at 26 million m^3 annually. (Foglar-Deinhardstein et al., 2015)

3.6 Forest ownership structure

Ownership of forests is generally seen as a key factor influencing forest land management and protection. Across the globe, as well as in Europe, the ownership has been gradually changing in most countries – shifting increasingly from the state to local communities and to individual households through privatization and resulting in an increasing complexity of stakeholder relations. (Forest Europe, 2015)

The total number of forest holdings, average sizes of holdings and nature of ownership are assumed to have major implications regarding forest management and various other socio-economic circumstances. However, these relationships typically vary across countries, depending on the level of development and other several factors that have not yet been fully investigated. (Forest Europe, 2015)

Studies have indicated that, in general the volume of market-based goods, such as timber, provided by private forests far exceeds their share of land ownership, suggesting significant economic benefit and employment particularly to populations in rural areas. Meanwhile public lands produce more fuelwood and multiple use goods and services. The environmental performance of private forests in terms of forest management plans, forest certification, and compliance with forest regulations appears to compare to that of public forests. (Forest Europe, 2015)

3.6.1 Nordic countries

Especially in Northern European countries, forest ownership is typically considered a very important social indicator. Aside from telling us about the structure of ownership, it can also serve as an indicator of well-being and employment of populations

in rural areas and the sustainable development of these same areas. (Finnish Forest Research Institute, 2011)

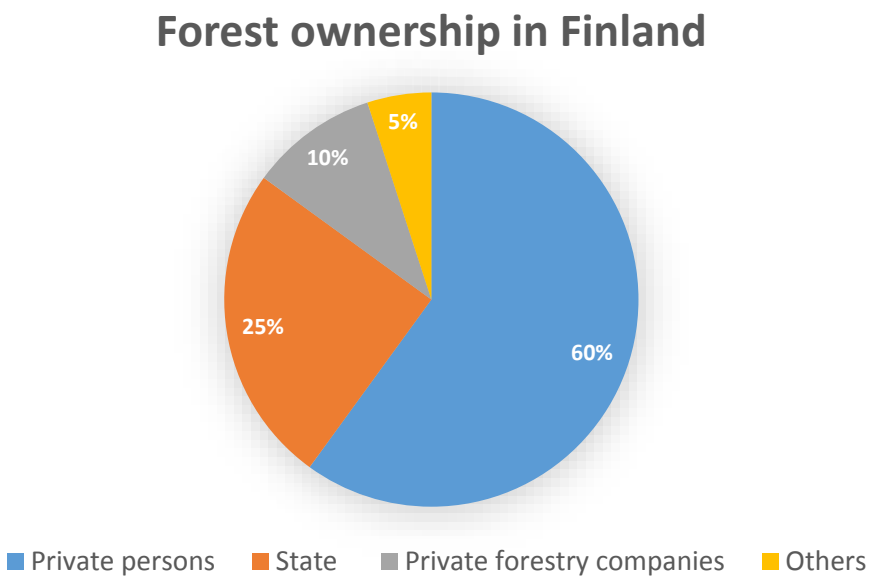


Chart No. 1: Forest ownership structure in Finland.

In Finland private people own roughly 60% of all the forest lands. The state owns 25%, large, private forestry companies some 10% and the remaining 5% are owned by municipalities and parishes. (Finnish Forest Research Institute, 2014) In total, there are some 632 000 individual forest owners in Finland, when all those owning forest either jointly or at least more than 2 hectares individually are counted. This means approximately 14% of the entire population are forest owners. The average size of these private forest holdings is 30.1 hectares. (Finnish Forest Association, 2016a; Živojinović et. al, 2015)

The state-owned forests of Finland are managed by state forest enterprise Metsähallitus. They are mainly located in the lower productive regions of Northern and Eastern Finland and 45% of these holdings are under strict protection. As a result of this the private forest owners have a key role in the material procurement of forest industries, as more than 80% of all wood utilized within industry comes from them. (Finnish Forest Research Institute, 2011)

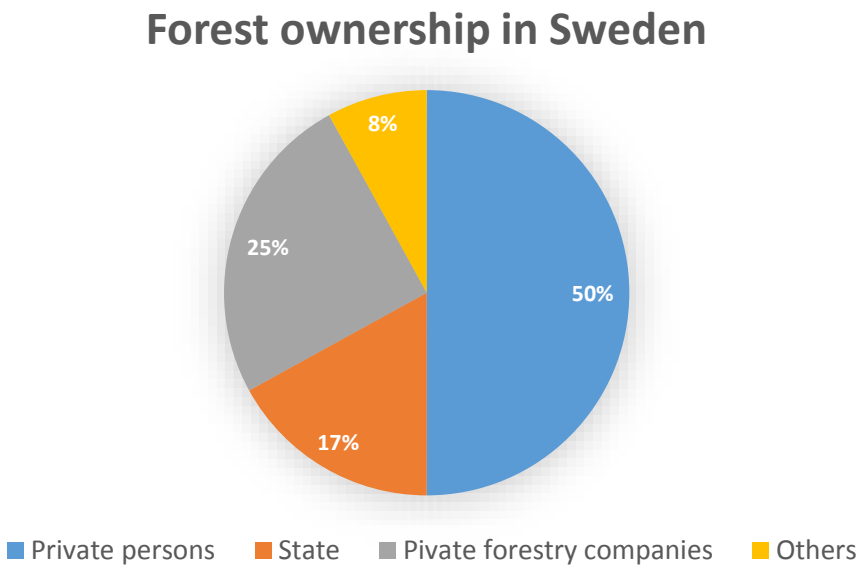


Chart No. 2: Forest ownership structure in Sweden.

In Sweden, the ownership structure is a lot similar to the Finnish one, with the main difference being a smaller role of state-owned forests and an increased role of private sector companies. Private individual forest owners hold approximately 50% of all productive forest areas while the state owns about 17%, from which 14% is managed by the state forest enterprise Sveaskog. Private sector companies have some 25% holdings and the remaining 8% are held by other private or public owners, such as counties, the Swedish Church and many non-profit organizations. (KSLA, 2015; Živojinović et. al, 2015)

The average private forest holding size in Sweden is about 50 hectares but the variation of size is great. More than 200 000 families with forest holdings greater than 5 hectares make up the majority of private forest ownership, while in total there are some 350 000 private owners. Similarly as in Finland they are the most important source of wood procurement for the industry. (KSLA, 2015; Swedish Forest Industries Federation 2012)

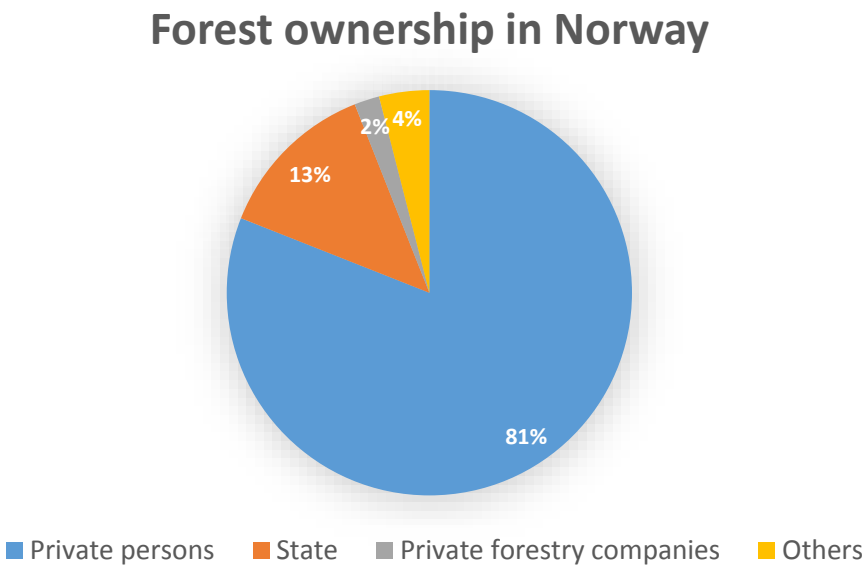


Chart No. 3: Forest ownership structure in Norway.

In Norway the portion of private ownership is by far the highest in Nordic countries, with 81% of all productive forest lands being privately held. With state and municipalities owning 13%, the share of land owned by forestry companies is only 2% and other private forest holdings such as non-profit organizations have the remaining 4%. Majority of state-owned forests is managed by state forest enterprise Statskog. According to Norwegian Forest Owners' Federation, in 2013 the privately owned forests were owned by approximately 129 000 individuals with forest holdings larger than 2.5 hectares. The average size of a forest holding was 54 hectares. (Živojinović et. al, 2015; Norwegian Forest Owners' Federation, 2014; Statistics Norway, 2016)

3.6.2 Central European countries

Between the three observed Central European countries, there are notable differences in the forest ownership structures, much more so than in the Nordic countries observed. In comparison to Nordic countries in the Czech Republic and Slovakia particularly the role of the state as a forest owner is more significant while the share of private owners are diminished. On the other hand, in Austria the trend is exactly opposite, with a large majority of forests being owned by private companies and private individuals.

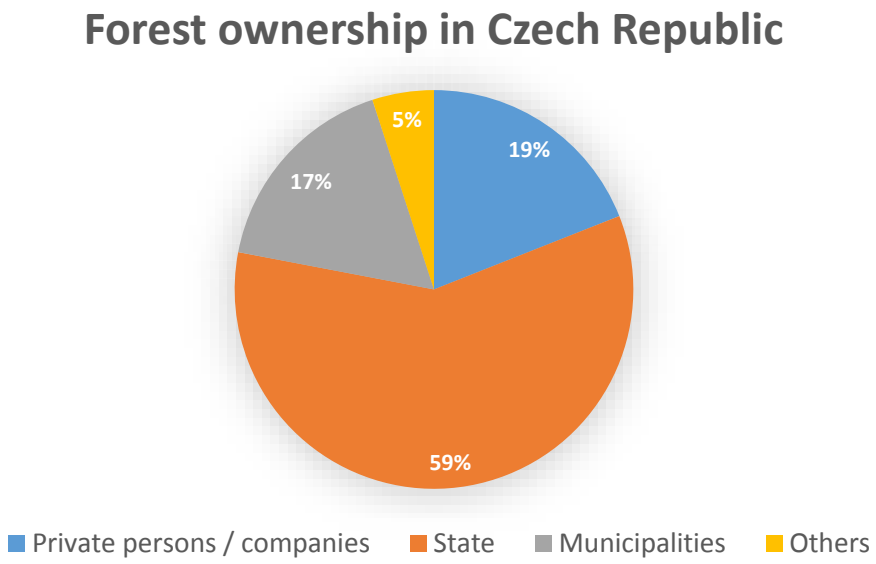


Chart No. 4: Forest ownership structure in Czech Republic.

As mentioned, in the Czech Republic most of the forest lands are owned by the state and predominantly managed by Lesy České Republiky. In total the forests owned by state amount to more than 59% of all. Other managers of state forests include for example the military, Ministry of Environment and regional operators such as secondary schools. Private individual owners make up the next largest group of forest owners, with slightly more than 19% share of forest holdings and municipalities own approximately 17%. The remaining areas belong mostly to other public or private entities such as churches, cooperatives and associations. (Krejzar, 2015; Živojinović et. al, 2015)

According to the Association of Municipal and Private Forest Owners in the Czech Republic there are some 150 000 private forest owners in Czech Republic and the average size of their holding is 3 hectares. For municipalities the average size of forest property is 78 hectares. (Růžková, 2013)

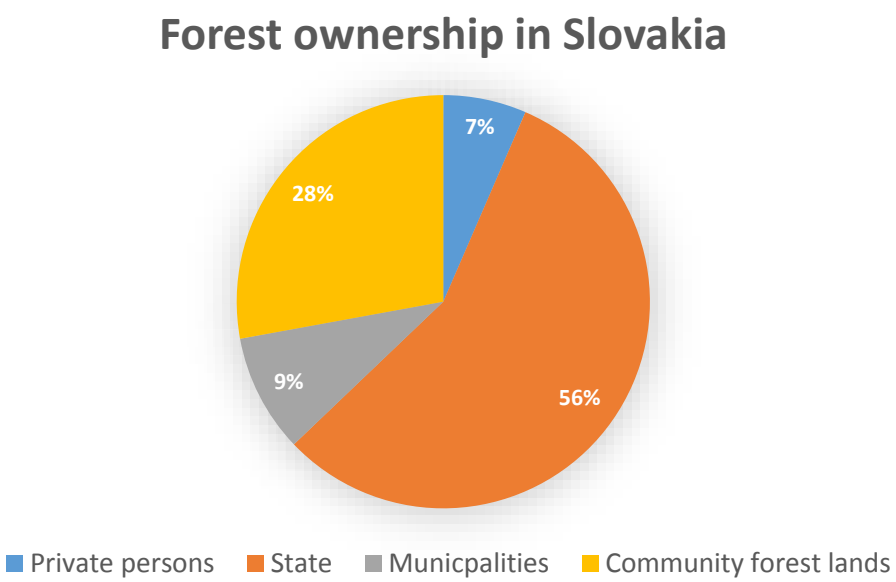


Chart No. 5: Forest ownership structure in Slovakia.

In 2010, the Slovakian state forest enterprise was managing 55.4% of the country's total forested areas, however it held property rights to only 40.9% of these. This situation is caused by the state's role in managing also forests that are pending the restoration of their ownership rights, properties of unknown owners and those properties leased from non-state owners. (Ambrušová et al., 2013; Živojinović et. al, 2015)

Similarly as in the Czech Republic, the state forests are managed by multiple separate entities falling either under Ministry of Agriculture and Rural Development or Ministry of Defense. Municipalities and private individuals own only 9.1% and 6.4% of forest lands respectively while the second largest owner-group is the 'community forest lands', owning 27.4% of all forested lands. (Ambrušová et al., 2013) In 2009, the total amount of individual forest owners was estimated at 57 000. (Weiss et al., 2012) Community forests signify a property owned by many co-owners that cannot be divided, because these forests are supposed to be managed as a whole. (Živojinović et. al, 2015)

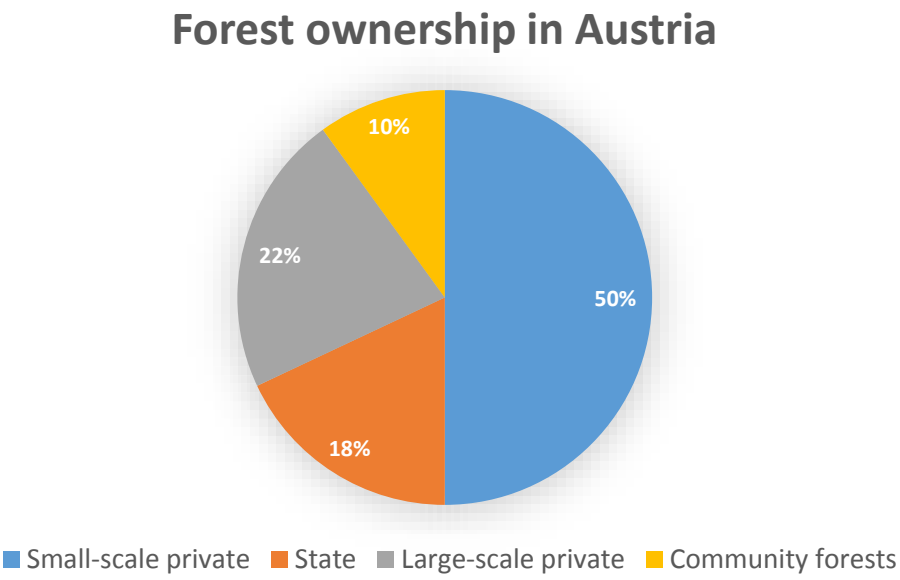


Chart No. 6: Forest ownership structure in Austria.

The forest ownership structure in Austria resembles more that of Nordic countries than its neighboring countries, as Austrian forests are managed above all by private forest owners. According to a FAO commissioned country report of Austria's forest resources and Austrian Forest Report 2015, the most frequent structure is small-scale private ownership of holdings less than 200 hectares, which makes up approximately 50% of all Austrian forests. These are held by some 145 000 individuals. (Foglar-Deinhardstein et al., 2015; Živojinović et. al., 2015)

Private forest holdings larger than 200 hectares are mainly in the ownership of some 1500 forestry enterprises, which account for about 22% of forest area and another 10% are classified as community forests. Austrian Federal Forests and some forest holdings of provinces and municipalities represent the Austrian publicly owned forests, with a share of 18%. (Foglar-Deinhardstein et al., 2015; Geburek et al. 2013)

3.7 Forest sector and the economy

The forest sectors and forest-based industries have been crucial and integral especially for the socio-economic development of Sweden and Finland, meaning in particular that these industries have been a major force driving the advancements and improvements of national economies. Originally rather poor and non-industrial countries,

largely thanks to forests they have evolved towards prosperity and have become major contributors in global wood and non-wood product markets. (Remröd, 1997)

Forests are still of major importance and significance for many European countries and this is reflected by socio-economic indicators such as the contributions of forest sector (including forestry and logging) to national gross domestic product or the role of industry in regards to foreign trade. Similarly the profitability of forest entrepreneurship, the employment rate provided (Graph No. 7) and the use of forest-based energy can also be used to gauge the industry's both economic and social importance. (Finnish Forest Research Institute, 2012a)

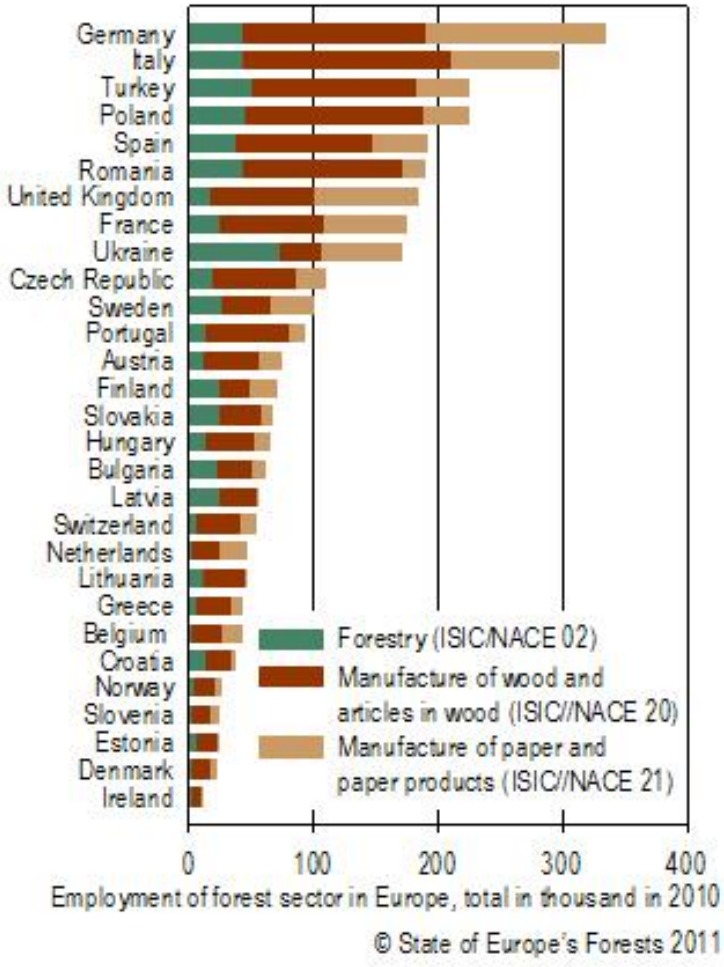


Chart No. 7: Employment provided by forest sector in Europe, 2010. (Natural Resources Institute Finland, 2012a)

Continued economic viability of forestry is in particular vital to maintenance of habitation, employment and entrepreneurship in rural areas, which are still abundant and vast in Nordic countries, but also in Central Europe to some degree. Because of this, forestry is often not only supported by several measures of regional policies such as mitigated taxation and government subsidies, but also structural funds of the European Union. (Finnish Forest Research Institute, 2012a)

The following sub-chapters will briefly focus on the economic significance of each national forest sectors and the forest related industries of the countries. Numbers regarding employment, exports and contributions of forest sector to national GDP are mostly estimates, gathered from multiple sources of varied dates due unavailability of collective recent data. As such, they are presented mainly as reference, not strictly accurate information. The share of forestry in national GDP does however correlate quite well with the estimates presented below (Graph No. 8), where the information was gathered as part of State of Europe's Forests in 2011.

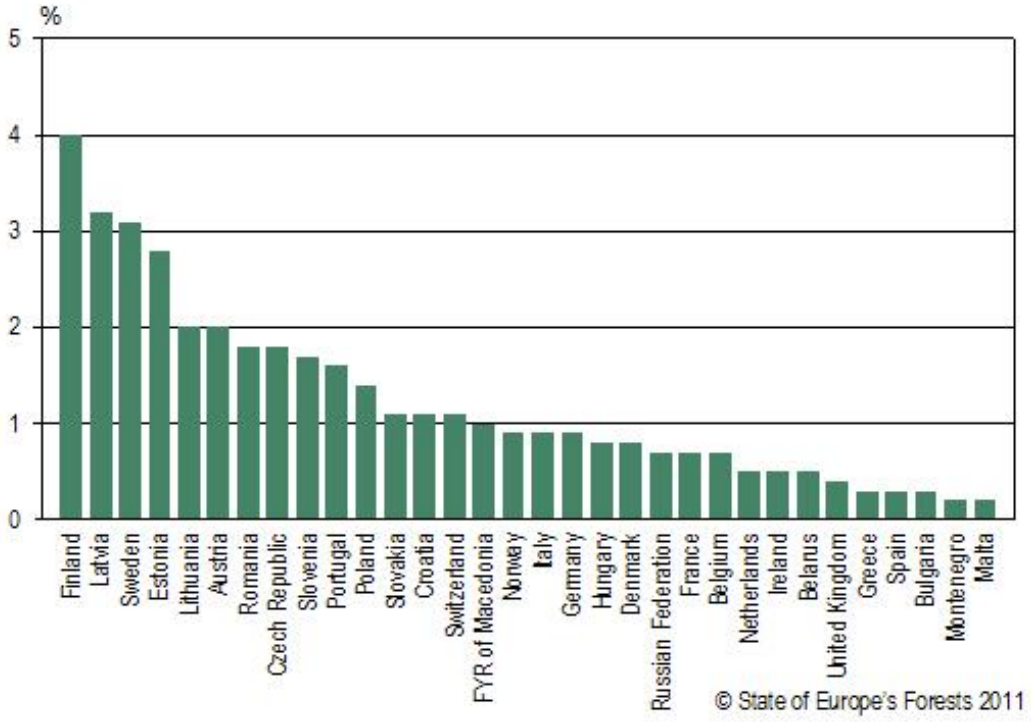


Chart No. 8: Forest sector share in national GDP in Europe, 2010. (Natural Resources Institute Finland, 2012)

3.7.1 Forest sector in the economy of Finland

The forest industry today is the main source of income for many of the regions in Finland. Around 50 paper, paperboard and pulp mills, 130 industrial sawmills and panel mills as well as many other wood product-based companies still operate in Finland, providing employment directly to more than 42 000 people. Approximately 20 000 work in the pulp and paper industry and 22 000 in the wood product industry. The amount of people directly employed by the whole forest sector, which also includes forestry and logging, is more than 70 000. The forest industry accounts for in total around 15% of the whole country's industrials jobs. (Salo, 2015; Finnish Forest Association, 2016b)

In addition to direct employment of forest industry, also some 9000 people are employed by furniture manufacturing industry and tens of thousands of other people are employed not directly, but somehow indirectly by the forest sector. (Finnish Forest Association, 2016b) It is very typical, that the chain of income that originally starts from the forest has vast indirect employment effects that may even exceed the direct effects in value. In 2013, Finnish forest industry operating abroad employed more than 46 000 in other countries, with 65% of these people working in other European Union countries. (Salo, 2015)

Main products of Finnish forest industry come from the chemical (paper and pulp) and the mechanical (wood products) forest industries. The chemical industry initially produces chemical and mechanical pulp and further processes it into paper and paperboard products. The mechanical industry includes all of sawn goods, plywood, other timber boards and their further processed products such as construction components or furniture. (Finnish Forest Association, 2016b)

The macroeconomic significance of forest-based industries in Finland is reflected by their relatively large portion of Finland's national gross domestic product. The contribution of the entire forest sector varies annually and depending on sources approximately between 4 and 5% of Finland's total GDP, worth more than 9.5 billion €. The industries' share in GDP is more than 3.5%, while regionally in rural areas even 15-20% of local GDP can be from forest-based industries. (FAO, 2014a; Finnish Forest Research Institute, 2012b; Kainulainen, 2011)

The forest industry is also heavily export-oriented, as over 90% of paper and paperboard and over 60% of sawn wood products are exported. 20% of the entire export

revenues of the country, in 2014 worth almost 11 billion euros, come from forest-based industry when including also furniture. As such Finland is the world's 4th biggest exporter of wood products. (Forest Europe et al., 2011, Kainulainen, 2011; World Atlas, 2016b)

3.7.2 Forest sector in the economy of Sweden

According to Swedish Forest Industries Federation, bulk of the country's forest industries are based on some 50 pulp and paper mills, 120 sawmills and 40 more companies which are members of the Federation. The total amount of companies is however somewhat higher. (Swedish Forest Industries Federation, 2016)

In the year 2013, 27 800 people were directly employed by companies producing wood and wood products, 29 000 were directly employed by companies producing paper and paperboard products and more than 10 000 by the other companies within the industry, bringing the entire workforce directly employed by industries around 70 000. (Christiansen, 2014; Swedish Forest Industries Federation 2016) With forestry operations included the number rises over 100 000, while together with all sub-contractors of forest operations including transport, the amount of people finding employment through forest sector is estimated as high as over 200 000. In several counties forest sector accounts to even 20% or more of all industrial employment. (KSLA, 2015)

Similarly as is in Finland, the main products of Swedish forest-based industry are pulp, paper, sawn timber and prefabricated wood construction materials. In 2015 the production volumes of these products were 11.6 million tons of pulp, 10.2 million tons of paper and 18.1 million m^3 sawn timber. (Swedish Forest Industries Federation, 2016)

The forest-based products industry in Sweden plays a major role in the economy of the country, as it accounts for between 9 to 12 percent of Swedish industry's total employment, sales and added value. In 2011 the whole forest sector accounted for around 3.1% of Sweden's total GDP and the forest industries' share was approximately 2.2%. (KSLA, 2015; Forest Europe et al., 2011; Swedish Forest Agency, 2011)

Sweden is the biggest producer of roundwood among European Union states and the world's 3rd largest exporter of pulp, paper and sawn timber. Close to 90% of all pulp and paper products and about 75% of all sawn products produced are exported. (Eurostat, 2016; KSLA, 2015) Currently the total value of Sweden's exported wood-

based products can exceed 13 billion euros annually, worth approximately 10% of all exports. (Swedish Forest Industries Federation, 2016)

3.7.3 Forest sector in the economy of Norway

Norway is perhaps not as well-known as its neighboring countries for its forest industries, but forests are still one of fairly meaningful sources of income for the Norwegian mainland economy, especially important they are for the employment of rural areas. Similarly as in Sweden and Finland, the industry is divided between the wood producing industry that produces sawn lumber and solid wood products, and the chemical, wood fiber-based industry that produces pulp and paper products. The Norwegian forest industry is also heavily export-oriented. (Nordic Timber, 2012)

In Norway there are some 225 industrial-scale sawmills, 36 different machines producing paper and board products and 17 production units producing chemical pulp. By 2014 these paper mills, sawmills and woodworking industry employed almost 16 000 people, while in total the entire workforce within the forest sector is estimated to be something over 30 000, equaling slightly less than 2% of total workforce from mainland Norway. The number of people working within the industry has steadily declined in past decades. (Nordic Timber, 2012; Hannerz, 2003)

By total gross domestic product in 2011, the share of whole forest sector in Norway was only 0.8% and the forest product industry 0.6%. For the economy of mainland Norway, when excluding the vast industries of petroleum production, natural gas extractions and shipping, the value of forest industries is noticeably higher with an approximate 1.6% share of GDP. In 2015 the export value of the forest industries amounted to approximately 1.2 billion euros, which equaled slightly less than 10% of total exports from mainland Norway. (Forest Europe et al., 2011; Hannerz, 2003; Rognstad et al. 2016)

3.7.4 Forest sector in the economy of Czech Republic

Wood processing industry is not a key industry of the Czech economy, particularly when compared to other manufacturing industries in volume of production, sales and revenue. It is regarded more among middle-sized sectors while more major sectors include for example engineering, car and electronics industries. Forest sector still occupies a rather irreplaceable position in the field of production and particularly employment. Paper and cellulose industries are also a promising and competitive sector of the manufacturing industry, particularly due to a wide range of foreign investors. (Czech Trade Promotion Agency, 2016)

According to Forest Europe's publication State of Europe's Forests 2015, the forest sector in Czech Republic was estimated to employ a total of some 86 000 people. 48 000 were estimated to be working in processing of wood and wood products, 24 000 among the pulp and paper industry and the remaining some 14 000 in roundwood production and procurement of forestry. People indirectly employed by forest sector should naturally be much higher, but no recent estimates of that were found. The total share of the Czech Republic's forest sector in relation to national GDP is about 1.8% and excluding forestry and logging operations 1.2%. The value of entire forest sector equals around 3.5 billion euros. (Forest Europe, 2015; FAO, 2014a)

Information or evaluations in English regarding the importance of forest sector exports to Czech Republic's total exports are scarce or mostly highly outdated. With the aid of "The Observatory of Economic Complexity"-website, it could be found out that in 2014 the total export values of "wood products" were $2.11 billion and of "paper goods" $3.17 billion, which would equal only some 3.3% of the entire national export value. In 2014 the most valuable exported wood products were rough and sawn wood, which are especially imported in high quantity to neighboring countries of Austria and Germany. From paper products the largest export commodities are toilet paper, printed materials, paper containers and Kraft paper, which are all exported mainly throughout Central Europe. (OEC, 2014a)

3.7.5 Forest sector in the economy of Slovakia

While Slovakia has reasonable forest resources, the country's wood-based products industry is fairly modest by production. In 2011, Slovakia's entire sawn timber production was around 2 million m^3 and saw-dust based chipboard accounted for a major part of wood panel production with 0.5 million m^3. Some 23 sawmills with an annual processing capacity higher than 20 000 m^3 carry out the majority of roundwood processing. As for the chemical pulp and paper industry, Slovakia is a rather important producer compared to many other countries in Central and Eastern Europe, but not so much compared to Nordic countries. Annual paper production volumes in the 21st century are reaching just under a million tons, with printing and writing paper production accounting for over half of it. (Ambrušová et al., 2013; Marttila, 2013)

State of Europe's Forests 2015 estimates, that the number of people directly employed by the forest sector in 2010 was around 55 000 people. Some 19 000 are employed by forestry operations and wood procurement, 27 000 by wood-product processing and 9000 by chemical forest product industries. (Forest Europe, 2015)

The estimates regarding contribution of the forest sector to Slovakia's GDP have large variation depending on source used, but generally the number is around 2%, sometimes even closer to 1%. According to State of Europe's Forest 2011, the contribution of forest sector was only around 1.2%, but FAO's State of the World's Forests from 2014 had the value doubled to 2.4%, which at least does not seem believable development. (Forest Europe, 2011; FAO, 2014a) In 2014 according to the OEC website, combined exports of wood products and paper goods from Slovakia had value of $2.4 billion, equaling only about 3.1% of all exports. (OEC, 2014b)

3.7.6 Forest sector in the economy of Austria

Austria´s forest-based sector has long been a major international center of timber business in the heart of Europe and, in addition, it is one of the country´s most important employers. In 2010, directly employed by the forest sector were estimated 74 000 people - within forestry and timber industry approximately 11 200, in pulp and paper industry 17 900, and in the manufacturing of wood and articles in wood approximately 44 700 people. The total amount of people employed, also indirectly by forests and forest industries is estimated to be as high as 250 000-300 000. Forestry and the forest industries are not only

boosting the domestic economy, but are naturally also a very significant factor for foreign trade balance of Austria. (Geburek et al., 2013; Quadt et al., 2013)

As can be seen from the general employment trends of Austrian forest sector, the main products of the industry are very much similar as in Nordic countries. A notable difference however is to be seen in the far larger amount of companies operating. In 2015, the Austrian wood product industry was comprised of some 1300 individual companies, almost 1100 of them being sawmills. Similarly the pulp, paper and board and converting industries of paper and board were based on 166 different companies. With the amount of people employed not being particularly larger than in Finland and Sweden, it can be determined that the industry in Austria is heavily based on family-owned, small and middle-sized companies. (Advantage Austria, 2016a)

According to the most recent calculations, in 2013 the entire forest sector of Austria contributed about 1.7% to the total nation GDP, with the share of forest product industries being 1.3%. In absolute value, the forest sector added a gross value of 4.91 billion euros to the economy. While the value of forest sector has greatly increased in the past couple decades, the importance to overall economy has significantly decreased duo to other, more competitive industries. (Foglar-Deinhardstein et al., 2015)

The total export-share of whole Austrian forest sector varies between 12 and 15%. In 2015 more than 70% of wood and all wood products, including sawn timber, and 85% or more of all processed wood products like paper, paperboard and viscose were exported. Including the export values of smaller forest-related industries such as particle board industry, wooden furniture manufacturing, cellulose and wood pulp production, the export value of the Austrian forest sector exceeded 9.46 billion euros. (Advantage Austria, 2016b)

3.8 Management and accessibility of forests for social and cultural uses

Areas of forests designated for social services indicate to what extent countries and forest managers are actively considering these services as part of the benefits of forests. According to the definitions for FRA in 2005, such social services can include for example recreation, tourism, education and conservation of sites with cultural or spiritual importance. Such a definition leaves much space for interpretation to each

country themselves on what to include under this theme, but it will also be assessed later on regarding the specific countries in question. (GreenFacts, 2017)

As part of the most recent Global Forest Resources Assessment from 2015, there was conducted a global collection of national data, answering how much forest area in each country is managed for the benefit of ecosystem services and cultural or spiritual values as its primary designated function. The data was presented as total amount of hectares, but also further divided into four categories of:

1. Public recreation
2. Carbon storage of sequestration
3. Spiritual or cultural services
4. Other (Specified in national country report)

(FAO, 2015b)

Notable with these categories is that because the national classification was reported by the countries themselves, varied assessment methods of forest primary designated function led to some interesting differences.

The sources and data quality used for the collection of information were ranked by tiers through 1 to 3, with tier 3 indicating the highest quality of reliability. For the countries examined within the topic of this thesis, the data from all others were given the highest rating of tier 3, but for Norway, which lacked this data of protected areas altogether. (FAO, 2015a; FAO, 2015b)

Social and cultural uses of forests are typically strongly linked with all types of outdoor recreation and activities which again are also many times linked with non-wood products provided by forests. Important for the possibilities of recreation and availability of non-wood products is also the public accessibility of forests. As everyone is not a forest owner themselves, in order for all to enjoy the social and cultural benefits of forests, public access or “right to roam” is also an important aspect of forest socio-economic functions to consider.

4. Materials and methods

4.1 Collection of information and materials

Because the thesis was written as a literature and library-based analysis, the collection of information was mostly done through searching of literature from the internet and usage of physical copies of books. Some of the primary sources of information used were the larger publications of international report compilations, which included for example FAO-commissioned "Global Forest Resources Assessments", "State of the World's Forests", "State of the World's Forests Genetic Resources"-collections and Forest Europe's "State of Europe's Forests"- reports. Also the individual country reports made for these compilations provided more detailed information. Most of these documents were obtained either as PDF-files or some as physical copies from professors of the faculty. Some additional primary sources were the web pages and research publications of different national forest institutes, forest owners associations and forest education centers from the countries examined.

Some sources of the literature review used can perhaps be seen as secondary, because while they provided useful information, they may not be seen as precise or as credible as the primary ones due to their nature. For example information from national statistical yearbooks used for numerical data, which do not offer much else to go with the numbers is also dependent on the readers own interpretation. Also information from somewhat outdated sources or collected from various web sites of companies which do not operate in forestry may not be as credible as one obtained from recent, official forestry publications.

Older literature not found or available as actual physical copies of books was mostly found with the aid of the Google Scholar, while peer-reviewed research publications regarding similar topics were searched through websites of Scopus and ScienceDirect. Google Scholar is a freely accessible web search engine that searches either full text or metadata of scholarly literature across a vast variety of publishing formats and systems. Scopus and ScienceDirect are bibliographic databases containing abstracts, citations and even full documents of academic journal articles, which greatly aids in finding the names and authors of potentially useful publications. In a same way, the Finnish Forest Research Institute's own e-library "Research Papers" provided

multiple older publications, especially studies regarding ecosystems, forest functions and theory of socio-economic functions from Nordic forests in general, which served particularly well as background reading.

4.2 Methodology of comparison

As the compilation of all information regarding the topic was based purely on written sources, statistics and literature, the methods used for the comparison are also mostly written and statistical, combined with graphic presentation. Particularly the quantitative socio-economic factors are first illustrated by graphs, charts and tables, after which they are analyzed and broken down.

Compared are not only the two groups of countries, but in most situations also individual countries or countries from within the same group. In some cases if valid or sufficient data regarding a topic is not available or does not exists from a certain country, the possible reasons for this are observed.

The background information used for analysis of most topics consists partially of things already presented in the literature review, but also of additional studies and reports of forest socio-economic functions, national statistics etc. Particularly numerical, quantitative data presented in the charts and tables is most often obtained from the annexes of global or pan-European report compilations from FAO or Forest Europe. The comparison, its results and interpretations presented are based not only on the available sources and literature, but also personal and outside observations available regarding the subject.

Simultaneously with the primary comparison, when it is also attempted to assess how the measurement and valuation of these functions is typically approached within the two groups of countries and in each countries individually, to see if there are any major differences or similarities.

4.3 Graphs, charts, tables and maps

Most of the graphs, charts, pictures and maps presented within the literature review of this work have been referenced or cited from international publications such as

the "State of Europe's Forests" or from forest research institutes to enhance the presentation of information. The charts used to demonstrate the forest ownership structures in each country were made with Microsoft Excel, to achieve more uniform look and to represent accurately the most recent numbers available.

For the results section of work, the tables, graphs and charts showing mainly the quantitative factors of the comparison have also been made with the help of graphical tools in Microsoft Excel and Microsoft Word. The information shown in self-made tables is either already cited earlier in the literature review or referenced below the tables.

4.4 Choosing the topics of comparison

The main topics of the comparison are based on the multiple indicators of criterion 6 from the "Criteria & Indicators of Sustainable Forest Management" (C&I). C&I are an internationally agreed-upon policy instrument originally created by the MCPFE, which today is a commonly used tool for the evaluation and reporting of the sustainability of forest management in each country or region and their progress towards Sustainable forest management (SFM). (Forest Europe, 2016)

The criteria characterize or define some of the essential elements and sets of conditions or processes by which sustainable forest management may be assessed and in the Pan-European set they are divided as follows:

1. Maintenance and Appropriate Enhancement of Forest Resources and their Contribution to Global Carbon Cycles
2. Maintenance of Forest Ecosystem Health and Vitality
3. Maintenance and Encouragement of Productive Functions of Forests (Wood and Non-Wood)
4. Maintenance, Conservation and Appropriate Enhancement of Biological Diversity in Forest Ecosystems
5. Maintenance and Appropriate Enhancement of Protective Functions in Forest Management (notably soil and water)
6. Maintenance of other socio-economic functions and conditions

(Forest Europe, 2016)

As mentioned, the topics of the comparison for this work are based on the indicators of thid 6th criterion, "Maintenance of other socioeconomic functions and conditions". These indicators are variables and descriptions, which show changes over time for each criterion and demonstrate the progress made towards its specified objective. Indicators can be either quantitative or qualitative. Quantitative indicators are commonly expressed in measurement units and time, while qualitative indicators are more about description and assessment. Qualitative indicators can also be used to portray the legal and institutional frameworks of forestry or the policies and instruments for the implementation of SFM. (MCPFE, 1998)

The indicators and other topics used for the comparison are mainly of quantitative nature for the reason that this kind of information is typically much more available and more often measured from each of the countries. They are also more reasonable topics for the sake of comparison as the qualitative factors can often be based more on interpretation and local conditions. As such, the topics chosen to evaluate and compare are:

- Forest ownership structure (Public and private forest ownership)
- Contributions of forest sector to national economies (Gross domestic product, exports and imports)
- Employment in forest sector (Workforce and occupational safety and accidents in forestry
- Domestic consumption of products of the forest industries and wood-based energy usage
- Protection of forests for recreation and social values (Public access to forests and the socio-economic value of non-wood forest products)

(Forest Europe, 2015)

The further reasoning, breakdown and explanation for the comparisons of each subject are presented within the results.

5. Results

5.1 Forest ownership structure

Evaluating forest ownership structure in regards to what best benefits and supports the socio-economic functions of forests is a complicated task. As it was stated in literature review, especially in developed countries both public ownership and private ownership of forests contribute in different ways to the different socio-economic aspects of forests, better than the other or sometimes equally well.

As each of these aspects are important in their own regard, it is reasonable to state that both forms of ownership are important for the maintenance and sustainability of forest socio-economic functions as a whole. An optimal ratio of these two forms of ownership in particular could be expected to provide sufficient raw materials for industries, economic benefits and employment to rural areas while also contributing to social aspects of forests including multiple use goods and services.

5.1.1 Public ownership

State ownership covers the majority part of public ownership in each of the observed countries, but in the Czech Republic and Slovakia significant portions of public forest areas are also held by communities and municipalities. In the Czech Republic communal and municipal forests amount to some 17% of all forest areas, and in Slovakia about 8-9%. These forests are often either managed by limited companies founded by the municipalities for productive functions or maintained as parks and other green areas. In each of the Nordic countries the forest ownership of municipalities and local county councils amount only to 2% or less of all forest areas and they are almost exclusively managed for recreational and social purposes. Communal or municipal local governments and provinces of Austria own approximately 4% of the country's forest lands. (Živojinović et. al., 2015; Local Finland, 2013)

Czech Republic and Slovakia also have by far the highest shares of state-owned and managed forests, 59% and 55% respectively, while in all the Nordic countries and Austria the share is 25% or less. (Chart No. 9) While the other countries' forests have for long gone through the process of gradual privatization, the Czech and Slovakian

forests were fully held by the state until the fall of communism in the beginning of 1990s. Today the Slovakian state in reality holds property rights to only approximately 40% of all forest lands, but manages and uses the 55% as stated, because the state agencies also manage forests leased from non-state owners and un-claimed forests of still unknown ownership. (Živojinović et. al., 2015; Krejzar, 2015; Ministry of Agriculture of the Slovak Republic, 2009)

Majorities of the state-owned forests are managed in each country by single state-owned companies or enterprises, but depending on country, other entities exist as well. As such, there can be identified some differences how the management of state-owned forests is nationally divided and for what specific forest functions these forests are primarily managed for.

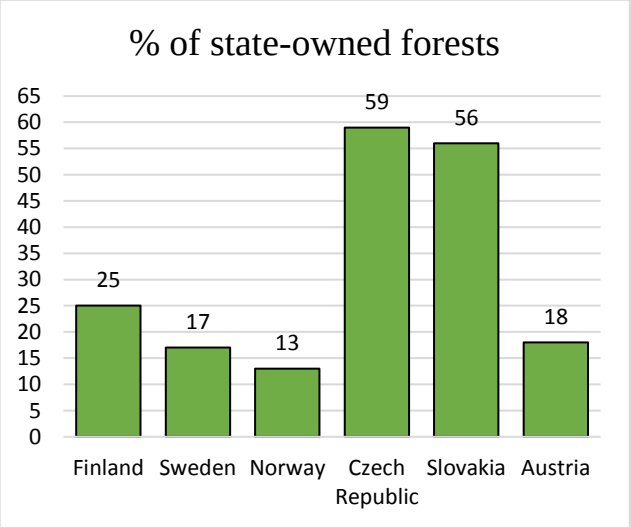


Chart No. 9: Share of state-owned forests in countries observed. (Živojinović et. al., 2015)

In Finland, Norway and Austria the state-owned forest lands are practically managed by only by the state forest enterprise, Metsähallitus in Finland, Statskog SF in Norway and the Austrian Federal Forests SC, Österreichische Bundesforste in Austria. In Sweden the majority of state-owned forests, 14% of all, are managed by the state-owned limited company Sveaskog, while other major owners of state forest own some 3% of all forested lands. They include the National Property Board, which primarily owns the sub-alpine forests in the northwestern parts of Sweden and the Swedish Fortifications Agency,

which functions as the landlord for the Swedish Armed Forces. (Živojinović et. al., 2015; Sveaskog, 2016)

In the Czech Republic the state enterprise Lesy České Republiky manages approximately 50% of all forests, while the remaining 9% owned publicly are divided between state enterprise Military Forests and Farms, Ministry of the Environment, regional forests owners including secondary schools, universities and the like and other, smaller public entities. The management of Slovakian state forests is divided among the state enterprise Forests of the Slovak Republic, s.e. Banská Bistrica, Forest –agricultural Estate s.e. Ulič and the State Forests of Tatra National Park, all of which fall under the Ministry of Agriculture. (Živojinović et. al, 2015)

From the Nordic countries, Metsähallitus and Sveaskog are some of the biggest producers of industrial roundwood, while unlike its other Nordic counterparts, the Norwegian Statskog's forestry operations are relatively small-scale, contributing only about 5% of the total logging in Norway. A common denominator among all Nordic countries is that majority of the state-owned forests are located in the poorer, less productive Northern parts of the countries. In the case of Statskog, only some 5% of its forest holdings are productive forests. While all of the state forest enterprises manage significant conservation areas, the Finnish Metsähallitus is the only one responsible for the management of also National Parks, in other countries this is issued to other governing bodies. (Statskog, 2017; Metsähallitus, 2016b; Sveaskog, 2016)

Overall it can be said, that the most major differences in public ownership structure of forests in these countries are not so much related to region or culture, but mainly historical context of Slovakia and Czech Republic. The situation in Austria is very similar to that of Nordic countries, where privatization of forest sector has already for long taken effect and the share of publicly owned forests has significantly decreased. In the Czech Republic and Slovakia it has only just recently begun. Aside from the largest public ownership share, the state forests of these two countries are also the most divided among multiple managers, while in the other countries they are more centralized.

Considering the services provided by public forests, all state forest enterprises from both regions have relatively similar main functions, although some further responsibilities come with small differences, as presented. They are all more or less involved in production of industrial roundwood, but each also strongly invest and put

effort into nature conservation and provision of social and recreational values, which makes them essential to the maintenance of socio-economic functions in the forests they manage. (Živojinović et. al, 2015)

5.1.2 Individual private owners

	% of private forest owners	% of female forest owners	Total individual private forest owners	Average size of forest holding (ha)
Finland	60	25	632 000	30.1
Sweden	50	38	350 000	50
Norway	81	25	129 000	54
Czech Republic	19	-	150 000	3
Slovakia	6.4	-	57 000	2.9
Austria	72	-	145 000	-

Table No. 1: Individual private forest ownership in countries observed. (Živojinović et. al, 2015; Forest Europe, 2015; Swedish Forest Industries Federation 2012; Finnish Forest Association, 2016a)

From the countries observed in the comparison, the private ownership of forests has some similar features and equally large shares of forested lands across all the Nordic countries and to some extent in Austria, while in the two other Central European countries the later start on privatization of forests is well visible. (Table No. 1) The average sizes of forest holdings is another noticeable difference from the table and serves as a good general indicator of probable viability and profitability of private forest ownership from an economic point of view. While on average private forestry may be economically viable with less area in Central Europe, the differences of averages are large.

Interesting to note from the same subject is how these statistics are in general perceived and measured differently in the two regions, related most likely to massive difference in average sizes. The number of total private forest owners in Finland, 632 000 or similar, is announced in multiple sources “with ownership exceeding two

hectares of forestland in total." Likewise in Norway, the official Statistics Norway normally includes only estates with 2.5 hectares productive forest area or more into its statistics as private forest holdings. What is perceived as minimum in Finland and Norway to be counted in official statistics is near the average size of holdings in Slovakia and Czech Republic. (Živojinović et. al, 2015; Finnish Forest Association, 2016a; Norwegian Forest Owners' Federation, 2014)

Austria on the other is distinguished from the other countries entirely in this regard, as the Austrian private forestry ownership is typically announced in two distinct categories; private forests under 200 hectares and private forests over 200 hectares. From the 145 000 owners, almost 99% of all proprietors hold less than 200 ha of forestland and almost 40% hold less than 3 ha. Some 1.5% of them own more than half of all forestland, with an average size of about 1200 ha. Therefore it is more difficult to pin-point any meaningful average of individual forest holdings. As mentioned in the literature review, these holdings larger than 200 hectares are actually mostly in ownership of some 1500 private forestry enterprises. This is another difference of both ownership forms and compilations of statistics. In Sweden, Finland and Norway some large private companies hold significant forest areas, but they are always counted separately in statistics from the private forest sector of individuals. (Živojinović et. al, 2015; Foglar-Deinhardstein et al., 2015)

One more distinguishable regional difference regarding the measurement of private forest ownership is the compilation of statistical data on genders. Sweden is the only country even from Nordics to include gender-disaggregated data into annual official statistics, while from Finland and Norway this information is found as landscape register- and survey-based data. From the Czech Republic and Slovakia no public data exists and from Austria it only exists from business-level surveys. (Follo et. al. 2016; Živojinović et. al, 2015

Especially in countries with significant forest industries like Finland, Sweden and Austria, the main socio-economic importance of private forestry has been in the production of raw-materials for the industries to a much larger degree than publicly owned forest. This is further supported by the fact that in Sweden, Finland and Austria, the share of country's total growing stock are significantly higher on privately owned

lands compared to public lands (more than 70% on private), while in the Czech Republic and Slovakia the situation is reversed. (Schmithusen & Hirsch, 2010)

5.2 Contributions of forest sector to national economy

5.2.1 Gross Domestic Product

To avoid using scattered information from multiple different years and sources in the basic comparison, the figures presented in the chart below (Chart No. 10), regarding the share of forest sector in the national GDP, were taken from the FAO-commissioned State of the World's Forests 2014 report-compilation. Figures reported there are from the year 2011. In the case of some countries, the share of GDP however seems to fluctuate even widely depending on source. Because of this, for comparison sake are also presented the 2010 figures from State of Europe's Forests 2015 -compilation (Chart No. 11). This brings the possibility of noting the most significant differences and evaluating where these variations may rise from.

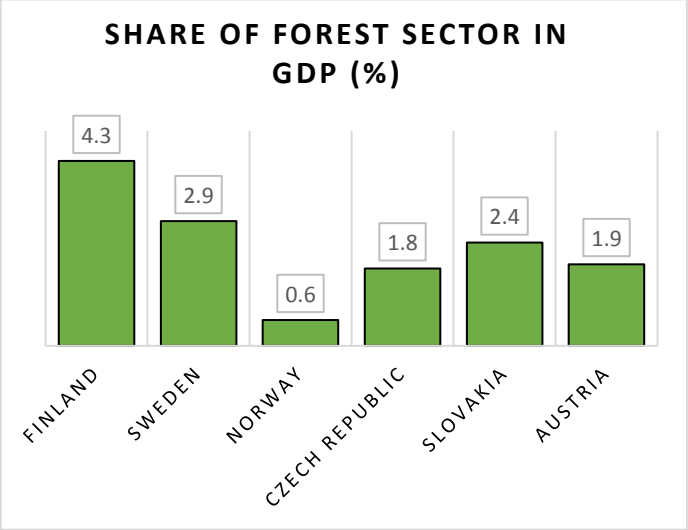


Chart No. 10: Share of forest sector in national GDP 2011. (FAO, 2014a)

Comparing the two sources of information, (Chart No. 10 and Chart No. 11) the only notable difference is the situation in Slovakia, where the GDP share of forest

sector in statistics jumps from 1.1% to 2.4% in a span of one year which is not at all believable. This is more than likely a mistake in reporting from 2011, further evidenced by the State of Europe's Forests 2011. There it is stated, that the share was 2.8% in 2000 but was diminished to 1.1% in 2010 due to rapid growth of non-forest sectors. (Forest Europe, 2011)

Other than Slovakia, the two sources of information seem to match each other fairly well and the numbers compare well with other official sources as well. As it was mentioned in the literature review, for Norway the share of forest sector in GDP is significantly decreased due to massive oil and fishing industries, but for mainland economy the share is approximately comparable to Central European countries, 1.6%. (Hannerz, 2003)

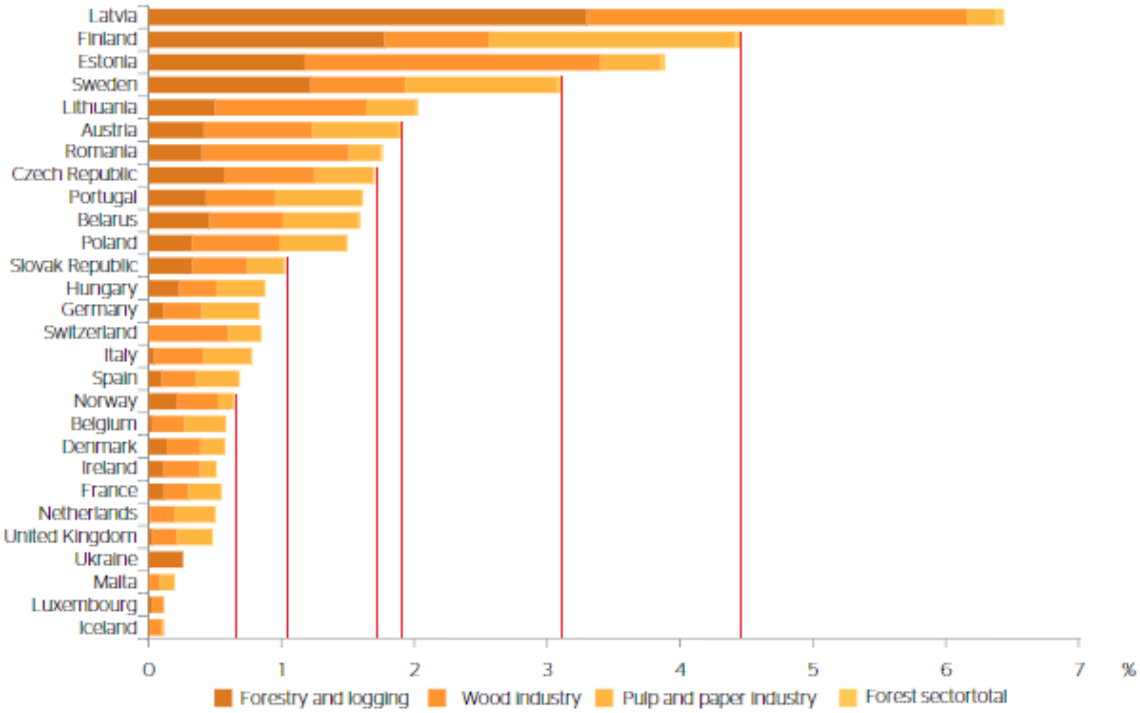


Chart No. 11: Share of forest sector in national GDP 2010. (Forest Europe, 2015)

Aside from giving a chance to simply compare two sources of information, the chart cited from State of Europe's Forests 2015 (Chart No. 11) allows to observe the approximate importance of each different industry branch as part of the total forest sector. Overall it can be said, that relatively speaking forestry and logging activities are more

important to the forest sector in Nordic countries, where they accounted for around 40% of the total value in Sweden and Finland and some 30% in Norway. Meanwhile in Austria the branch of forestry and logging is the least valuable and also in Slovakia and Czech Republic it is trumped by wood manufacturing industries. Wood manufacturing industry has highest relative value from the Central European countries, while in Nordic countries the value of wood industry is the lowest of the sector, overtaken also by the large paper industries. These differences are further and better observed in the following chapter through the import and exports of the forest sector.

5.2.2 Exports and imports of wood and wood products

The data presented regarding the exports and imports of wood and wood products is also retrieved from Forest Europe's State of Europe's Forest 2015 and the figures presented there were obtained as averages from the time period 2008-2011. As such, the information presented here includes only imports and exports of primary wood and paper products; roundwood (rough wood), sawn wood, wood-based panels, paper and paperboard.

When observing the numbers it is also worthy to note, that they are still partially from the time when the impact of the European economic crisis was still strongly felt, which may mean the situation has somewhat changed since then. This can be noticed also if comparing the information shown here with the one presented earlier within the literature review, however for the sake of this comparison it is not necessarily a significant issue. While the monetary amounts may have been down then, they are so for each country and as such this data can be used to distinguish the general outlines.

Another factor why differences can be met among varying sources, particularly the ones used in literature review of this work, is that different sources include different things regarded as forest products. For example the OEC-website cited multiple times in the literature review for information on Czech Republic and Slovakia includes among forest products many such products, which other sources consider more indirectly from forest, such as carpentry and furniture manufacturing. The OEC-website is however used in this chapter as a tool to identify the main products which each country is exporting and importing, from where and where to.

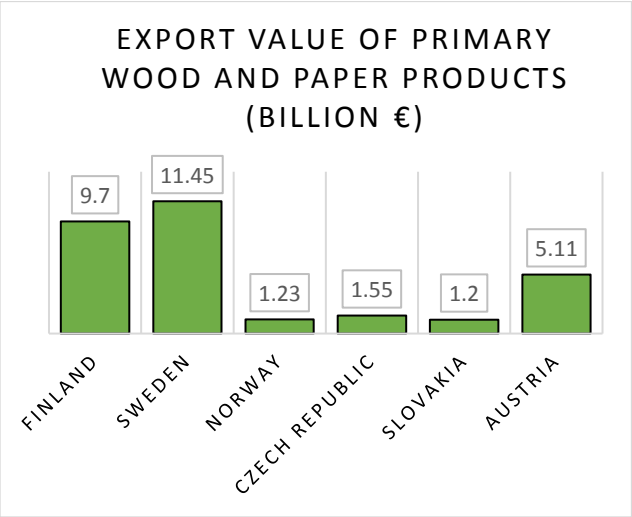


Chart No. 12: Export values of primary wood and paper products / billion € (Forest Europe, 2015)

When observing the export-statistics of the OEC-website, we can find that the main export products of Finnish and Swedish forest sectors are the manufactured and refined wood products; sawn wood and plywood from Finland, mostly sawn wood from Sweden, which equal in both countries almost 80% of all wood imports. The main directions these products are exported to in Europe are the United Kingdom (UK), Germany and France with Sweden exporting also to Norway and Denmark. Internationally especially Japan, China, Egypt, Algeria and Israel are major markets. Main paper products are coated and uncoated papers, which are also exported mostly to UK and Germany, but from Finland also to the United States. Norway is mostly the opposite from these two, as more than 60% of its wood exports is rough, unmanufactured roundwood to Sweden, Denmark and Germany, while the main paper exports are mainly uncoated paper to same countries. (OEC, 2014c)

From the Central European countries, Austrian forest exports are also heavily focused on the manufactured products, exporting sawn wood in great amounts to Italy and Germany, but also to Japan and Algeria. Also plywood, particle board and fiber board, coated paper, uncoated paper and paper containers are exported mostly to Italy, Germany and France. The Czech Republic exports approximately equal amounts of both rough wood and refined products around Central Europe and Italy, while most common paper products are toilet paper, uncoated paper and paper containers in the same regions.

Quite similarly as Norway, Slovakia's main export is rough wood to Czech Republic and Austria, but also to smaller degree sawn wood, uncoated paper and toilet paper around Central-Eastern Europe. (OEC, 2014c)

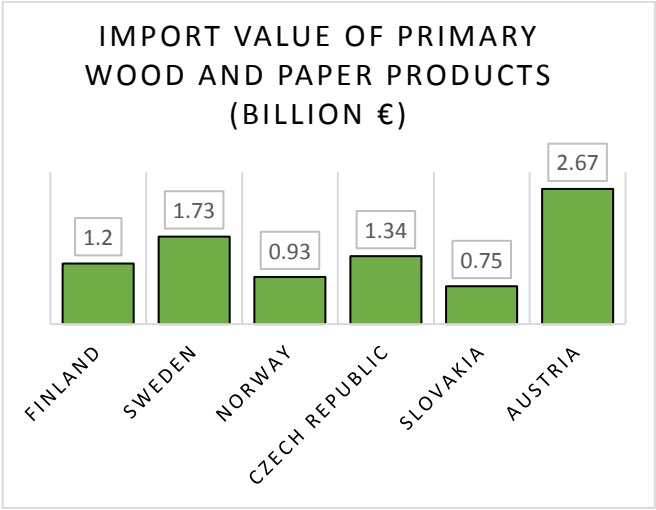


Chart No. 13: Import values of primary wood and paper products / billion € (Forest, Europe, 2015)

More than half of Finland's wood imports are rough wood and fuel wood for pulp production from Russia and Estonia, while most notable paper imports are toilet paper from Sweden. Sweden similarly imports mainly rough and fuel wood, but it is mostly from Norway, Latvia and Estonia. Some particle and fibre board is also imported from Norway and Germany and toilet paper from Finland. As Norway provides Sweden with rough wood, it in exchange imports refined sawn wood, plywood and fibre board from Sweden, but also from Finland and Germany. Printed paper and toilet paper are also imported by Norway from Sweden. (OEC, 2014c)

Czech Republic and Austria import a lot of rough wood from Slovakia, while Slovakia mostly imports refined sawn wood, particle board, plywood and toilet paper from both of them. Austria imports rough wood also from Czech Republic and sawn wood from Germany. In addition to the rough wood from Slovakia, Czech Republic imports sawn wood and particle board from Germany, Austria and Poland. (OEC, 2014c)

In general, Sweden, Finland and to lesser degree Austria can be seen as the major producers of more refined, high-quality, internationally sought-out products. Especially sawn wood and coated papers, are exported in large quantities from these countries to their neighbours and bigger European countries, but also far outside of Europe to Africa, Asia, and even United States. Majority of their imports come in the form of rough wood from their neighbouring countries, which do not have similar industrial manufacturing capacities. From all the countries Austria is the biggest importer of wood and wood products, as their domestic consumption equals that of Finland and Sweden, but their own annual fellings are not sufficient. (Further shown in chapter 5.4.1)

Compared to their neighbours, Slovakia and Norway are clearly more in the role of producers of raw-materials and obtain a lot of their refined final forest products through imports. Czech Republic is located somewhere in between of these two groups, as it acts both as a source of raw-materials for others, but also exports significant amounts of some of its own refined products. Similarly like Sweden and Norway do together, Czech Republic and Slovakia work in close collaboration with Austria, exporting there raw-materials and importing from there finished products.

5.3 Employment

5.3.1 Workforce in forest sector

Although the number of people employed in the forest sector has significantly decreased across Europe in recent decades, the sector still plays an important role in regards to employment, often especially in rural areas. Again to avoid scattered information from multiple years or multiple sources of information, data for the total workforces in forest sector in each country were taken from the State of Europe's Forests 2015. There are again some particularly noticeable differences in numbers presented here and the ones presented earlier in literature review or other sources, but the most major ones are noted and possible reasons evaluated. Different conditions and different measurement methods lead to different results, but the figures from Forest Europe most importantly show the approximate state of things.

The figures presented in Chart No. 14 below are converted in to full-time equivalent (FTE), which is done to avoid overestimates, resulting from for example part-

time or contractual work. In plain words, one FTE is equivalent to one employee working full-time. In Chart No. 14 one unit equals one thousand FTE. The information was originally collected via Forest Europe, UNECE and FAO commissioned national enquiries on pan-European quantitative indicators. They are based on the "Statistical classification of economic activities in the European Community" (NACE) -classification system. The employment numbers of forestry include the entirety of NACE category A2, wood manufacturing C16 and paper industry C17. (Forest Europe, 2015; European Commission, 2010)

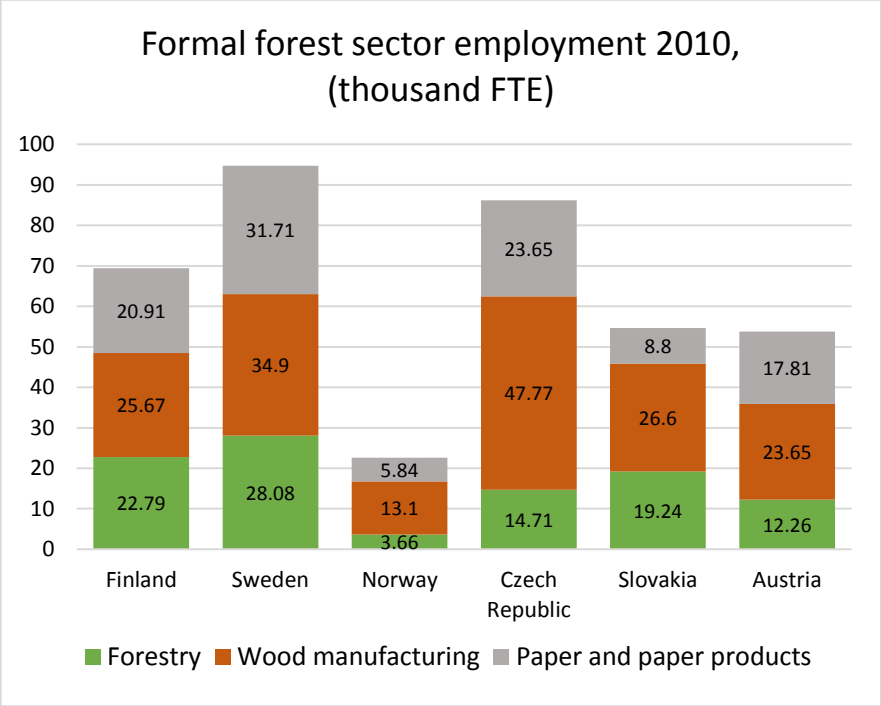


Chart No. 14: Formal employment in the forest sector, thousand FTE. (Forest Europe, 2015)

For the Nordic countries the figures reported by Forest Europe correlate fairly well with the amounts presented also in the literature review of this work, which are taken from more recent sources. For Finland and Sweden only workforces in forestry and logging operations are shown slightly lower by Forest Europe, which could possibly be caused by the fact that practically all logging operations are done as contractual work and the FTE factors in. (Blombäck et. al., 2003) For Norway the forest industries numbers

are slightly higher in 2010 than in recent sources, but the overall workforce is reported lower. This could possibly be explained by both automatization of industrial work and again the FTE conversion of 2010 statistics, which perhaps shows workforce in forestry operations lower than other sources.

The workforce numbers of Slovakia and Czech Republic here are the same as they were presented in the literature review, because more recent, similarly credible collective data was not found in English. For Austria the estimated numbers in the literature review are from relatively the same time period as Forest Europe's and otherwise match rather well with, but for some reason the workforce of wood manufacturing is estimated massively larger than here.

Some conclusions can be made overall from the sizes of workforces tied to each sector in different countries. Despite much higher rates of mechanization and thus efficiency, Finland and Sweden have by far the highest employment numbers in forestry. This results not only from larger forest resources, but the importance of that branch overall, as was also shown by its highest shares in national GDP's. Meanwhile Norway's total growing stock is far less than half of that of Finland's and a third of the Swedish, while annual increment equals about a quarter of its neighbours' – reason enough to explain significantly lower employment in forestry. From Central European countries, Austria's lowest numbers compare well with forestry's low share of national GDP, but also correlate with smaller forest resources combined to some degree of mechanization and high import rates of roundwood. Wood manufacturing industries employ majority of people in Central European forest sector and this correlates well with the fact it is the most important branch also to national GDP's. Despite this relative higher significance and employment, the manufacturing industries of Sweden and Finland are still more valuable overall likely due to technology, quality and efficiency-reasons.

From the four countries with the most significant workforces in paper products industries, it should be noted that the Czech Republic has quite comparable employment rates as Finland and Sweden, even higher than Austria. Despite this, the value of this industry is significantly higher in the other countries, as is shown by the industry's share of GDP and trade values. The probable reasons for this, which also applies in Slovakia and to a lesser degree in Norway, is the industries' main products. Finnish, Swedish and Austrian paper industries produce a large variety of products, which

include high quality coated papers, while uncoated papers, toilet paper and paper containers are the main products in the other countries.

Despite Czech Republic and Slovakia having comparably high direct employment in the forest sector as Finland and Sweden, the lesser total value of the sector in Central Europe is reflected aslo in average salaries. For comparison, in 2008 the highest average monthly salary within the Czech forestry sector was recorded in the state forest enterprise, which was 18,779 Czech crowns, slightly more than 500 €. (UN Economic Commission for Europe, 2009) In Finland the average salaries for forestry labourers are closer to 2500 €, while even much higher for forestry officials. (Yle, 2016)

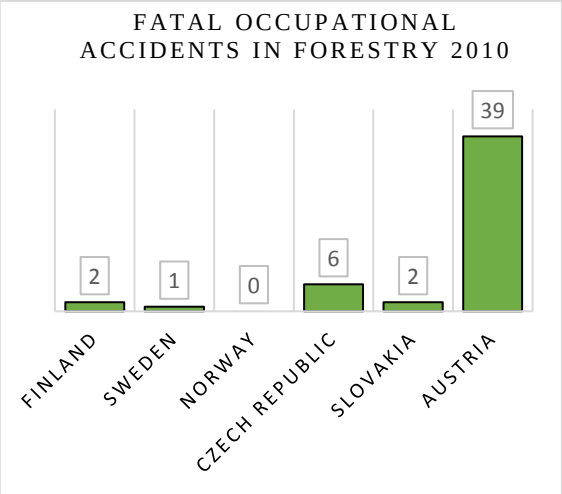
In Forest Europe's 2015 report there were also given estimates on the gender relations regarding the employment of each branch of the forest sector, but in this regard all the countries observed are fairly homogenous. Each branch are fairly male-dominated, both forestry and wood manufacturing industries having well above 80% share of male employees. Women were slightly better presented in paper and paper products industries, but still the share of men was on average above 70% in each country except for Czech Republic, where it was only 57.6%. (Forest Europe, 2015)

Aside from direct employment the forest sector employs vast amounts of people indirectly, but no collective data or universal measurement methods for these informal workforces exists. Only some estimates are given like mentioned in the literature review, such as Sweden's "more than 200 000" or Austria's 250 000 - 300 000. Similarly data for the amounts of foreign labor, which is utilized at least to some degree in Central European countries for forestry operations, is fairly little reported.

5.3.2 Occupational safety and accidents in forestry

The risks that hard and potentially dangerous forestry work imposes can be mitigated by developing working methods, adopting preventive measures and mechanizing the work. The recognition and monitoring of occupational accidents and diseases helps in developing these better working methods and improvement of safety. Although accident frequency is only one aspect of safety and health, it can be considered a key indicator for working conditions, enterprise culture and the intensity of investment in human resources. (Finnish Forest Research Institute, 2012c; Forest Europe, 2011)

The figures representing both fatal and non-fatal accidents in forestry in the charts below (Chart No. 15 & Chart No. 16) were taken from the State of Europe's Forests 2011 and they include data from the year 2010. The Austrian numbers are skewed and thus exceptionally high in both charts due to salvage work on windblown timber during that time. For comparison sake the annual average of non-fatal accidents between 2000 and 2005 in Austria was 110. (Forest Europe, 2011)



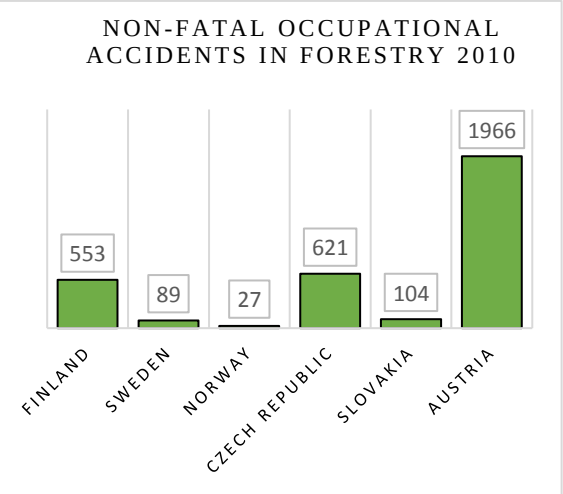


Chart No. 15: Fatal occupational accidents in forestry 2010. (Forest Europe, 2011)

Chart No. 16: Non-fatal occupational accidents in forestry 2010. (Forest Europe, 2011)

While the charts above do not represent it entirely, the general consensus is that Nordic countries report on average a lower accident frequency in forestry than Central European countries. While this is probably partially due to differences in the efforts made to implement preventive measures, mechanisation of work is most likely the single biggest factor reducing the accident risk of forestry work. This is well illustrated by the Nordic countries where higher levels of mechanisation in forestry have accounted for a large reduction in the exposure to accident risks. Meanwhile in the observed Central European countries, the motor-manual systems still remain as the most commonly used harvesting procedures. (Forest Europe, 2015)

That said, it is also well-visible that the Finnish numbers presented are also exceptionally high for the Nordic averages, but there is a high probability this is due to

different measurement principles and not natural conditions like in Austria. Coincidentally in the newer State of Europe's Forests report from 2015, Finnish numbers were not included at all.

An important difference to note about Finnish forestry work overall is that due to a special government subsidy-system KEMERA a lot of the silvicultural forestry work done via motor-manual systems, is done by the forest owners themselves or non-professional workers, such as young summer workers. From the websites of Finnish Forest Research Centre, it can be understood that also accidents among them are reported within the national statistics, which can be seen as significant source of more injuries reported internationally. (Finnish Forest Centre, 2016; Finnish Forest Research Institute, 2012c) Aging forest owners or young people with little proper training or inadequate equipment, who may not always know the necessary precautions forest work requires are obviously more susceptible to accidents than trained professionals. Similar subsidy-systems do not exist in the other Nordic countries, which most likely results in less incentive for forest owners to work themselves or hire cheap help.

Ignoring these "anomalies" in statistics, the overall trend of lower accident frequency in Nordic countries is somewhat noticeable, especially when also figuring in the total amounts of workers in forestry in each country. Some additional factors, other than higher rate of mechanization, which could lead to less accidents are; smaller sizes of felled trees, easier terrains and less use of potentially more risky systems such as cable-yarding. One more factor to consider in Nordic countries is the lack of cheap foreign labour hired for forestry operations, which happens to a degree in Central Europe with East-European workers. (Blombäck et. al., 2003)

As it was said, work-related accidents constitute only a small fraction of the topic regarding occupational safety. Studies exist, and it is known, that long-time physical labor in forestry can subject people to for example long-lasting injuries or mobility-related illnesses and diseases. Similarly an increasing proportion of employees in forestry are becoming clerical employees with their work being increasingly a subject to profit targets and schedules. This comes with the effect of increasing the psychological stress of work and the consequent susceptibility to disease. (Finnish Forest Research Institute, 2012c). However the implementation of these more complex aspects within the frames of

this work were not found realistic, particularly because sufficient data of anything specific regarding them in each of the countries observed could not be found in English.

5.4 Consumption of forest products

5.4.1 Per capita consumption of products of the forest industries

The quantity of wood and wood products consumed, which are renewable and environmentally friendly, is an indicator of the relative importance of forests as a source of raw materials. Therefore it can also be seen as an essential part of the sustainable development of the forest and forest products sector. This indicator demonstrates the intensity of domestic wood consumption, which can also be correlated with other indicators, most notably the GDP. (Forest Europe et. al. 2013; USDA, 2014)

Along with trade in wood, the consumption of wood products indicates how well the country's own forest resources contribute to the provision of raw materials for domestic markets and those abroad and if this is sustainable or not. Consumption per capita is an indication of the value people and businesses place on wood products instead of non-renewable materials and products. As such it also serves as indicator of sustainable consumption patterns in a society and also shows the status and appreciation of wood in society at large. (Forest Europe et. al. 2013; USDA, 2014)

The data regarding per capita consumption of forest products was collected for the State of Europe's Forests report 2015 and the numbers shown are the averages calculated from in-between 2008 - 2012. The estimates are based on estimates derived from local production levels and net trade balance. The unit expressed is cubic meters of roundwood equivalent (RWE) and the figures are reported in cubic meters RWE per 1,000 inhabitants. RWE is based on conversion, which includes the consumption of wood fuels, sawn wood, wood-based panels, paper and board and removals of other industrial roundwood. Sawn wood is converted at 1.84 RWE per m^3 of finished product, wood-based panels at 1.6 RWE and paper and board at 3.6 RWE per metric tonne. (Forest Europe, 2015) The amount of wood fuels consumed is later also separately addressed.

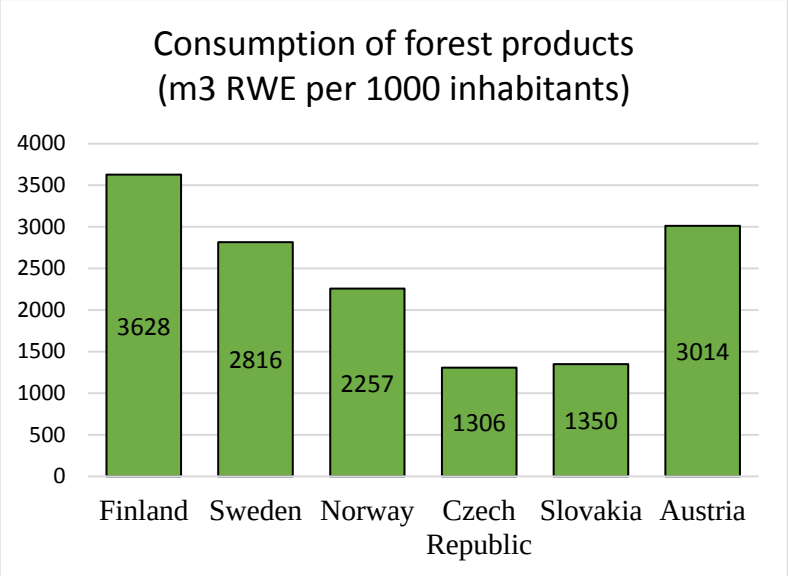


Chart No. 17: Consumption of forest products, m3 RWE per 1000 inhabitants. (Forest Europe, 2015)

From the rates of forest product consumption, it is more difficult to assess the reasons for differences among countries than with other indicators, especially due to the complexity of the given unit. While it can easily be seen that again Finland, Sweden and Austria hold the largest shares, in this indicator also Norway reaches rather comparable numbers, whereas Slovakia and Czech Republic have by far the lowest consumption rates.

Notable is how Austria topples even Sweden in the case of domestic consumption. This can however at least partially be explained by the estimation method used (local production levels and net trade balance) and the fact that almost 40% of Austria's total consumed wood products come as imports. Norway has the same share like Austria, while Finland and Sweden have only around 20% of consumption from imports. (Wolf, 2012)

A major reason explaining the three largest consumers of wood can be, as seen in the next chapter, the share of wood-based energies in total primary energy supply. Forests are the main source of bioenergy in the Nordic countries, in Sweden and Finland the consumption of wood-based energy by the rural population is more than five times the European average. (Kettunen, et. al. 2012) However most likely the biggest reason for differences, which also positively affects Norway in this regard, is wood used in construction and particularly housing. In Norway, Sweden and Finland, the market share of wooden houses accounts for approximately 90% of all, because high quality timber is

well accessible, industries produce prefabricated materials and traditions regarding wood construction span already for centuries. Building with wood also has a good and positive reputation as being ecologically friendly. (Shauerte, 2010) This obviously accounts for a large share of sawn wood and wood-based panels included in RWE-unit.

Meanwhile from the Central-European countries, the share of wood-building in Austria by 2008 was approximately 20% of all but while the traditions in wood construction are long, many have disappeared. (Klein, 2014) In the Czech Republic it is estimated wooden houses account from less than one percent to some few percent of the total annual construction (Rymarovske Domy, 2017; Czech Statistical Office, 2009) and they are very rare in Slovakia as well. (Eco-Innovation Observatory, 2015) In these countries it has been observed, that there can be reluctance to using wood for construction, as it is believed to be causing damage to the nature, forests and trees which need to be cut down to obtain timber. (Rametsteiner & Kraxner, 2003)

Regarding the secondary comparison, there are most likely no differences in regard to any national assessment methods, as it is quite straightforward quantitative factor, based on a set estimation method. The national or even regional differences are much more so cultural and based on customs and traditions, rather than different measurement methods.

5.4.2 Usage of wood-based energy

In FAO's State of the World's Forests 2014 it was estimated by each nation the share of wood-based energies in their total primary energy supply (TPES). Information regarding it was collected from the energy statistics produced by the International Energy Agency (IEA) from the year 2011. TPES is the total amount of energy used in a country from all sources and it is measured using again a common unit.

In this case, TPES and wood energy consumption were measured in million tons of oil equivalent (MTOE), where one MTOE equaled approximately 3.8 million m3 of wood. Wood-based energy consumption in MTOE in each country and wood-based energy in TPES are presented in Table No.2 and Chart No. 18.

	Finland	Sweden	Norway	Czech R.	Slovakia	Austria
MTOE	9	10	2	2	1	4
% in TPES	25.3	21	5.6	4.7	3.2	12.5

Table No. 2: Share of wood based energy in primary consumption. (FAO, 2014a)

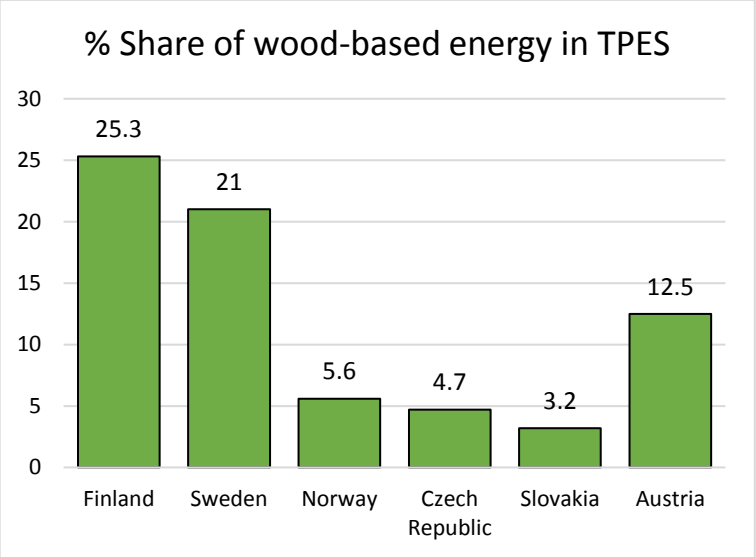


Chart No. 18: Share of wood based energy in primary consumption. (FAO, 2014a)

As it was mentioned in the previous chapter, the amount of wood-based energy used correlates rather well with the total domestic consumption rates of forest products presented earlier, which included "wood fuels". Sweden and Finland are the leading producers of wood-based energy, while the Czech Republic and Slovakia still stay with the lowest shares. (Kettunen et. al., 2012) The oil- and gas-rich Norway also falls lower in the usage of wood-based energies. In the case of most countries, the numbers reported by FAO correlate fairly well in other and recent sources as well, such as the European Union 2014 review on Energy Policies of IEA Countries. (OECD/IEA, 2014)

For comparison, another complete, comprehensive and cross-sectoral report regarding wood energy usage in Europe is the Joint Wood Energy Enquiry (JWEE) commissioned by UNECE, in collaboration with FAO. (Steierer, 2010) From the year 2013, JWEE reported similar percentages for each country as FAO did from 2011. In Finland and Norway the reported shares of woody biomass in TPES were slightly lower,

about 23% and 4% respectively, while from Sweden and Czech Republic were reported practically same figures as in 2011. In Austria the share reached almost 15%, while Slovakia was not included in the 2013 results. (UNECE, 2013) In the results of previous JWEE-report from 2011, the Slovakian usage of wood-based energies was reported exactly the same as by FAO. (UNECE, 2011b)

Other than by percentage share in TPES, observed countries differ also by how and by who the wood-based energy is consumed. According to the JWEE 2013, in Finland and Sweden more than 80% and in Austria more than 60% of wood-based energy was used for either transformation of woody biomass for commercial power and heat production or it was internally used by the forest based industries (sawmills, pulp, panel) for processing and drying activities. In the Czech Republic and Norway, the share of these activities was lesser, as more than 60% of wood-based energy consumption went to heating of private households. (UNECE, 2013)

As mentioned, Slovakia was not included in the 2013 JWEE-report, but according to the earlier 2011 report rather surprisingly only some 30% of wood energy usage went to heating of private households while almost 70% was used in commercial production of power and heat or internally by forest industries. (UNECE, 2011b) However as seen later, the volumes of all wood-based energy sources in Slovakia are clearly the lowest of all observed countries.

Table No.3 illustrates the shares and total amounts of each different sources of wood-based energies used. These estimates were once again received through Forest Europe/UNECE/FAO enquiries on pan-European quantitative indicators, meaning they were included in the State of Europe's Forests 2015. The unit expressed is million metric tons of dry matter.

	Finland	Sweden	Norway	Czech R.	Slovakia	Austria
Direct wood fibre sources	5.38	6.9	1	2.35	0.95	3.27
Co-products and residues of wood processing	13.18	14.75	1.34	1.67	1.31	6.89
Processed wood-based fuels	0.07	2.24	0.09	0.13	0.027	0.5
Post-consumer recovered wood	0.2	0.44	0.03		0.035	
Unspecified sources			0.23			
Total energy supply from wood	18.83	24.33	2.69	4.15	2.322	10.66

Table No. 3: Energy supply from different sources wood, million metric tons dry matter. (Forest Europe, 2015)

Most importantly from these figures it can be mentioned, that in the countries with most significant forest industries, Finland, Sweden and Austria, very high volumes of forest-based energy comes from industrial and forestry residues such as black liquor, bark, sawdust and other wood residues. A large portion of that energy however in all countries is used by the industries themselves.

Direct wood fibre sources include all wood fibre materials entering energy production without additional treatment or conversion. Although by volume their usage is higher again in Finland, Sweden and Austria, by percentage they are more significant in Norway and Czech Republic. In these two countries, as earlier mentioned, majority of wood-based energy consumed is via heating of private of households which explains this relative significance. In Finland and Sweden the users of direct wood fibre sources are also private households to a small degree, but mostly the commercial production of heat and power. In Austria and Slovakia the commercial production and private household heating have approximately the same shares of wood energy use. (UNECE, 2011b; UNECE 2013; Kettunen et. al., 2012)

5.5 Protection of forests for recreation and social values

The figures regarding forest areas managed and protected with a primary assigned function of ecosystem services, cultural or spiritual values were received from the individual country reports produced for the compilation of FAO's Global Forest Resources Assessment 2015.

	Finland	**Sweden**	**Norway**	**Czech R.**	**Slovakia**	**Austria**
Public recreation	249 000	2 236 000	N/A	36 000	24 000	35 000
Carbon sequestration	-	-	N/A	-	-	-
Cultural services	452 900	-	N/A	-	-	-
Others	340 800	-	N/A	44 000	-	-
Total area (ha)	1 042 700	2 236 000	N/A	80 000	106 000	35 000

Table No. 4: Forest area managed and protected with a primary assigned function of ecosystem services, cultural or spiritual values, 2015. (FAO, 2015a)

According to the FRA, from the Nordic countries in 2015 Finland was protecting a total of 1 042 731 hectares, or 10 427 km^2 of forests for the purposes of "Ecosystem services, cultural and spiritual values". In the further categorizing, approximately 250 000 hectares were assigned the primary designated function of "public recreation", 453 000 hectares with "spiritual and cultural services" and the remaining 340 000 as "Others". The content of the "Others" category however was not specified within the country report as it should have been and the lack of this was noted in the commentary by: *"Some elements of this category are missing in our data."* (FAO, 2014c)

For Sweden it was reported that in 2015 a total of 2 236 000 hectares, or 22 360 km^2 of forests were protected for these purposes. However in the Swedish country report it was stated regarding the further categorization, that: *"Most categories in table 5a-b are not relevant or cannot be interpreted into anything meaningful for Swedish condition. In the category "of which for public recreation." is reported the area within protected areas (NP, NR, NCA and Natura 2000) as these areas, among other functions, also explicitly should fulfil public need for recreation."* Tables 5a-b mentioned include

also the forests for protection of soil and water. This means that for Sweden a majority of protected nature areas were basically lumped under purposes of public recreation as a primary function, due to incompatibility of national and FAO-used categorization. (FAO, 2014d)

As was earlier mentioned in literature review, the country report of Norway did not include any numbers regarding these specific reasons of protection. The reasoning for this is also be found from the Norwegian country report. Instead of recreation or cultural services, the protected forests in Norway are managed for and given the primary assigned function of either "Protection of soil and water" or "Conservation of biodiversity". Together these protected areas total more than 4 715 000 hectares of land. The category for biodiversity conservation is stated to include also the areas of National Parks and nature reserves. In comparison, for Sweden they are included under public recreation, while for Finland it is not specifically stated, but most likely the same. (FAO, 2014e; FAO, 2014d)

For the Central European countries observed, there was a clear difference with the amount of areas protected with the primary designated function of "Ecosystem services, cultural and spiritual values" in comparison to Sweden and Finland. The difference however is not entirely due to the smaller sizes of the countries, but similarly as in Norway, more because of different valuation and assessment methods in forest protection.

From the Czech Republic it was reported that in 2015, an area of only 36 000 hectares were protected for the main purpose of public recreation and 44 000 hectares for "other" reasons of ecosystem services, cultural and spiritual values, making the total 80 000 hectares. The other services are noted to include *"forests in spas, research and education forests and forests with other public interests requiring special management."* The conservation data of FRA has been collected since 1990 and for the Czech Republic there is visible a clear trend of change in methods of assigning the primary function. Simultaneously while the protection of forests for recreation and social uses has come down from its peak in 2000 (261 000 hectares) the area of forests used for protection of soil and water have risen from 66 000 hectares in 1990 to 271 000 hectares in 2015. During the same timeframe the area of forests designated for the conservation of biodiversity has risen from 193 000 to 337 000 hectares. (FAO, 2014f)

The Slovakian country report shows that in 2015 the total area protected directly for public recreation was only 24 000 hectares and in total 106 000 hectares for ecosystem services, cultural or spiritual values. The rest however is not further categorized due to it not being designated in national legislation. The total area for these purposes has significantly decreased since 2000, when it was as high as 592 000 hectares. Unlike in Czech Republic this change cannot be, at least entirely, attributed to changing of protection purposes. The other categories of protection have not simultaneously notably grown and in the Slovakian report it is stated, that: *"The area of forests directly managed for recreation is decreasing because of lack of financial resources for their maintenance."* (FAO, 2014g)

Austria's approach to assigning the primary function of forest protection also differs from the other countries observed, but the total area protected for public recreation is relatively similar with its neighboring countries, a total of 36 000 hectares. For these purposes were reported the areas, which were given the key function "recreational function" in Austrian national Forest Development Plan. When there exists a high interest in the recreational potential and use of certain forests, they can, with compensation to the forest owner, be declared recreation forests. All other available categories were not found compatible with Austrian standards, except for "Protection of soil and water", under which was reported the entire forest area of the country. (FAO, 2014h)

Overall it can be said, that such varied results and different answering methodology implies that there are multiple differences between countries observed, both regarding the weight of importance given for the protection of recreational and social values and how the primary function of protected forests in general is assigned. Additionally it can also be noted that the national classification systems of each country seem to very differently fit the standards used for the FAO country reporting.

The Central-European countries are perhaps both classifying and reporting forest protection for recreational uses quite similarly among each other, but differ in other aspects. Their own classification methods also seem to find most FAO categories not applicable. Meanwhile the national classification systems of Nordic countries seem to be entirely different among each other and different factors are clearly given more importance over others. They are obviously also not so well suited to fit in to the FAO set categories and standards of reporting. While the Finnish country report utilized the given

categories best from all observed countries and even specific numbers were given, complete lack of definition what these reported areas actually contain makes it difficult to evaluate the relevancy of given answers.

5.5.1 Public access to forests

The figures presented in the previous chapter can be deceptive, as they represent only the very small portions of forests which are *primarily* protected for the reason of recreation and social uses. Protection and management of forests for other primary functions does not however exclude them from being available to public access as well. In fact, in each of these countries more than 90% of forested areas are reported to have public access and be available for recreation, as can be seen from the statistics compiled for the State of Europe's Forests 2015.

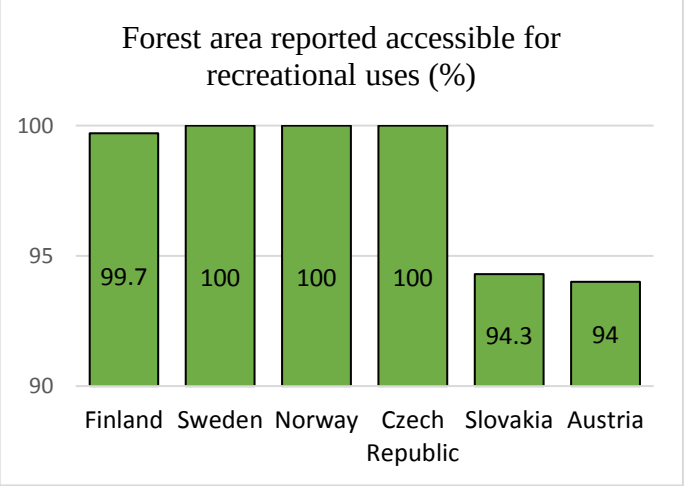


Chart No. 19: Percentage of forest area reported accessible to public for recreational uses. (Forest Europe, 2015)

The 0.3% of forests in Finland, that are reported not accessible for recreation, include the few state-owned, specific strict nature reserves which have been set under protection by law for scientific and educational purposes. Their protective regulations are stricter than in for example National Parks and typically they are closed from general public. (Metsähallitus, 2016a)

In Slovakia the few percent excluded from public include also strict nature reserves, military forests and game enclosures, meanwhile access to some forests is permitted only on way marked paths due to nature conservation interests and some mountain forests are inaccessible due to terrain constraints, such as dwarf pine communities. (FAO, 2014g; Ministry of Agriculture of the Slovak Republic, 2009) The Austrian Forest Act allows all people as a basic principle to access forests for recreational purposes, but few forest areas, such as young stands are exempted from this permission. (FAO, 2014h)

The extent of what public access or freedom to roam compasses in each country depends on legislation. All the Nordic countries share a rather similar concept of "everyman's rights" within their legislation, which allows people, locals and foreigners alike, to rather freely use forests for multiple purposes of recreation regardless of ownership. There are some small differences between each countries, but the general outline is the same; these freedoms automatically include for example hiking, skiing, biking, camping, boating and picking of many non-wood forest products, such as wildflowers, wild berries and mushrooms, as long as the species are not protected or endangered. In most areas if there is no risk that fire will spread, it is also allowed to light a campfire. (Finnish Ministry of the Environment, 2016; Naturvårdsverket, 2016; Norwegian Environmental Agency, 2016)

These rights come also with responsibilities, as exercising the everyman's right includes an obligation not to harm, disturb or litter the nature and not to damage crops or wildlife. Disturbing the privacy of people's homes by camping too near to them or making too much noise is also prohibited. (Finnish Ministry of the Environment, 2016; Naturvårdsverket, 2016; Norwegian Environmental Agency, 2016; Bauer et. al., 2004)

The Central European countries have more varying legislation regarding freedom to roam and typically the extent of recreational activities allowed through public access is somewhat more constricted than in Nordic countries. In Austria, since 1975 the right to roam in forests has been guaranteed by federal law, but this right is restricted to day-time use only. Walking, running, hiking, and resting are automatically allowed to the public in almost all forest areas, but for example horse riding, bike riding, driving motored vehicles and camping are not, and can only be practiced with the land owner's permission. Main regulation concerning forest consumables in Austria, such as mushrooms and

berries is that they are in free access "for recreational purposes", while the regulation assumes that collecting things to a minor extent goes with the recreational use. It is also assumed that the owners will implicitly accept this use as long as they do not say otherwise – they are allowed to forbid or restrict collection of NWFP's and they are allowed to ask for fees, but it must be announced properly through for example sign posts. (Foglar-Deinhardstein et al. 2015; Bauer et. al., 2004; European NWFP Policy Portal, 2016)

According to the Czech Act on Forests (1995), Article 19 *"individuals shall be entitled to enter the forest at their own risk. While doing so, they shall be obliged not to damage the forest and not to interfere with the forest environment."* This means citizens have a legal right to enter the forests on foot, while also for example the rights of gathering dry twigs lying on the ground, mushrooms and berries for personal purpose are guaranteed. Generally prohibited activities include driving and parking of motor vehicles, cycling, horse riding, skiing and sledging, without landowners' permission, outside of roads and marked paths. Use of open fires and camping outside designated areas is also prohibited. (Bauer et. al. 2004; Krejzar, 2015)

The Slovakian Forest Act (1993) provides, that anyone may enter forest land and forest stands while *"keeping indispensable caution and not disturbing the environment"*. Similarly as in Czech Republic and Austria, access to forest is in general allowed on foot, but other activities require forest owner's permission, marked paths or usage of forest roads. Foraging of typical forest consumables such as berries and mushrooms is allowed. Meanwhile it is prohibited to make a fire, camp, drive motored vehicles, cut trees, collect seeds, and disturb the soil cover or to disturb peace and silence. (Ministry of Agriculture of the Slovak Republic, 2009; Bauer et. al., 2004)

In general it can be said, that within both regions the differences are very few regarding the extent of activities enabled by legislation of forest access. Comparing the regions to each other, in the Nordic countries the everyman's rights hold slightly more freedoms, particularly those of camping and staying outdoors almost anywhere, with also the possibility of making open fire in most places. Similarly slightly more freedom is given in regard to moving in forests, which in Nordic countries is rarely tied to forest roads and marked paths when not moving on foot.

5.5.2 Socio-economic value and importance of non-wood forest products

Traditionally non-wood forest products (NWFP) are primarily classified among the productive functions of forests. However as seen, in the countries observed especially forest consumables are mostly free to pick for all public. Therefore when considering the combined recreational and cultural values of forest roaming while foraging or hunting, health benefits of these products and the possible economic benefits received, NWFP-collection can also be seen to hold significant socio-economic benefit. Vast majority of collected forest consumables or hunted game is not sold commercially, but consumed privately among families and friends. This makes it difficult to even evaluate the simple economic value of NWFP-removals. Evaluating their socio-economic value is even more complex, if possible.

The most recent and comprehensive collection of data regarding NWFP-removals and estimating their values nationally is the FAO's Global Forest Resources Assessment 2010, where the information was collected via country reporting of official national statistics. Estimated quantities and values (in local currency) of multiple products were reported from the year 2005. In the case of NWFP's, different measurement and valuation methods by country are well-visible within the FAO reporting. This combined with a wide range of products differing by each country, it is not applicable to tabulate them all into one presentative form. Therefore Table No. 5 here presents only the estimated total monetary values by country, while the full tables including all reported products and key species by quantity and value are included as annexes. As some monetary values were originally reported in different currencies, they were converted into euros as per 2005 exchange rates found via websites of European Central Bank. (European Central Bank, 2017)

Notable is also that the reported numbers mostly indicate the quantities and values of products sold commercially, not those kept for private consumption (particularly berries and mushrooms). Only in the case of Czech Republic it seems that the estimates given for FAO, regarding forest consumables represents the total estimated harvest rather than just commercial. The figures presented are the same as the total estimates given in a survey-study from Šišák in 2006, studying the "Importance of non-wood forest product collection and use for inhabitants in the Czech Republic". (Šišák,

2006) Different countries have different estimation methods for total amounts of removals, but accurate measurement of this obviously is not applicable.

	Finland	**Sweden**	**Norway**	**Czech Republic**	**Slovakia**	**Austria**
Total value of NWFP removals 2005 (€)	106 800 000	94 737 000	117 572 000	134 161 000	11 670 000	115 565 000

Table No. 5: Estimated values of NWFP-removals in the countries observed, 2005.

All Nordic countries share quite similar estimated values of their commercial NWFP-removals while also the reported products and key species are mostly the same. Bags of game, with moose (Alces Alces) being by far the most valuable species, constitute more than half of the value of NWFP's in all Nordic countries. Wild berries, mostly bilberries (Vaccinium myrtillys), cowberries (Vaccinium vitis-idaea) and cloudberries (Rubus chamaemorus) are clearly the second most valuable NWFP's and third come commercially grown/sold Christmas trees. (FAO, 2010b; FAO, 2010c; FAO, 2010d)

From Norway and Finland mushrooms were reported by value as the 4th most important product. In the Swedish report they are together with berries, but none named as key species, indicating in reality a similar situation in Sweden. Sweden reported altogether only these 3 groups of goods, citing the other NWFP's as very marginal. From Finland however was also mentioned medicinal and aromatic plants and from Norway hides and skins of game, while both countries mention also decorative lichens (Cladonia Stellaris). Especially the additional products from Finland held quite notable economic value. (FAO, 2010b; FAO, 2010c; FAO, 2010d) (Refer to annexes 1, 2 and 3 for more comprehensive information on Nordic countries)

From the Central European countries, the Czech Republic and Austria reported numbers similar to those of Nordic countries, with Czech Republic having the highest total value. As mentioned earlier however, it is probable the Czech estimates include at least partially also estimates of non-commercially collected products. The Slovakian total value reported was strangely only about one tenth of that what the others reported, which could indicate either a completely different measurement method or simply lesser

commercial and economic importance of NWFP's in Slovakia in general. (FAO, 2010e; FAO, 2010f; FAO, 2010g)

The Central European countries also did not share similar uniformity in main products and key species as the Nordic countries did. By far the most important NWFP's from the Czech Republic are mushrooms, which according to the country report equal more than half of the value of all NWFP-removals. After mushrooms, bilberries are clearly the second most valuable product collected in large quantities, followed by game meats of wild boars, roe deer and red deer and more forest berries such as raspberries, blackberries, elderberries and cranberries. (FAO, 2010e, Šišák, 2006)

In Slovakia the most valuable NWFP's are game animals, mainly wild boars and red deer, but also pheasants, roe deer and hares. Combined with "all other animal products", which includes mouflons and other rare game, hides skins and trophies, hunting constitutes in Slovakia more than half of the commercial value of all NWFP's. Mushrooms have the third highest value after main game species, but compared to Czech Republic and also Nordic countries they were reportedly collected in rather marginal amounts. Bilberries, cranberries and raspberries were the most collected berries, but also in very marginal amounts compared to other countries. (FAO, 2010f)

By commercial value, Austria's main NWFP's are by far Christmas trees, with the key species being the Nordmann fir. It is followed by bags of game meat mainly from roe deer and large quantities of wild honey, which is not even mentioned by other countries. Mushrooms and berries (with key species being rowanberry) were reportedly collected even in less quantities than from Slovakia. Forest consumables were overtaken in value even by collection of forest seeds and game skins, hides and trophies. (FAO, 2010g) The amount of consumables is affected by landowners' right to limit their picking from privately owned forests. Coupled with strong prevalence of orchards, wholesale of forest mushrooms and berries is insignificant and mostly these products are imported. (Foglar-Deinhardstein et al., 2015) (Refer to annexes 4, 5 and 6 for more comprehensive information on Central European countries)

As mentioned earlier, the FAO-reported numbers are rough estimates and mainly include commercially sold NWFP's. As such they best serve only as indicators in regards to which non-wood forest products are best available in each countries and what is their relative significance. There do not exist any on-going annual statistics compilations on

the amounts of berries picked or marketed across the Nordic countries, however a number of additional studies exist to attempt estimations of total amounts and values. (Kettunen et. al. 2012) Some countries have also created set estimation methods for these totals. As an example of this in Finland, where approximately every other person goes berry-picking each year, the annual total harvests of wild berries have typically been estimated 6–9 times and for mushrooms 2–6 times that of commercial picking. Nowadays the total annual berry-harvest alone is estimated around 60 million kg with a theoretical value of more than 120 million euros. (Natural Resources Institute Finland, 2015)

In the Czech Republic and Slovakia these totals have been estimated via questionnaire-based surveys and mathematical analysis (Šišák, 2006; Kovalčík, 2014). Results of the Czech study were already mentioned, while in Slovakia the theoretical annual value of picking forest consumables was estimated even as high as 110 to 140 million € with most of it coming from mushrooms and much different from the figures reported to FAO. (Kovalčík, 2014) This also goes to show the earlier indication of less value given to NWFP's in Slovakia false. From Austria no such, more in-depth studies were found, possibly related to lesser significance and more restricted availability of these products.

While NWFP's clearly can provide individuals with an economic benefit either by saving money or through sales, the collection of forest consumables in particular is primarily seen as a recreational activity. In the Czech Republic according to Šišák, only approximately 12% of people collecting forest consumables did it to save money or to receive other economic benefit. (Šišák, 2006) Similarly the survey from Slovakia concluded that only about 1% of pickers appeared to be gathering forest berries and mushrooms for selling them further. (Kovalčík, 2014)

Overall it can be said, that estimation-, product- and value-wise NWFP-removals are extremely similar within the Nordic countries and in between the Central European countries there are more noticeable differences. In the Nordic countries, as well as in Slovakia and Czech Republic the most of the important NWFP's are those which are either free or at least well available to public such as berries, mushrooms and game. Austria however differs greatly from its neighbouring countries and the Nordic ones. Many of the reported Austrian main NWFP's are primarily for commercial collection and use and not always available to everyone. Hunting is shown to be an important

recreational activity everywhere, while as a regional difference can be seen the key species hunted. The value given for skins, hides and trophies seems to be higher in the Central European countries.

5.6 Approaches to evaluation of forest functions

As was occasionally mentioned in the previous chapters, some very specific and trivial examples were found on how some of the indicators of socio-economic functions presented were measured or announced differently depending on country. However more precise methodology, even on theoretical level, regarding the measurement or evaluation of socio-economic functions specifically was not found from any of the countries observed. In a broader sense however, it was observed if the approaches or systems of evaluating forest functions in general would differ in these countries. Based on the information obtained through search of peer-reviewed works on the topic, the most different and comprehensive approach on evaluating forest functions would seem to come from the Czech Republic. Internationally commonly used methodologies are normally based on anthropocentric views and values, but the "Ecosystem method of quantification and evaluation of forest functions" from Vyskot rather evaluates the functional capacities of ecosystems, based on their natural traits and conditions. (Vyskot, I. et al., 2003)

The method by Vyskot is very data-demanding and is based on multiple calculations, with the key parameters being "real potential of forest functions", "real topical effect of forest functions" and the "topical social effect of forest functions". Explained in a simple way, these parameters estimate how well the specific forest ecosystem unit could produce a certain function under *optimum conditions*, how well in its *current condition* and what is the current *social interest* for each function in this ecosystem. (Vyskot, I. et al., 2003) More detailed information on the method in English can be found directly from the 2003 publication "Quantification and Evaluation of Forest Functions on the Example of the Czech Republic".

No similarly comprehensive and especially differing methods as Vyskot's, towards evaluation or measurement of forest functions were found from the other countries observed. Information on the subject overall seemed scarce and when available, extremely theoretical and abstract. From the Nordic countries relatively few studies or papers even mention forest functions as a concept outside of use within international

standards such as C&I for SFM. Most often when discussing the different uses or multiple-use of forests in the Nordic countries, the concept of forest ecosystem services and it's sub-categories of provisioning, regulating, habitat and cultural services are used instead. In this case however no specific or nationally individual approach was identified, as in most evaluations, the international standards of either The Economics of Ecosystems and Biodiversity (TEEB) or Common International Classification of Ecosystem Services (CICES) are used. Particularly in the case of TEEB-studies, the Nordic countries have also worked in co-operation towards identification and classification of ecosystem services in the region as a whole. (Kettunen, et. al. 2012)

As the main evaluation methodologies of forest functions in the Central European countries still appear to dominate the simpler, anthropocentric views of assigning forests with a primary function in regard to demands and needs of humans. These methods much more straightforwardly differentiate basic groups of functions, most commonly economic, ecological and social (or similar), and other partial functions are differentiated within these groups. Nationally there are some differences how these groups are formed, but basic ideas remain the same. For example, the forests in Slovakia are typically classified by their primary assigned function into categories of commercial (economic), protective (ecological) and special purpose forests. Special purpose forests fulfil primarily social functions of forests such as recreational, medicinal-curative, nature protective or educational-research. For every forest unit is assigned one of the 67 specific function combinations in Program of Forest Care or Forest Management Plan. (Kunca & Olah, 2016) These main categories are practically the same in the Czech Republic as well according to the 1995 Czech Act on Forests, before the further implementations of Vyskot's method. In Austria forests are assigned one of the four "key functions" in the Forest Development Plan and these include economic, protective, beneficial and recreational functions. (Foglar-Deinhardstein et al., 2015)

The inter-relatedness of forest functions and ecosystem functions has also been noted and further studied in other countries as well similarly as Vyskot, but not to the same extent. For example, Kunca and Olah in their work "Present state and relationships of forest functions and ecosystem services in Slovakia" (2016) argue, that some of the forest functions categorized within the traditional anthropocentric methodology used are in fact more identifiable as ecosystem services. (Kunca & Olah, 2016)

6. Conclusion

The main characteristics associated with the socio-economic functions and benefits provided by forests in the two regions proved somewhat similar, particularly by the social aspects and the prevailing forest management-related goals. Main differences between the countries are better identifiable through the economic aspects of these functions. The total range and value of the socio-economic functions which the forests provide, seem to highly relate not only to the amount of forest resources, but also to the cultural, historical and political backgrounds of each country and concurrently to the current size, importance and level of development of the local forest-based industries.

From the Nordic countries, Sweden and Finland are global economic powerhouses when it comes to forestry and forest industries, because they have developed on top of massive natural resources and a long history of wood as the most important raw-material available. In Norway, although technology used is often similarly advanced and major forest resources exist, the relative significance of industries is quite small due to their vast riches of other resources, such as oil and natural gases. From the Central European countries, Austria has a rather significant forest sector on global scale as well, but the significance of forests to the overall national economy is smaller. The Czech Republic compares somewhat well on European level, while Slovakia, much like Norway is slightly less significant when it comes to forest-based industries. Although the forests of these Central European countries also hold long cultural and economic significance historically, other resources used by more competitive industrial sectors have surpassed the forest sector and diminished its value. All these mentioned circumstances are well-reflected in the scope of many of the socio-economic functions of forests in these countries.

Differences in specific approaches used for the measurement or valuation of socio-economic functions were found few and rather trivial. In a broader observation on what methods are used to evaluate forest functions in general, only the detailed and thorough ecosystem-based system by I. Vyskot from the Czech Republic stood out. Otherwise the methodologies used are strongly based on the standards used by different international platforms.

7. Závěr

Hlavní charakteristiky spojené se socio-ekonomickými funkcemi a výhodami se v těchto dvou oblastech ukázaly být podobné, zejména sociální aspekty a cíle spojené s řízením lesa. Hlavní rozdíly mezi zeměmi jsou lépe identifikovatelné mezi ekonomickými aspekty. Celkový rozsah a hodnota socio-ekonomických funkcí, které lesy poskytují, se vztahuje nejen na množství lesních zdrojů, ale také na kulturní, historické a politické prostředí v každé zemi a současně k velikosti, významu a úrovni rozvoje místního průmyslu založeného na lesnictví.

Ze severských zemí to jsou převážně Švédsko a Finsko kdo tvoří globální ekonomické velmoci, pokud jde o lesní hospodářství a dřevařský průmysl, protože dřevo je nejdůležitější přírodní zdroj v těchto zemích a zpracování má zde dlouhou tradici. V Norsku, i když používají podobně pokročilé technologie a mají rozsáhlé lesní zdroje, je dřevařský průmysl poměrně slabý vzhledem k obrovskému bohatství jiných zdrojů, jako je ropa a zemní plyn. Ze středoevropských zemí, Rakousko má poměrně výrazné odvětví lesního hospodářství na celosvětové úrovni, ale význam lesů v celkovém národním hospodářství je menší. Česká republika má srovnatelné výledky na evropské úrovni, zatímco Slovensko, podobně jako Norsko, má o něco méně významné pokud jde o odvětví založené na lesnictví. Ačkoli lesy v těchto zemích střední Evropy také mají historicky velký kulturní a hospodářský význam, jiné zdroje, použité ve více konkurenceschopných průmyslových odvětvích, překonaly odvětví lesního hospodářství a snížily jeho hodnotu. Všechny tyto zmíněné okolnosti se odráží v rozsahu mnoha socio-ekonomických funkcích lesů v těchto zemích.

Rozdílů v konkrétních metodách používaných pro měření nebo hodnocení socio-ekonomických funkcí bylo zjištěno několik a byly docela nepatrné. V širším úhlu pohledu na to, jaké metody jsou použity pro zhodnocení funkcí lesa obecně platí, že vyčnívá pouze podrobný a důkladný systém založený na ekosystému od I. Vyskota z České republiky. V opačném případě se použité metodologie zakládají na normách různých mezinárodních platforem.

8. Discussion

Reflecting back on the simplified definition of socio-economic functions: "the benefits to society of economic activity" given by FAO, it occasionally proved seemingly appropriate amidst evaluating the scope and range of forest socio-economic functions in the countries observed. Sweden, Finland, Austria, followed by the Czech Republic have most significant forest-based industries within the groups, and the economic activity they practice does seem to in most cases lead to a higher proportion of realization of some socio-economic benefits. Positive trade surplus from wood products, higher rates of wood-based energy consumption and larger workforces in the forest sector are just some examples of this. This view however, as mentioned is a very narrow presentation of the actual nature and range of forest socio-economic functions.

Sebera mentions in his work "Assessment of non-wood-producing functions of the forest as forest services to the public" (2004) that "*An assessment of social functions of the forest is very complicated not only because the forest itself is rather a complicated object whose functions in the society are multiple, but also because the required forest services constantly develop along with the development of the society – closely related to the economic and social standard of the society, its culture, traditions and customs*." (Sebera, 2004). This correlates well with the observations made earlier in the conclusions of this work, regarding what factors have affected the development and values of forest socio-economic functions in the countries observed.

The overall research design and methodology of the work felt like it suited well the fulfillment of most set research objectives and the primary aim of the work; a comparison of Nordic and Central European forests for their socio-economic functions. The results obtained met on most parts both pre-existing personal expectations and the ones strengthened by the theoretical framework made for and before the study. Overall the literature review and compilation of relevant data felt successful, despite being written in most parts before the full scope of the work was finalized.

The research design of the work also ended up having some limiting hindrances, although in most cases they were more so consequences from lack of available data. With the use of broad, internationally set standards as the basis of the comparison, also the socio-economic functions were examined from a broader, national-level point of view.

This understandably could exclude some more specific, only locally prevalent socio-economic benefits which forests can provide. However relevant data on more such cases, particularly in English is hard to come by, which is why the international standards were found more applicable. Another related problem is, as it has been established before, the lack of a clear and universal agreement of what exactly is the definition of a socio-economic function or benefit, especially one provided by forests. Therefore it is difficult to assess such functions outside of those included within the internationally agreed-upon C&I or other standards. The addition of less specific and less measured or qualitative functions only potentially socio-economic by nature, would have left the addressing of these topics too much to authors' own interpretation

A lot of the official statistical data utilized in the work is not entirely recent or there can be some issues regarding its accuracy (for example in the case of economic value of NWFP's). Also many economic figures presented are partially from the time period when the economic crisis was still affecting Europe. However these are not necessarily major issues, as the statistics primarily serve only as reference. They approximately indicate what the relative significances or ranges of each socio-economic functions are in different countries. Therefore exact numerical data is not even required, and as in this case it was also simply not available from all countries.

The most major limitations of this work however related to the secondary aim of the work and its related research objectives, which resulted in unmet expectations and unfortunate shortcomings in results. Information needed for answering the secondary aim of the work – countries' different approaches to measuring and valuating the socio-economic functions and forest functions in general – proved unexpectedly difficult. It is probable, that the selected methodology of using C&I as the standard of the socio-economic functions of forest did not best support this secondary comparison. C&I, as mentioned approaches the socio-economic functions from a rather wide perspective and even if national approaches exists, they must fitted within the frames of internationally standardized reports. As such, only in the cases of some topics covered there could be identified various small differences in how statistics were originally compiled (measurement) or how some socio-economic aspects seemingly were more culturally and socially significant in other countries.

The search for more in-depth information on some nationally used evaluation systems of forest functions or standards, led only to one particularly different example, the "Ecosystem method of quantification and evaluation of forest functions" (2003) from Vyskot, based on Czech natural conditions and the relationships of forest functions and ecosystem services. From the other countries some studies were found similarly observing these relationships on theoretical-level, but far from the extent of Vyskot's system. None of them are in actual wider use at national level, not from the countries included in this work at least. Based on the information available, it seemed the general approaches for evaluation and measurement of forest functions in these countries are more commonly based on those of international platforms, with only tweaks and twists done to better accommodate local conditions. Therefore in the end, no rational or meaningful comparisons could be made. In hindsight however, seeing how long the work grew even with little emphasis placed on the secondary aim, an additional comparison could have bloated the overall scope even too much.

Aside from these problems encountered, the overall procedure for obtaining information and finding relevant and sufficiently up-to-date sources felt successful. Especially from Finland, Sweden, Austria and the Czech Republic recent enough information was relatively easy to come by in English, while in the case of Norway and Slovakia further digging was often needed. Most relevant sources were obtained through libraries, online research libraries and from the staff of the Faculty of Forestry and Wood Technology in Mendel University. While most of the used statistics were derived from large, both national and international compilations as pure numbers, they were supported and given further insight via observations of additional studies and personal insights.

The main benefit, aside from vast amounts of self-learning, that can be retrieved on the basis of this work, is a less generalized and more in-depth examination on the inter-relatedness of both social and economic aspects of the presented forest functions in these countries. Instead of presenting these examinations as is, a comparison between these forested countries with different backgrounds and traditions also sheds light on the conditions other than natural, which affect the socio-economic benefits provided by forests. Overall it also works as a straight-up compilation of information from a more specific point of view.

Besides this, the work can serve in practice as a starting platform or initial groundwork for further, more specified work. As recommendations for further research could be suggested many improvements upon used methodologies or completely different perspectives for work. To delve deeper into the intricacies of the socio-economic nature of forest, further comparative studies in particular could be made from less broad points of view, the targeted areas smaller or perhaps focused on countries or localities of more different natural conditions or with larger gaps in overall development. It is probable however, that such work would also require more advanced methodology for obtaining relevant information and/or knowledge of local languages, as existing research and literature can otherwise be scarce.

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10. Annexes

Annex No. 1: FRA 2010 – Country Report, Finland: Non-wood forest products removals and value of removals

Annex No. 2: FRA 2010 – Country Report, Sweden: Non-wood forest products removals and value of removals

Annex No. 3: FRA 2010 – Country Report, Norway: Non-wood forest products removals and value of removals

Annex No. 4: FRA 2010 – Country Report, Czech Republic: Non-wood forest products removals and value of removals

Annex No. 5: FRA 2010 – Country Report, Slovakia: Non-wood forest products removals and value of removals

Annex No. 6: FRA 2010 – Country Report, Austria: Non-wood forest products removals and value of removals

Annex No. 1: FRA 2010 – Country Report, Finland: Non-wood forest products removals and value of removals (FAO, 2010b)

Rank	Name of product	Key species	Unit	NWFP removals 2005		NWFP category
				Quantity	Value (1000 local currency)	
1st	Bags of game	Alces alces	1000 kg	11 993	71000	Wild meat, includes skins
2nd	Wild berries	Vaccinium vitis-idaea		n.a.	10 800	Food
3rd	Christmas trees	Picea abies		n.a.	10 000	Ornamental plants
4th	Mushrooms			n.a.	9 000	Food
5th	Medicine and aromatic plants (yrtit)			n.a.	5 000	Raw material for medicine and aromatic products
7th	Lichens	Cladina spp.		n.a.	1 000	Ornamental plants
8th						
9th						
10th						
All other plant products						
All other animal products						
TOTAL					**106 800**	

	2005
Name of local currency	Euro

12.4 Comments to Table T12

Variable / category	Comments related to data, definitions, etc.
10 most important products	
Other plant products	
Other animal products	
Value by product	Value defined as market value of the products except that for berries is defined as 9 times the picking incomes and for mushrooms 6 times the picking incomes. These factors (9 and 6) has been estimated to describe the value of products used by house holds (never coming to markets).
Total value	

Annex No. 2: FRA 2010 – Country Report, Sweden: Non-wood forest products removals and value of removals (FAO, 2010c)

Rank	Name of product	Key species	Unit	NWFP removals 2005		NWFP category
				Quantity	Value (1000 local currency)	
1st	Bush meat	Moose, Roe deer	Ton	15700	487 000	12
2nd	Berries and mushroom	Bilberry, cowberry	Ton	35875	301 000	1
3rd	Christmas trees	Picea abies	1000 psc.	2800	112 000	6
4th						
5th						
6th						
7th						
8th						
9th						
10th						
All other plant products						
All other animal products						
TOTAL					**900 000**	

	2005
Name of local currency	Swedish crown

12.5 Comments to Table T12

Variable / category	Comments related to data, definitions, etc.
10 most important products	
Other plant products	Christmas trees are harvested both on forest land and agriculture land. The share coming from the forest is not known.
Other animal products	
Value by product	The values of the goods are ruff estimations. The value of bush meat and berries of mushrooms are unfortunately not directly corresponding to the quantity.
Total value	

Annex No. 3: FRA 2010 – Country Report, Norway: Non-wood forest products removals and value of removals (FAO, 2010d)

Rank	Name of product	Key species	Unit	NWFP removals 2005		NWFP category
				Quantity	Value (1000 local currency)	
1st	Wild meat	See 12.2.3	1000 kg	7 419	579 728	12
2nd	Wild berries	Vaccinium myrtillus, Vaccinium vitis-idaea, Rubus idaeus, Rubus chamaemorus	1000 kg	17 500	210 000	1
3rd	Christmas trees	Picea abies, Pinus silvestris, Abies lasiocarpa, Abies nordmanniana, Picea pungens etc.	1000 pcs.	900	100 000	6
4th	Mushrooms	Boletus edulis, Cantharellus cibarius etc.	1000 kg	1 500	45 000	1
5th	Decorative foliage	Abies spp. (esp. Abies procera), Picea spp., Chamaecyparis spp.	1000 kg	300	3 250	6
6th	Decorative lichens	Cladonia stellaris	1000 kg	100	1 500	6
7th	Hides and skins	Alces alces, Vulpes vulpes, Martes martes	1000 pcs.	9	1 100	10
8th						
9th						
10th						
All other plant products						
All other animal products						
TOTAL						

	2005
Name of local currency	Norwegian kroner (NOK)

12.5 Comments to Table T12

Variable / category	Comments related to data, definitions, etc.
10 most important products	
Other plant products	A very limited production of aromatic oils based on foliage from coniferous trees and other plants is known.
Other animal products	Some of the animals shot during hunting will be further processed into trophies. These are mostly for private reasons, and quantity and financial value are not known.
Value by product	
Total value	

Annex No. 4: FRA 2010 – Country Report, Czech Republic: Non-wood forest products removals and value of removals (FAO, 2010e)

Rank	Name of product	Key species	Unit	NWFP removals 2005		NWFP category
				Quantity	Value (1000 local currency)	
1st	Mushrooms	Mushrooms	tons	19500	2048000	1
2nd	Blueberries	Blueberries	tons	7600	670000	1
3rd	wild boar	wild boar	tons	5028	251395	12
4th	Raspberries	Raspberries	tons	2600	246000	1
5th	roe deer	roe deer	tons	1864	233038	12
6th	Blackberries	Blackberries	tons	1300	125000	1
7th	red deer	red deer	tons	1548	108353	12
8th	Elderberries	Elderberries	tons	1300	101000	1
9th	Cranberries	Cranberries	tons	800	85000	1
10th	hare	hare	pieces	93377	28013	12
All other plant products					0	
All other animal products					61941	
TOTAL					**3957740**	

	2005
Name of local currency	CZK – Czech Crown

12.4 Comments to Table T12

Variable / category	Comments related to data, definitions, etc.
10 most important products	
Other plant products	No comprehensive info on the amount of plants collected for medicine purposes
Other animal products	
Value by product	
Total value	

Annex No. 5: FRA 2010 – Country Report, Slovakia: Non-wood forest products removals and value of removals (FAO, 2010f)

Rank	Name of product	Key species	Unit	NWFP removals 2005		NWFP category
				Quantity	Value (1000 local currency)	
1st	Wild boar		Individuals, (pcs)	21 804	48 142	12
2nd	Red deer		pcs	12 723	47 042	12
3rd	Fresh mushrooms		1000 kg	685	33 450	1
4th	Pheasants		pcs	127 943	22 390	12
5th	Roe deer		pcs	17 170	20 260	12
6th	Bilberry		1000 kg	180	11 500	1
7th	Hare		pcs	21 818	8 073	12
8th	Cranberry		1000 kg	65	4 875	1
9th	Fallow deer		pcs	2 257	4 288	12
10th	Raspberry		1000 kg	140	3 425	1
Together		-	-	-	203 445	
All other plant products					117 355	
All other animal products					127 894	
TOTAL					**448 694**	

	2005
Name of local currency	Slovak crown (SKK)

12.5 Comments to Table T12

Variable / category	Comments related to data, definitions, etc.
10 most important products	Most important products are by name in the table 12.4
Other plant products	Other plant products included other forest fruits , fodder, raw materials for medicine and aromatic products, raw material for utensils, handicraft & construction and ornamental plants.
Other animal products	Up to other animal products are include those kind of products: mouflon, rare game, other game and hides, skins and trophies
Value by product	Value by products is prevailingly market value timely year regardless of the are for subsistence and commercial use
Total value	

Annex No. 6: FRA 2010 – Country Report, Austria: Non-wood forest products removals and value of removals (FAO, 2010g)

Rank	Name of product	Key species	Unit	NWFP removals 2005		NWFP category
				Quantity	Value (1000 local currency)	
1st	Christmas trees	Nordmann Fir	pcs.	2 000 000	52 325	6
2nd	Wild meat	Roe deer	tons	10 733	22 408	12
3rd	Wild honey		tons	3 050	17 416	11
4th	Forest plants	Spruce	pcs.	31 000 000	11 232	8
5th	Skins, hides and trophies	Roe deer	pcs.	287 000	5 800	10
6th	Forest seeds	Spruce	tons	16.0	3 092	8
7th	Mushrooms	Chanterelle	tons	200	2 600	1
8th	Fruits and berries	Mountain ash	tons	123	460	1
9th	Resins	Austrian pine	tons	54.0	196	3; 7
10th	Raw material for aromatic oil	Swiss stone pine	tons	130	25	3
All other plant products					11	
All other animal products						
TOTAL					**115 565**	

	2005
Name of local currency	Euro

Variable / category	Comments related to data, definitions, etc.
10 most important products	**Information on quantities (collected within D3):** Christmas trees – data by D3 Wild meat – data by D1; E1 Wild Honey – data by D1; E2 Forest plants and seeds – data by D2 Skins, hides and trophies – data by D1; E3 Mushrooms – data by D3 Fruits and berries – data by D4 Resins – data by D3 Raw material for aromatic oil – data by D3
Other plant products	- Herbs used for distilling (key species: gentian) (D3). - The role of nuts (walnut, chestnut) is still unclear, but tends to be of minor importance. - The amount of decorative foliage is still lacking.
Other animal products	Marmot fat and deer tallow have no significant importance any more.
Value by product	All values are calculated by means of average prices paid to producers in 2005, except expert estimations for 'trophies' which are based on shot allowances.
Total value	