A thesis submitted to the Department of Environmental Sciences and Policy of Central European University in part fulfilment of the Degree of Master of Science.

Climate and biodiversity: a match made in fire

The limits and ecological implications of EU forest policies in relation to the value of forest ecosystem services

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Author's declaration

No portion of the work referred in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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ABSTRACT OF THE THESIS

Submitted by Eszter KISS

for the degree of Master of Science and entitled:

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Valuing and thus using forest ecosystem services properly is vital to mitigating climate change and conserving biodiversity. The European Union has recognised the importance of forest ecosystem services, which are included in many sectoral policies but in a non-coordinated or conflicting way. This is due to the lack of common EU forest policy, as forest policy remains the responsibility of the Member States. The thesis aimed to analyse the coherence of different sectoral policies, particularly the treatment of forest biomass as climate-neutral renewable energy and their ecological impacts, with a particular focus on two valuable forest ecosystem services, biodiversity and climate change mitigation. Using qualitative research methods through the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services' values of nature and the global forest governance frameworks, literature review, EU policy analysis, and in-depth interviews with eleven experts in the field of forestry and forest protection, the author investigated EU forest policies. She found that the EU's policy of treating forest biomass as renewable energy not only means the loss of valuable European forests and thus further loss of biodiversity but also jeopardises the climate objectives of the European Green Deal. The author concludes that a reassessment of how forest ecosystem services are reflected in policies is needed, for which she makes suggestions. Besides EU policies, NGOs also need a strategy change, which the author proposes for further academic research.

Keywords: forest, ecosystem services, EU policies, biodiversity, climate, mitigation, renewable energy, biomass, governance, nature values

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

CC	climate change
CCM	climate change mitigation
CBD	Convention on Biological Diversity
CO2	carbon dioxide
EC	European Commission
EU	European Union
FAO	Food and Agriculture Organization
FES	forest ecosystem services
GHG	greenhouse gas
HU	Hungary
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	International Panel on Climate Change
LULUCF	Land use, land-use change, and forestry
MEA	Millennium Ecosystem Assessment
MM^3	million cubic metres
MS	Member States
Mt	megatonne
NCP	Nature's Contribution to People
NGO	Non-governmental organisation
N2k	Natura 2000
NWFP	non-wood forest products
PA	protected area
RED	Renewable Energy Directive
SWE	Sweden
UN	United Nations

1. Introduction

1.1 Problem statement

Forest ecosystem services have become increasingly important in European Union policy over the last decade (Hetemäki 2022). This is understandable, as forest ecosystem services are essential for climate change mitigation (CCM) and biodiversity conservation (Pörtner et al. 2021). A stable climate, and healthy biodiversity and ecosystems, are necessary for the integrity of the entire planet, and thus humankind's long-term ability to survive and prosper (Pörtner et al. 2021, 2023). The European Union (EU) does not currently have a common forest policy, it is still a matter for the Member States (MSs), which is a problem in the work for establishing the various EU policies that also determine the legislation of the MSs (Aggestam and Pülzl 2018). At the same time, the EU is facing several equally critical problems that need immediate solutions, such as climate change (CC), the energy crisis, and an ongoing biodiversity loss. In the absence of a common forest policy, the various forest ecosystem services (FES) covered by different policies are often not coordinated and, in many cases, even conflict with each other (Elomina and Pülzl 2021; Hetemäki 2022; Winkel et al. 2022). This, however, makes it impossible to take effective action against the problems that ultimately threaten humanity and thus nature.

Nature, and hence FES, have many values that are equally important, such as energy, wood-based products, non-wood forest products (NWFP), tourism, education, mental health and human well-being, biodiversity, and CCM (Díaz et al. 2020; FAO 2022; Reid et al. 2005). The question is which FES are more important for humankind or even whether it is possible to prioritize them. FES have three different special values. These are instrumental values; relational values; and intrinsic values such as biodiversity and ecosystems (IPBES 2022). According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem

Services (IPBES), these three special values should be equally reflected in the policy. Yet, in scientific research and EU policies it is mainly the primarily anthropocentric values, that are highlighted (IPBES 2022).

The importance of the economic value of FES is reflected in the importance of woody biomass in the EU's renewable energy mix and the EU's policy approach to woody biomass. The EU has considered woody biomass as renewable energy since the 2009 Renewable Energy Directive (RED I) (EC 2015). The directive, which has been revised twice since then (RED II and III) (EC 2022 and EC 2021a), continues to consider not only secondary woody biomass, but also primary woody biomass as climate-neutral and renewable. As a consequence, nearly 60% of the EU's renewable energy is biomass (Scarlat et al. 2019), of which a large part is woody biomass (Calderón et al. 2020). In addition, as EU policies do not properly clarify the concepts of forests, protected areas, secondary and primary woody biomass, forestry often labels and uses primary woody biomass as secondary woody biomass causing enormous damage in terms of CC and biodiversity. According to forest ecologists and NGOs, for the EU to be effective in mitigating climate change, conserving biodiversity and meeting the 2030 and 2050 climate targets (EC 2023d), primary woody biomass should not be considered as net zero and renewable energy (Booth 2022; Luyssaert et al. 2018; Mather-Gratton et al. 2021; Naudts et al. 2016; Pörtner et al. 2021; Scarlat et al. 2015; Stubenrauch and Garske 2023; Ter-Mikaelian et al. 2015). In their view, by including primary woody biomass in the renewable energy mix in this year's revision of RED II (RED III) (EUCO 2023a), the EU has undermined the climate targets set in the European Green Deal (EC 2023d).

1.2 Aims and Objectives

This thesis aims is to analyse the extent to which the different vital ecosystem services provided by forests and woodlands are integrated in EU policies and their likely ecological

consequences. This is of particular importance because the intrinsic values of forest ecosystem services, such as the conservation of biodiversity are also essential for the survival of humanity (IPBES 2022). On the other hand, EU directives and legislation also determine MSs' legislation, so their direction and strength have an impact on the overall nature and forest situation in Europe. In the research presented here, which was conducted through an in-depth literature review and workshops, the author interviewed experts from different fields to answer the following questions:

- Are current EU policies in balance with the framework of forest ecosystem services?
- Can the EU reach climate goals by considering woody biomass as renewable energy?
- How are climate change mitigation and biodiversity as forest ecosystem services reflected in EU policies and what are the ecological implications?

1.3 Outline

The thesis consists of six chapters. The first, introductory chapter summarizes the problem statement and the research questions. The author is aware the thesis has several limitations which are also summarised here. The second chapter of this thesis is a literature review summarising the importance and role of FES in environmental policy, followed by a summary of the different strands of the main FES literature. As the author conducted interviews in two countries, Hungary (HU) and Sweden (SWE) during her research, she also summarises the literature on forest management and FES in these two countries. The third chapter presents the two theoretical frameworks that assisted the author during the thesis research. These are the IPBES Values of nature framework and global forest governance framework. In the fourth chapter, the author describes the method used to collect, analyse, and process the data and discusses the principles that ensured the ethical issues during the research, writing the thesis and storing the data. The fifth chapter discusses the findings of the research on the value of

FES and their representation in EU policy and its effectiveness and implications, then outlines possible strategies for nongovernmental organizations (NGOs) to strengthen effective advocacy for FES in policy, economic and social spheres. In the last chapter, the author provides her own conclusions drawn from the research and explores possible future research opportunities on the topic.

1.4 Limitations of the study

The focus of the research is to show how forests may provide a wide range of ecosystem services that are equally crucial and indispensable, not only for humans, but also for the healthy functioning of the planet. Precisely because of its importance and the many ecosystem services it provides, the complexity of the subject is illustrated by the thousands of studies on the subject, covering many different aspects. The paper is therefore only a brief summary to give a sense of the complexity of the subject and to illustrate the importance of policy by analysing one service, namely bioenergy, and its ecological consequences. Although the thesis examines the effectiveness of the current EU policies, it explores its visible consequences in two countries in detail through interviews and studies. Although these countries have been chosen to illustrate the attitudes towards bioenergy represented by EU countries, the fact that only two countries have been studied in the thesis influences the results of the research. The research is qualitative research, i.e. based on the personal opinions of the interviewees, and therefore not suitable for generalisations, especially as the author's selection process of interviewees may have influenced the conclusions of the thesis. Some interviewees have a background in forest ecology, also the workshops the author attended were organized by NGOs. Nevertheless, the author deliberately attended a forestry conference to learn about the perspectives of forest owners and managers, and also spoke to professionals working in forestry authorities, which

balanced the possible insights and reflections from the interviews. The results could serve as a starting point for other research in specific areas in the future.

2. Literature review

This chapter provides a literature review of previous literature and theories on the subject. Firstly, the author presents a brief overview of the historical context of European forests and forest management, and then summarizes the research and results related to FES, also the ecological impacts of considering forest biomass as renewable energy. Given that the author's research has focused on forest management and forest biomass use practices in two countries, HU and SWE, she also summarizes related research in these countries.

2.1 Forest land area in the past

Since the beginning of history, wood has been one of humanity's dominant raw materials and staples. Even though man has used many other raw materials throughout history, wood is still a very important raw material today. In addition to continuing to be used in the construction of buildings and furniture and playing an indispensable role in the transport and paper industries, wood still accounts for a large proportion of the world's energy mix (FAO 2022; Gurria et al. 2022). However, forests have many other roles besides being used as raw materials, which is why it is particularly important to understand what happened to forests in the past, as this knowledge provides an opportunity to understand the causes of e.g., global deforestation[1], the importance of other FES and the steps needed to save the remaining natural forest cover and start a significant and effective afforestation[2] process.

Thousands of years ago, much of the European continent was covered by deciduous and mixed forests, interspersed with meadows and savannah-like fields, but the emergence of

[1] According to the FAO definition deforestation means „the conversion of forest to other land use independently whether human-induced or not" (FAO 2020b, 6).
[2] FAO defines afforestation as „establishment of forest through planting and/or deliberate seeding on land that, until then, was under a different land use, implies a transformation of land use form non-forest to forest" (FAO 2020b, 6).

agricultural societies around 4000 BC had already resulted in significant deforestation of European forests for ploughing, grazing, firewood, shipping and building materials (Andresson 2021; Fernow 2022; Hughes and Thirgood 1982; Kaplan et al. 2009; Williams 2000). Braudel (1981) stated ”Civilizations before the eighteenth century were civilizations of wood and charcoal” (Braudel 1981, 362), meanwhile, German economist Werner Sombart distinguished pre-industrial history from post-industrial history by calling the former era: ”Wooden Age” (Warde 2006, 6). The continent experienced significant deforestation from as early as the 11th century BC, which, although increasing only slightly for a millennium after the fall of the ancient empires, was followed by a rapid loss of forest cover in Europe from the late 15th century onwards. The power and strength of Europe were given by its abundant forest resources (Braudel 1981), however, the consequence was disastrous for the forest resources, as the European continent lost a large part of its forest cover by the mid-19th century (Kaplan et al. 2009, Zanon et al. 2018). **Figure 1** shows the rate of deforestation on the continent from 1000 BC until AD 1850. As a consequence, in 2020, the forest cover of Europe was about 227 million hectares, 35% of the land area of the continent (Forest Europe 2020). Meanwhile, Europe almost completely eliminated its primary forests[3] (Kaplan et al. 2009; Sabatini et al. 2018), only rare patches have remained. The remaining area of old forests are mainly semi-natural

[3] According to FAO primary forests are ”naturally regenerated forest of native tree species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed” (FAO 2020b). Convention on Biological Diversity (CBD) use a longer and more detailed definition of primary forest by stating: „A primary forest is a forest that has never been logged and has developed following natural disturbances and under natural processes, regardless of its age. It is referred to "direct human disturbance" as the intentional clearing of forest by any means (including fire) to manage or alter them for human use. Also included as primary, are forests that are used inconsequentially by indigenous and local communities living traditional lifestyles relevant for the conservation and sustainable use of biological diversity. In much of Europe, primary forest has a different connotation and refers to an area of forest land which has probably been continuously wooded at least throughout historical times (e.g., the last thousand years). It has not been completely cleared or converted to another land use for any period of time. However traditional human disturbances such as patch felling for shifting cultivation, coppicing, burning and also, more recently, selective/partial logging may have occurred, as well as natural disturbances. The present cover is normally relatively close to the natural composition and has arisen (predominantly) through natural regeneration, but planted stands can also be found. However, the suggested definition above would include other forests, such as secondary forests.” (CBD 2006)

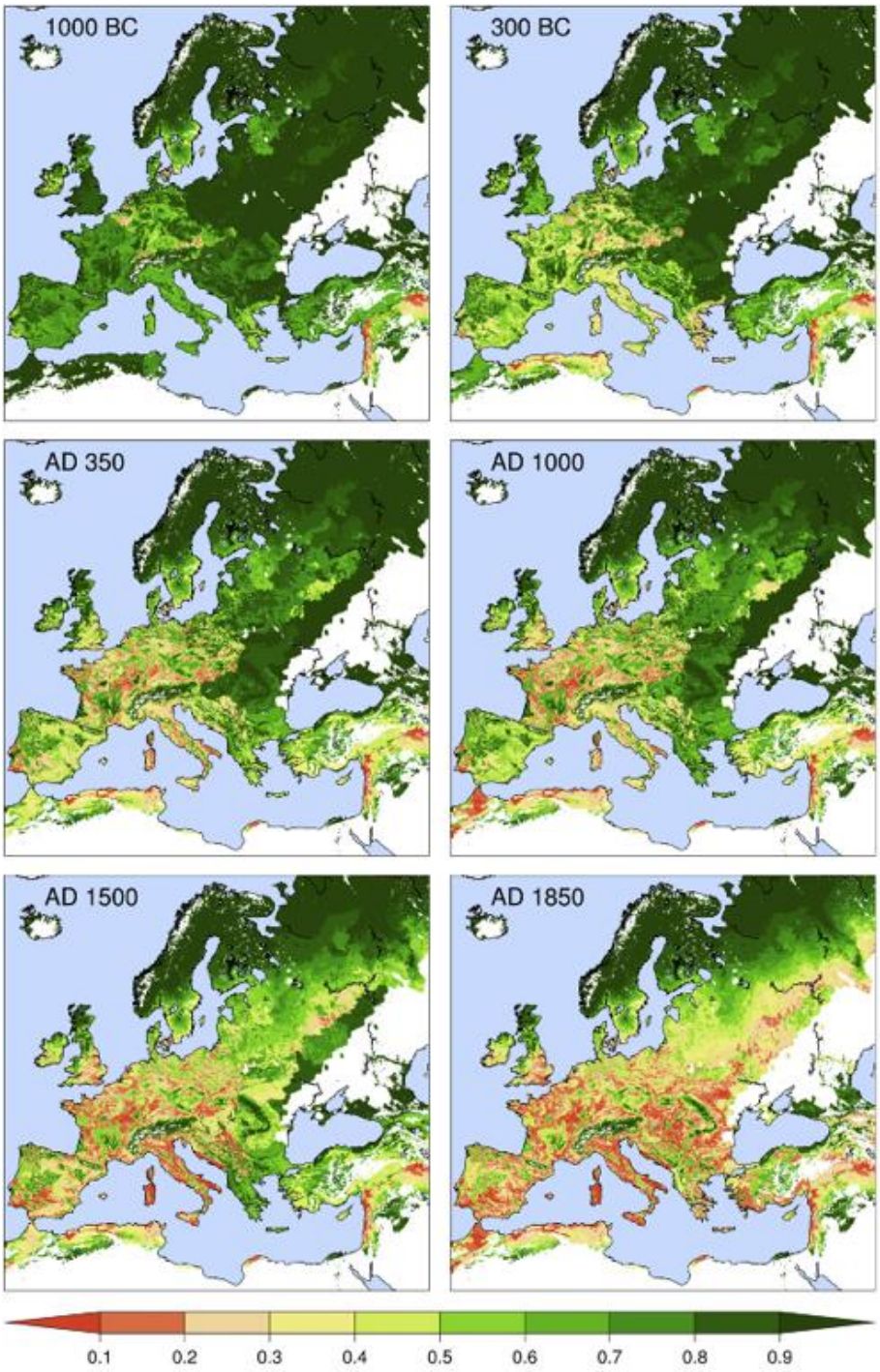

Figure 1: Kaplan's "deforestation map".
1000 BC, 300 BC, AD. 350, 350 AD. 1000 AD, 300 AD, 300 AD, 1000 AD. 1500 and AD. 1850. Source: Kaplan et al. 2009.

forests[4]. Intact primary forest, however, accounts for only 0,7% of Europe's forest area. Although 89% of Europe's old forests are protected, only 46% of them are protected strictly

[4] The semi-natural forest is used by European Environment Agency (EEA) as „a stand which is composed predominantly of native trees and shrub species which have not been planted. Also, a forest which has developed

from exploitation which means that half of these forests are still allowed to be logged (Sabatini et al. 2018).

2.2 Forest ecosystem services

For a very long period of time in history, wood had no value until it was logged and used for energy or raw materials (Braudel 1981). Today, however, forests are used for multiple purposes, like ecosystem services such as biodiversity conservation, water protection, erosion control, tourism, human well-being, and they also have a very important role in carbon storage (Reid et al. 2005). Yet, in many cases, we somehow forget the multitude of values that forests provide us. Even though, if we look only at their economic values, they are significant, exceeding in total the value that wood itself provides as a raw material (FAO 2022; Calama et al. 2010). Moreover, forests do not only have a monetary value, and their monetary value can even be dwarfed by the other values that they provide to humanity through their carbon sequestration capacity or biodiversity. The author briefly reviews the literature on FES. As forests are one of the most important elements for the existence of the planet and the human species and therefore provide several ecosystem services, the amount of literature on this topic is so large that the scope of this thesis is not suitable for a comprehensive literature review, and therefore the different directions and approaches are presented.

2.2.1 Beginnings of global forest ecosystem services policies

By the early 2000s, the value and importance of nature and forests in CCM was clear and it gave birth to extensive research in the topic. This considers that the demands placed on forests

gradually or accidentally, as its location or site quality was not suited for intensive exploitation or production-oriented management (e.g. in mountainous regions). This kind of reconstruction of the natural forest cover can be or has been achieved by using various silvicultural practices, e.g., natural regeneration or selective thinning and in some cases also planting. The definition used in the Helsinki Process. (EEA 2023)

and services are often in conflict (EC 2021). The concept of ecosystem services gained wider attention when the United Nations (UN) presented its Millennium Ecosystem Assessment (MEA) which analysed in detail the impact and likely consequences of ecosystem change on human well-being. The report summarises the ecosystem changes caused by humanity over the past 50 years that can only be reversed or reduced through significant policy change (MEA 2005).

The value of forests was highly recognized by the International Panel on Climate Change (IPCC) report of 2007, stating that ”in the long-term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fibre or energy from the forest, will generate the largest sustained mitigation benefit.” (Nabuurs et al. 2007, 543). However, the report also stressed that forests' particularly important role in global CCM can only be achieved if the necessary institutional framework and political will is in place, which has not been the case, and the global mitigation potential of forests has not been realised (IPCC 2007). This was a strong message to international policymakers and the forestry industry, given that deforestation accounted for 17.4% of global greenhouse gas (GHG) emissions in 2000 (FAO 2008).

It is no coincidence that the Food and Agriculture Organization of the United Nations (FAO) pointed out in the 2008 study ‘Forests and energy’ that the effectiveness and consistency of policies will determine the future of bioenergy and wood energy, but also points out that many problems and challenges need to be addressed. The same study also emphasized that policies, and the development of bioenergy could otherwise cause significant negative impacts on forests. These effects constitute increased deforestation due to increased demand for energy crops, resulting in increased GHG emissions, increased pollutants, and loss of biodiversity, and ultimately degradation of forest ecosystems (FAO 2008).

The IPCC 2007 and FAO 2008 publications have played a key role in emphasising the role of the forest sector in mitigating CC and maintaining forest ecosystems, so that issues such as stand or landscape-level carbon sequestration and carbon storage in wood products have been incorporated into the CC policy (Alarcón 2015). The end of the forest chapter of the IPCC 2007 publication perfectly summarises the shift in global policy:

"Developing the optimum regional strategies for climate change mitigation involving forests will require complex analyses of the trade-offs (synergies and competition) in land-use between forestry and other land uses, the trade-offs between forest conservation for carbon storage and other environmental services such as biodiversity and watershed conservation and sustainable forest harvesting to provide society with carbon-containing fibre, timber and bio-energy resources, and the trade-offs among utilization strategies of harvested wood products aimed at maximizing storage in long-lived products, recycling, and use for bio-energy." (Nabuurs et al. 2007, 578).

The process has started, bringing the role and value of forests to the forefront of global climate policy and scientific research. Research has explored the issue of forests, forestry and bioenergy from several angles, taking into account the wide range of ecological services provided by forests, the proportion of positive and negative impacts and their consequences.

2.2.2 Forest ecosystem services: Biodiversity

The role of forests is key to halting biodiversity loss, as highlighted in the EU's latest Biodiversity Strategy (EC 2020b) and Forest Strategy (EC 2021b) and the forthcoming Nature Restoration Law (EC 2023c). Nature, and forests within it, contribute to people in many ways (Díaz et al. 2020), conservation is therefore key to maintaining sustainability and biodiversity, which can only be achieved by increasing the proportion of protected areas (PAs) (Buckley et al. 2019). Yet, despite our understanding of the importance of biodiversity for maintaining

planetary balance and mitigating CC, biodiversity continues to decline worldwide due to underfunding of conservation projects, lack of adequate policies and inadequate monitoring of existing policies, the spread of invasive species, further encroachment of natural habitats, CC, lack of global cooperation, and overuse of resources (Barbier et al. 2018). Scientists argue that a broader conservation effort is needed worldwide than is currently the case (Barbier et al. 2018). But in most cases these efforts fail along other objectives, being a perfect example, is the EU's 2023 review of the RED II (EUCO 2023a) or the development of the Nature Restoration Law (EC 2023c), where in both cases short-term political will, economic purpose and industry will have overridden biodiversity, environmental and conservation objectives.

Considering the importance of nature and forests, Balmford et al. (2002), in examining the economic value of natural interests, concluded that "our relentless conversion and degradation of remaining natural habitats is eroding overall human welfare for short-term private gain. In these circumstances, retaining as much as possible what remains of wild nature through a judicious combination of sustainable use, conservation, and, where necessary, compensation for resulting opportunity costs [as called for at the Rio Summit] makes overwhelming economic as well as moral sense." (Balmford et al. 2002, 953). Díaz et al. (2020) also provide a detailed summary of the objectives that would be necessary for an effective conservation effort and biodiversity conservation, in addition to nature's contribution to people (NCP). In a comprehensive literature review, Ogden and Innes (2007) concluded that CC will require forest managers to adapt more and more, and that the role of sustainable forest management will become increasingly important. Their study showed that the conservation of biodiversity, soil and water resources, the maintenance of healthy forest ecosystems and the enhancement of the carbon sequestration capacity of forests should be the primary responsibility of forest managers, as this is the way to maintain the economic and social benefits of forests in the long term. Bates et al. (2008) in the IPCC Climate Change and Water

Report also emphasized the role of reforestation and afforestation in forest conservation, in this case including water management, meanwhile, Achat et al. (2015) investigated the effects of different forest harvesting methods on the carbon dioxide (CO2) sequestration in soils and concluded that intensive biomass use reduces the carbon sink role of forest soils.

2.2.3 Forest ecosystem services: Non-wood forest products

Even though humans have been collecting and using non-wood forest products (NWFP) since the beginning of history and that many industries (pharmaceuticals, cosmetics, food, tourism and recreation) depend on these products (Martinez et al. 2021), scientific research has only started to address their importance and value in the last 20 years. NWFPs such as cork, tubers, wild edible mushrooms, nuts and berries, acorns, resins, aromatic and medicinal plants, and flowering greens are an important part of Europe's cultural heritage to this day. While the value and importance of wood as a raw material are not in question, the importance of the goods and services provided by NWFP is significantly underestimated to date (Lovrić et al. 2021). This is illustrated by the 2020 State of Europe's Forests data, which estimated the commercial value of NWFPs at €2.8 billion (Forest Europe 2020). However, these data did not take into account the common, small-scale harvested NWFPs, e.g. berries of mushrooms collected by private persons, and informal NWFP use (Wiersum et al. 2018). One reason for this is that the value of NWFP is difficult to estimate due to the lack of adequate data. In addition, most models tend to focus on the quantity of NWFPs, while quality is the main concern for these products in terms of consumption, market, and price (Calama et al. 2010).

Yet, according to recent research, about 5.76 billion people use NWFPs worldwide (FAO 2022), 25-26% of households in Europe collect NWFPs, and their importance is increasing from Western to Eastern Europe (Lovrić et al. 2016). Despite this, their ecological role has not yet been recognised by the forestry industry or policymakers (FAO 2014; Lovrić

et al. 2021), probably because the value of NWFP is difficult to assess and quantify. This is particularly problematic given that the role of forests in the context of the bioeconomy, biodiversity and CC is increasingly evident (Lovrić et al. 2020). Yet Lovrić et al. (2020) calculate that the economic value of NWFPs is significant. In Europe, the annual value of collected plant NWFPs reaches €23.3 billion, which translates into an annual income of €20.5 per hectare of NWFPs harvested, including forests and wooded areas, of which 86% is currently collected for private, small-scale consumption in Europe, estimated to be two to three times the value of NWFPs traded (Wahlén 2017). By comparison, this amount is close to 71% of European roundwood exports per year (Lovrić et al. 2020). In fact, surveys have estimated that the value of NWFPs exceeds the value of wood in some Mediterranean areas (Calama et al. 2010). NWFPs on the market account for only 15.2% of the total economic value, with an estimated value of €3.5 billion per year (Lovrić et al. 2020).

Despite these figures, forest planning and management practices remain focused on logging, which results in a lack of knowledge and systems and tools to help foresters better exploit the potential of NWFPs (Calama et al. 2010). This is due to, among other things, the lack of established advisory and support services for logging, as well as the difficulty in acquiring the right expertise. Since in many cases forest holdings are family businesses, the buyers of NWFPs would need to secure a large lot to win contracts, and thus cooperation between them would be necessary, and a network or organisation based on it would need to be built, which is lacking (Muttilainen and Vilko 2022). Analyses also show that it is more profitable for forest holdings and forest owners not only to engage in logging, but to complement it with NWFPs (Kurttila et al. 2018).

In light of this knowledge, one of the tasks for national, forestry and European policies would be to re-evaluate the potential of the European forest sector, including strengthening the value of the NWFP, and making changes in political ownership and tax regulation. Taking into

account the other ecological services outlined below, it may turn out that a review of the economic value of forests for the forest sector and European policy could be a way to revisit the economic value of forests, which is also more in line with the EU's objectives towards bioeconomy (EC 2018). The NWFPs of the forest-based bioeconomy will create new jobs, provide a sustainable source of livelihood for forest managers, offer experiential nature-based tourism services, and move people towards sustainable, environmentally friendly diets (Weiss et al. 2020).

2.2.4 Forest ecosystem services: Tourism

Nature-based tourism in PAs is one of the fastest-growing industries. In their research, Costanza et al. (2014) pointed out that ecosystems can add value to human well-being through human capital, social capital and built capital. In an earlier study, they calculated and estimated economic values for 17 ecosystem services for 16 biomes[5], concluding that ecosystem services are essential and contribute significantly to economic well-being. The results of this study concluded that on average, these ecosystem services are worth US$33 trillion/year (Costanza et al. 1997). They note that this valuation framework was also used by the IPBES in the framework for valuing ecosystems. In 2014, an updated study was published by Costanza et al., which found that the value of ecosystem services was US$125 trillion/year in 2011. They concluded that global land use change resulted in a loss of US$4.4-20.2 trillion/year in ecosystem services between 1997 and 2011 (Costanza et al. 2014). De Groot et al. (2012) examined the economic value of 10 biome ecosystems, finding that the value of ecosystem services was US$490/year per hectare for open oceans and US$3,500/year per hectare for coral reefs. In their 2015 study, Balmford et al. (2015) estimated the number of annual visits to

[5] According to CBD's definition, forest biome „reflects the ecological and physiognomic characteristics of the vegetation and broadly corresponds to climatic regions of the Earth. In this document, it is used in reference to boreal, temperate and tropical forest biomes." (CBD 2006).

terrestrial protected areas at 8 billion, of which nearly half, 3.8 billion visits, were to Europe. The estimated value of this, based on their calculations for countries alone, was estimated to reach US$600 billion in a year at 2014 prices globally, while the so-called consumer surplus has reached US$250 billion a year. In comparison to these figures countries collectively spend less than US$10 billion on PAs each year, which illustrates the under-valuation of PAs economically and consequently their under-funding (Balmford et al. 2015; Pörtner et al. 2021).

For several decades, the research of connection of nature and tourism were focusing on economic values and benefits, while several other aspects should also be taken into account according to Gross et al. (2023). Looking at previous research on the valuation of nature by tourists, their analysis shows that, in addition to economic aspects, there is an increasing emphasis on social and cultural aspects, including other values in addition to monetary aspects. Given that nature's ecological services do not have only a monetary value and that people do not only value nature in economic terms (Jacobs et al. 2016, 2018), a transdisciplinary research approach would be needed to further broaden the research perspective and involve stakeholders (Gross et al. 2023; Pascual et al. 2017).

2.2.5 Forest ecosystem services: Mental health and well-being

Research on the impact of being connected to nature on mental health and well-being has explored the link between access to nature and mental health. Research has demonstrated that connecting with nature and being in nature, have several benefits, including mindfulness, sleep, and stress management, which can save significant amounts of money through the cost of the resulting health treatments (Bratman et al. 2012, 2019; Buckley and Brough 2017; Capaldi et al. 2014; McDaid et al. 2019; Van den Bosch and Meyer-Lindberg 2019; White et al. 2021). Oh et al. (2017) and Yi et al. (2022), reviewing previously published studies have reached a similar conclusion that, although there is no strong evidence that time spent in the forest has a

positive effect on mental health and reduces depression, the hypothesis itself is supported. Kobayashi et al. (2018) have already investigated the effects of walking in the forest on the autonomic nervous system, showing that walking in the forest produces stronger autonomic relaxation than walking in an urban environment alone. In a survey across 18 countries looking at the relationship between mental health and the natural environment and attachment to nature, White et al (2021) found that people who live close to nature or in a place connected to nature have better well-being, and that time spent in nature reduces mental stress and has a positive effect on well-being, even reducing the likelihood of medication for depression and anxiety. However, time spent in nature needs to exceed 120 minutes per week to provide significant benefits in terms of well-being and mental health, regardless of whether the interviewees' place of residence is high or low in green space (White et al. 2019). The type of forest is not significant in terms of its impact on mental health, confirming that forest characteristics provide well-being for people (Clark et al. 2023). Outdoor tourism can not only reduce depression, but also have positive effects on work performance, sense of purpose and clarity of vision, so in some cases therapeutic outdoor tourism can be an effective component of therapeutic treatment (Buckley 2019). Hence, the economic value of PAs is also significant in terms of the economic benefits of improving the mental health of visitors, with research by Buckley et al. (2019) suggesting that they are worth US$6 billion per year in terms of the cost of health services, which also changes the established practice of valuing PAs economically.

2.3 Forest biomass and climate change

One of the biggest debates in both scientific and political circles is the role of forests in mitigating CC, and whether the use of wood for energy is sustainable or whether the world and the EU are risking their climate goals in exchange for wood-based energy. The use of woody biomass as renewable energy stems from the conclusion that it can be considered CO2 neutral,

as forests regrow and thus compensate for the carbon produced for bioenergy. Environmental sustainability of using forest biomass as renewable energy has been questioned in several studies (Agostini et al. 2013; Booth 2018, 2020, 2021; Giuntoli et al. 2022; Jonsson and Rinaldi 2017; Jonsson et al. 2018; Marland 2010; Mather-Gratton et al. 2021; Merfort et al. 2023; Norton et al. 2019; Ogden and Innes 2007; Ter-Mikaelian 2015), yet it is still referred to in global CC policy to this day. A recent study, for example, concluded that due to the large-scale land clearing, CO2 emissions from biofuels can exceed the CO2 emissions from fossil fuel combustion, and that it is therefore imperative to modify the CO2 emissions calculation for biomass, including the introduction of CO2 pricing, to protect against deforestation and other destruction of natural areas for bioenergy (Merfort et al. 2023).

The centrality of the topic and debate is understandable. In Europe, wood-based bioenergy accounts for almost half of Europe's renewable energy sources (Calderón et al. 2020) which reduces the net carbon uptake of forests (Ceccherini et al. 2021). The starting point of the problem is the theory that biomass CO2 is considered to be climate neutral because atmospheric CO2 is the source of biomass CO2, which is absorbed by the living plant during regrowth, so that CO2 is balanced by the harvest and regrowth cycle, and hence emissions are zero (Norton et al. 2019). The way of calculation is also followed by the EU, which considers biomass, including woody biomass, as carbon-neutral renewable energy, similar to hydro, wind and solar energy (EC 2005, 2021, 2022; EUCO 2023a).

The EC incorporated biomass as renewable energy into their policy with the 2009 RED and it still defines its strategy to tackle CC, which set a target of 20% renewable sources in the EU's energy mix by 2020 (EC 2015). The RED allowed countries to base their National Action Plans on biomass as a renewable energy source. While European countries' consumption of domestically sourced biomass has been steadily increasing (Eurostat 2020, see **Figure 2**), wood pellets imported from the United States, Canada and Russia have also been growing. Between

2009 and 2019, the European Union's (EU-27) wood pellet imports increased from 2.3 Mt to 8.6 Mt (Statista 2021). Moreover, the Europeam Commission (EC) estimates that bioenergy production in Europe will increase by 25% by 2030 and 47% by 2050 (EC 2020a). Since then, the EU has modified RED in 2018 (RED II, EC 2022) and on March 30, 2023, European Council (EUCO) and European Parliament (EP) reached a provisional deal on RED III, which set the minimum share of renewable energy in the EU energy mix at 42.5% by 2030 (EUCO 2023a). To achieve this, the EU will continue to rely heavily on bioenergy, including woody biomass. Therefore, it is no surprise that RED III continues to consider biomass, including primary and secondary woody biomass, as a carbon-neutral renewable energy (EUCO 2023a). RED III is part of the "Fit for 55" package adopted by the EC in 2021 to review EU legislation and introduce new directives to be in line with the EU's ambition of 55% net GHG emission reductions by 2030 (EUCO 2023b).

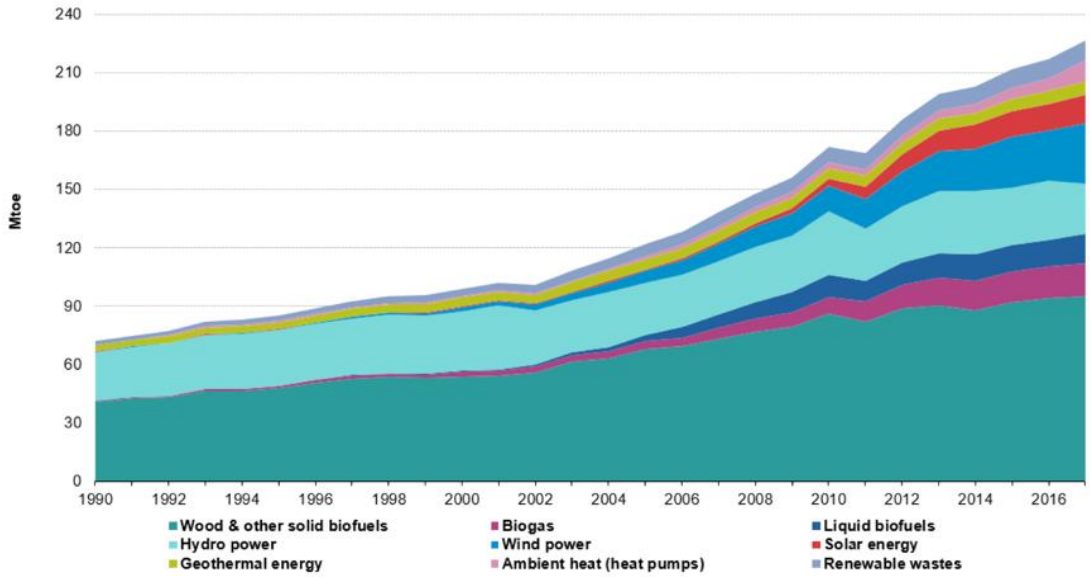

Figure 2: Primary production of energy from renewable sources.
EU-28, 1990-2017(Mtoe). (Source: Eurostat, 2020)

The problem is that mitigating the effects of CC requires not only reducing emissions, but also reducing the amount of CO2 already accumulating in the atmosphere. At the moment,

there is no safe and feasible technology available to do this (Hickel and Kallis 2020; Hickel 2020). Therefore, humanity can only do it by preserving the biodiversity of natural and managed ecosystems, meaning preserving existing forests, also engaging in vigorous reforestation, since more than 50% of man-made CO2 emissions are stored in biomass and organic matter, mostly forests and in the oceans (Pörtner et al. 2021, 2023). Therefore, a sustainable society cannot exist without a stable climate and a healthy ecosystem (Pörtner et al. 2021, 2023). Achieving all these goals is not possible without a sufficient quantity and quality of forest ecosystems, which play a key role on several fronts, but are in a state of continuous degradation (FAO 2022; Pörtner et al. 2021). Forests play a crucial role on several fronts, as they are not only a source of raw materials and energy through their by-products, but also the most important terrestrial CO2 sinks and provide biodiversity essential for CCM (Pörtner et al. 2021). Natural forests, old-growth forests and primary forests are particularly important, as they have higher biodiversity and store more carbon than planted or secondary forests (Pörtner et al. 2021; Sabatini et al. 2018; Waring et al. 220).

Despite this, however, international and among many others, European policy promotes the burning not only of secondary woody biomass such as by-products from logging, but also of whole wood, i.e. primary woody biomass[6], because wood can be considered as a renewable energy source (EC 2015, 2022, 2021a, 2023a, 2023b). The growing demand for woody biomass and wood pellets has become a secure source of income for a large number of countries, mostly in Eastern Europe, many of which have valuable primary and old forest ecosystems (EC 2017; Hurtes and Cai 2022; Sabatini et al. 2020). This demand was further increased by the outbreak of the Ukraine war in 2022 and the EU's RePower EU response (EC 2023a), which put

[6] The EU defines primary woody biomass as all roundwood harvested from logging operations and the resulting wood, or wood removed from forests due to natural decline. Secondary wood biomass is wood that is a by-product of the forest industry. Forest or woody biomass refers to all types of wood, i.e. tree trunks (logs), branches, tops, stumps and roots (Camia et al. 2021).

additional pressure on European forests (Hurtes and Cai 2022; Prins 2022; Zimmermann and Guilot 2022).

The current European policy to increase the demand for woody biomass is therefore strongly contradictory to the objectives and the need to mitigate CC and conserve biodiversity (Booth 2022; Luyssaert et al. 2018; Mather-Gratton et al. 2021; Naudts et al. 2016; Pörtner et al. 2021; Scarlat et al. 2015; Stubenrauch and Garske 2023; Ter-Mikaelian et al. 2015). These are also reflected in EU policies, such as RED III (EUCO 2023a) and RePowerEU (EC 2023a) and the methods defined for this purpose, and the objectives of the Birds Directive (EC 2019) or the Habitats Directive (EC 2013), or the Nature Restoration Law (EC 2023c), which is in the process of approval. The climate mitigation strategies also illustrate this contradiction, as they tend to focus on increasing forest CO2 sequestration capacity and replacing fossil fuels and fuel with biomass (Skytt et al. 2021). Tackling CC and preserving biodiversity together, both at a global and national levels, is essential to mitigate CC, through policy and action (Pörtner et al. 2021). Therefore, a coordinated EU policy is necessary that addresses all aspects of the different objectives. It is also important because EU policies determine national climate action plans which influence forest and conservation policies in EU countries, and thus the forest sector itself (Aggestam and Pülzl 2018).

Considering that the total bioenergy production in Europe has tripled since 1990 (Booth 2022) and that nearly 60% of renewable energy in the EU is still biomass (Scarlat et al. 2019), mostly woody biomass (Calderón et al. 2020), several studies analysed the CO2 emissions from biomass combustion. Research findings (Agostini et al. 2013; Bernier and Paré 2013; Haberl 2012; Holtsmark 2012; Laganière 2017; Marland 2010; McKechnie 2011; Mitchell et al. 2012; Repo et al. 2015; Ter-Mikaelian et al. 2015; Walker et al. 2013) have confirmed that biomass power plants emit more CO2 per unit of energy than fossil fuel plants. The CO2 payback period of course depends on many factors, ranging from a minimum of 90 to 340 years. Accordingly,

when taking these aspects into account, burning woody biomass not only reduces emissions compared to fossil fuels, but rather increases them.

In contrast, some studies argue that large reductions in emissions can be achieved in the short term and highlight the positive results of using woody biomass for energy. Galik and Abt (2015) concluded that due to the EU's renewable energy targets, the growth of the woody biomass market from the United States is expected to lead the southern United States to increase the logging rate of those forest types that meet the specified sustainability guidelines. The use of wood pellets and afforestation can thus be expected to result in an increasing rate in GHG emission. These processes are expected to increase the price of forest land, thereby reducing the potential for other land uses with lower CO2 emissions. Studies (Dwivedi et al. 2011, 2014) suggested that wood pellets imported from the United States and Canada could reduce GHG emissions in European countries by 65-80%. Based on Dwivedi et al. (2014) analysis, the United Kingdom's GHG emissions could be reduced by at least 50% by importing wood pellets from the North American continent. Jonker et al. (2014) point out that the choice of CO2 calculation method and reference scenarios used in analysis has a strong influence on the results regarding the CO2 payback period. Using their calculation, they measured a CO2 payback period of 5-11 years following a stock-level approach, with a payback period of 12-46 years for the CO2 compensation parity point. As these reveals, methods and criteria used in the analysis of CO2 and GHG emissions are particularly important for the final result, considering that as was highlighted on page 20, research calculate the payback period to 90-340 years. Therefore, according to Marland (2010), only a life-cycle analysis can determine the effectiveness of any emission reduction strategy, taking into account all costs and benefits. Marland (2010) and Agostini et al. (2013) also come to the same conclusion when measuring the efficiency of biomass combustion, that the payback period of carbon debt for bioenergy depends on the fossil fuel being replaced, the efficiency of biomass use, the forest growth rate,

the initial carbon stock of the landscape, the intensity of biomass extraction in the area, and the CO2 reserve included in the analysis (above ground biomass, below ground biomass, dead wood, litter, soil and harvested wood products). In the short term, it will lead to an increase in emissions compared to fossil fuels and only in the long term, even after centuries, will it lead to GHG savings and CO2 neutrality. Canadell and Raupach (2008) concluded that forests, through their CO2 sequestration capacity, would provide a range of economic, environmental and socio-cultural benefits in addition to CCM if they were included in global CC policy. In their view, there are four key areas where CO2 emissions can be reduced through the introduction of appropriate forestry activities, namely "(i) to increase forested land area through reforestation, (ii) to increase the carbon density of existing forests at both stand and landscape scales, (iii) to expand the use of forest products that sustainably replace fossil-fuel CO2 emissions, and (iv) to reduce emissions from deforestation and degradation." (Canadell and Raupach 2008, 1456).

Research trying to predict the likely consequences of the use of bioenergy and certain logging practices has confirmed the expected negative consequences of business as usual or growth. The EC's updated 2020 Reference Scenario looks at the expected evolution of the EU energy system up to 2050, taking into account the trends in the global economy, technology, society and policy (see **Figure 3**, EC 2021c). The Joint Research Centre (JRC), analysing the prospects for the bioeconomy up to 2050, noted that the business-as-usual pathway is not sustainable (M'barek et al. 2019). The International Institute for Applied Systems Analysis (IIASA) has analysed the projected impacts of bioenergy demand up to 2050, with a particular focus on the impacts of biomass use on the global environment and natural resources (Forsell et al. 2016). In addition to the baseline scenario, four policy scenarios were considered in the analysis, and all conclude that in all cases, pressure on forests to meet or increase GHG targets will increase, with bioenergy use increasing significantly in Europe over the next decade(s)

(Forsell et al. 2016). Jonsson et al. (2018) made projections for future logging practices in European forests between 2020 and 2030 in terms of CO2 retention and forest condition.

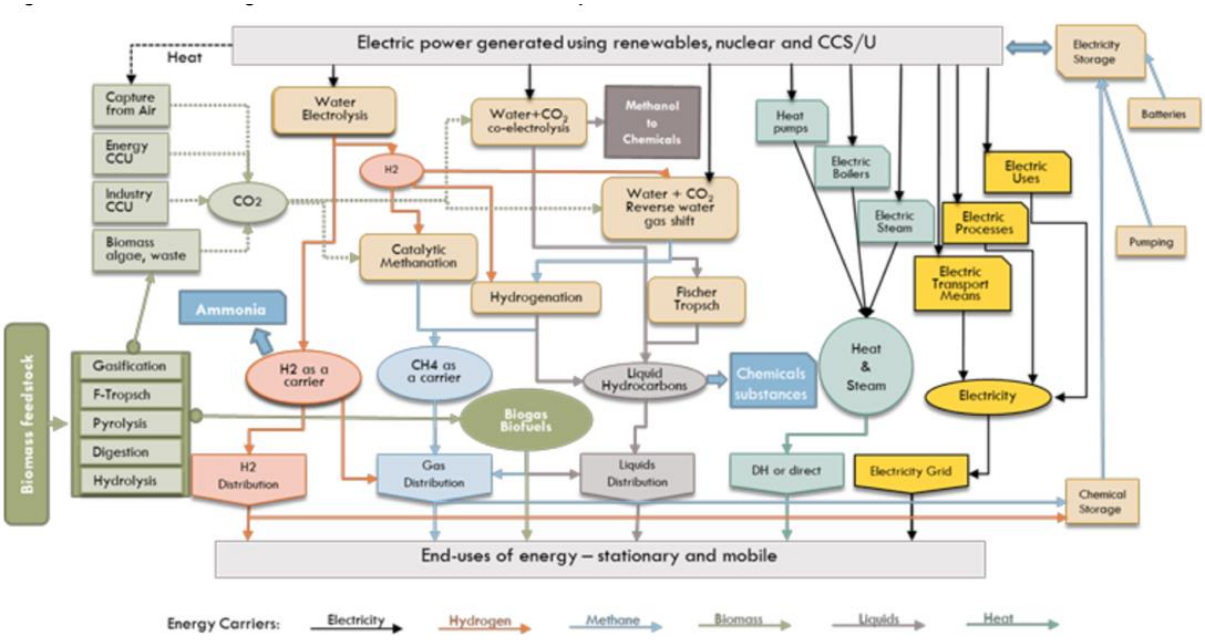

Figure 3: Sectoral integration chains.
The chains are covered in the updated PRIMES model. Source: EC. EU Reference Scenario 2020. 2021c.

According to their results, if logging increases by 7% by 2030 compared to previous periods (business as usual), carbon stock changes will decrease by 10% by 2030 due to the decreasing capacity of forests to grow. However, if harvesting levels are even higher due to increased demand for fuelwood, this will significantly (up to 83%) reduce the ability of forests to sequester CO2 from the atmosphere in the medium term. The results of this analysis are particularly relevant for future forest management practices and biomass use because satellite observations show that the percentage of forest area in a significant number of European countries may be lower than the data. Ceccherini et al. (2020) found that the percentage of forest area was stable between 2004 and 2015, but between 2016 and 2018 the percentage of harvested forest area increased by 49%, especially in countries where the economic impact of forest management is significant, most strongly in Sweden and Finland. The size of harvested forest area also increased by 34% compared to the previous period, moreover, biomass growth

was even higher, with a 69% increase compared to 2011-2015, which of course, has an impact on the CO2 sequestration capacity of forests. However, the results from this study have been heavily criticized (Wernick et al. 2021; Palahí et al. 2021) and recalculations have been updated (Ceccherini et al. 2021). Nevertheless, the main finding, that harvesting levels have increased, remained after checking the models used in the original study.

2.4 Forestry and forest ecosystem services in Sweden and Hungary

2.4.1 Sweden

Of Sweden's (SWE) 40.7 million hectares of terrestrial land, 27.9 million hectares is forest land, (including forests in the alpine areas with 4.9 million hectares) (SLU 2022), which is the largest forest area in the EU after Finland and Spain (Eurostat 2023). However, 85% of the 27.9 million hectares, 23.5 million hectares, is productive forest land[7] (SLU 2022). Sweden is within the Boreal region, and the forest cover is dominated by the two coniferous species Norway spruce and Scots pine, but the proportion of broadleaved forests is also increasing (SLU 2022).

Already in the Middle Ages, forests were an important raw material for the country, as wood tar, pitch and potash were important exports, and mining, metallurgy and shipping were also heavily dependent on wood (Campos 2022). The rapid population growth in the early 19th century led to further deforestation due to the proliferation of smallholdings and the huge increase in livestock (Eriksson 2022). The introduction of Swedish timber to European markets started in the 19th century (Antonson 2011) and by the 1860s, almost 40% of the country's export revenue came from timber exports (Lindahl et al. 2017). Industrial wood pulp and paper production started in the 1850s and by 1917 it was the country's most important export sector (Lindahl et al. 2017). All this led to the country, once rich in forests, losing a significant part of

[7] Productive forest land is land suitable for forest management with an annual production capacity of at least 1 m³sk per hectare, which is not used for any other purpose (Source: SLU 2022).

its forest cover by the beginning of the 20th century, which led to massive afforestation of the country. It was needed because when the country started to compile the National Forest Inventory the forest area stock was only 1,790 MM^3 (SLU 2022). Modern forest management practices started to be introduced in the early 1900s, and intensive forest management with clear-cutting started after the 1950s, which further increased the number of trees available for harvesting. (Östlund et al. 1997). Currently, the total forest cover in the forest complex is 3,544 MM^3, of which 40% is Scots pine and 39% is Norway spruce (SLU 2022).

Some analyses have been carried out on the deforestation rates in Sweden's boreal forests and thus on the country's forestry history. Östlund et al. (1997) investigated changes in a large forest landscape from the late 19th to the late 20th century, also Ericsson et al. (2000) carried out a similar study by analysing the changes in forest structure in a landscape in central SWE. Eriksson (2022) studied the changes in the forest understory in the Swedish boreal forest over the last century. All three studies proved a complete transformation of forests since the 19th century through the commercial use of the forest. However, although the amount of standing timber in the country has increased since the 1950s, the average age of the forest decreased from 200 years in the 19th century to 74 years, and the amount of dead wood, diseased trees and tree logs were radically reduced (Ericsson et al. 2000), resulting in a significant reduction of ecosystem services provided by the forests. As can be seen, the emergence of modern forestry has significantly changed the Swedish forest landscape and forest stock, has had a major impact on the Swedish economy and forest industry, and even plays a major role in the country's energy mix. Sweden has the highest share of renewable energy in final energy consumption in the EU (see **Figure 4**, EEA 2023b), accounting for 63% of total energy consumption in 2021 (Statista 2023). However, 58% of renewable energy is bioenergy, supplemented by 30% from hydro/marine and 11% from wind (Irena 2022). It can be seen, therefore, that the forestry sector is not only important for the pulp and paper industry,

but also relies heavily on wood and wood-derived bioenergy for the country's climate goals through the bioenergy generated from its by-products. For all these reasons, there is a significant body of research on the subject.

Figure 4: Share of energy from renewable sources by country.
(Source: EEA 2023b)

Research has addressed the sustainability of forest management[8] and harvesting in SWE (Andersson and Keskitalo 2018; Gamfeldt et al. 2013; Lindahl et al. 2017; Vestin et al. 2020), showing that although the growth rate of timber production does not exceed the forest growth rate in numbers, the current forest management, which is geared towards maximising production, will have negative consequences in the long term (Andersson and Keskitalo 2018). Ahlström et al. (2022) studied the rate of logging in old-growth forests[9] and found that 19% of

[8] According to FAO sustainable forest management refers to "a dynamic and evolving concept, [that] is intended to maintain and enhance the economic, social and environmental value of all types of forests, for the benefit of present and future generations (FAO 2020b), meanwhile the pan-European Ministerial Conference on the Protection of Forests in Europe in 1993 defined as: "the stewardship and use of forest lands in a way and at a rate that maintains their productivity, biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil 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." (EC 2023b)

[9] Old-growth forest is defined by CBD as „stands in primary or secondary forests that have developed the structures and species normally associated with old primary forest of that type have sufficiently accumulated to act as a forest ecosystem distinct from any younger age class." CBD 2006).

logging in the last two decades occurred in truly old-growth forests, which implied a loss of old-growth forest area at a rate of 1.4%. They calculate that at a similar rate of logging, by 2070 there will be no old-growth forest left in SWE. The country operates its forest management according to the so-called 'Swedish forestry model'[10], however, its sustainability has been assessed in various ways. Kleinschmit et al. (2012) analysed previous research on the subject, which concluded that a transformation of the forestry sector will be necessary, moreover, a transformation of the Swedish forestry model is necessary taking into account global processes such as CCM, land use, energy supply, or the importance of biodiversity (Lindahl and Westholm 2010, 2012). It is necessary because, despite the positive steps taken in the last two decades, the Swedish forestry model continues to interpret sustainability in purely economic terms, focusing on logging rather than social, ecological and environmental goals, when it could help to move towards sustainability by redefining policy mechanisms (Lindahl et al. 2017). However, this also requires SWE to revise its CO2 accounting practices, as Lindroth and Tranvik (2021) found that wetlands, lakes and rivers emit significant amounts of carbon, so the currently calculated carbon sequestration capacity is lower for the country. Therefore, the focus should be on preserving the CO2 sink of forests rather than extracting forest biomass, as this is the only way to meet the Swedish target of negative emissions after 2045 (Lindroth and Tranvik 2021). Reduced logging levels can bring rapid and significant climate benefits to the country by having a positive impact on the carbon balance. The higher the productivity of the forest, the greater the positive short-term impact of reduced harvesting. Conversely, although the short-term positive effect is smaller for low-productivity forests, it lasts longer. Therefore, current, or higher harvesting levels would only provide long-term climate benefits

[10] The Swedish Forestry Model describes the forestry system that Sweden has been following since the revision of the Forestry Act in 1993 (RSAAF 2009; Lindahl et al. 2017). The Swedish Forestry Model is said to be an example of sustainable forest management, however many researchers and NGO studies found that the Swedish forestry model cannot be considered sustainable, including one of the researchers from the interviewees, also a workshop organized by Fern which the author attended dealt with this topic.

in terms of carbon sequestration (Skytt et al. 2021). Therefore, for long-term climate goals, the conservation of natural and old-growth forests is necessary because natural forests can absorb more CO2 than planted forests (Waring et al. 2020,), and in addition to CO2 storage capacity, many other FES are stronger in a species-rich forest, such as biomass production, NWFPs ratio and number, and biodiversity ratio (Gamfeldt et al. 2013). Their research confirmed that monoculture forests are not able to meet all ecosystem services, and some services negatively reinforce each other. Thus, they suggest that even in production forests there is a need to plant more tree species.

2.4.2 Hungary

Hungary's (HU) forest cover differs significantly from SWE's, which of course also affects forest management itself, as is reflected in the number and subject matter of the research studies themselves. Hungary's current forest map and forest cover are determined by three factors: its climate and consequent rainfall, its location, and its history. The country's climate is determined by the continental climate of Eastern Europe, the oceanic climate of Western Europe and the Mediterranean climate of the Mediterranean (Kovácsevics 2014). This is due to its location, lying in the Central Danube basin from the eastern end of the Alps to the curve of the Eastern Carpathians. It is a lowland country in terms of topography, with 73% of its territory below 200 m altitude and only 7% of its territory higher than 350 m (Somogyi 1997). Accordingly, the natural vegetation cover is forested grass steppe in the lowlands and European deciduous forest in the highlands, but the original vegetation cover is only preserved on 9% of the country's territory. Despite this, the country is particularly rich in biodiversity, with a plant species richness fifteen times higher than the global average (Kovácsevics 2014). This is why it is particularly important to preserve and manage not only HU's forests but also its unique natural resources.

The history of today's Carpathian Basin forests began about 12,000 years ago, when local and southern European species that survived the Ice Age spread and most of the Carpathian Basin was covered by forest, which was cut down by man from the very beginning. However, in the central parts of the basin, in the Great Plain, there was probably no continuous forest cover even then, and instead the landscape was characterised by wooded steppe and wetlands occupied large areas (Szabó 2006). Deforestation was also significant in HU, with forest cover in the late 15th century the country being only about 25% (Szabó 2006), thus providing a limited resource for the population. A massive afforestation started in the 18th century, but the Trianon Peace Treaty after the First World War created a completely new situation. The country lost a large part of its territory, and 84% of its forest area. Within HU's newly-defined borders, the country's forest cover was less than 12%, making it one of the most forest-poor countries in Europe (Kovácsovics 2014). After the Second World War, a massive afforestation drive was launched, with the dual aim of preserving existing forests and increasing forest cover in the Great Plain. Currently, HU has 21% of its territory covered by forests (Global Forest Watch 2023), 22% of which are protected natural areas of national importance, including Natura 2000 (N2k) sites (BISE 2023a).

The analysis of forest health and its causes in HU is particularly important for forest management (Szepesi et al. 1997; Tóth et al. 2001), as it helps to identify positive and negative changes and their impacts in the future and thus to make policy recommendations focusing on prevention (Komarek 2018). Similarly, it is important to consider possible future directions of agroforestry[11] based on past and present experiences, especially regarding the country's forest cover (Takács and Frank 2009). Forest grazing, although prohibited, is still a common practice that has negative impacts on forest understory vegetation (Varga et al. 2020). The evolution of

[11] According to CBD agro-forest „is a complex of treed areas within an area that is broadly characterised as agricultural or as an agro-ecosystem." (CBD 2006).

biodiversity and related institutional, financial, and legal changes between 1989 and 2016 using the IPBES framework was investigated by Mihók et al. (2017). The role of ecosystem maps and frameworks is similar but important for conservation and biodiversity (Tanács et al. 2021, 2022), for which the Hungarian Mapping and Assessment of Ecosystem Services (MAES-HU) is the basis. Zoltán et al. (2023), based on the MAES-HU project and the national forest database, examined the results of forest condition assessments, and found that current forest monitoring systems are not suitable for conservation and biodiversity analysis. Széchy and Szerényi (2023) were the first to attempt to determine the economic value of Hungarian forests for forest ecosystem recreation. They calculated the annual value of hiking and walking to be between €52.4 and €161 million, with a central estimated value of €101.7 million per year, which represents 20% of the annual value of wood production (Széchy and Szerényi 2023). Looking at the species composition of herbaceous understory vegetation, Márialigeti et al. (2017) concluded that it is mainly influenced by light conditions and species richness, while Molnár et al. (2012) summarised future trends in forest-steppe vegetation based on past documents and a current database.

Biomass is an important research and policy topic in HU, especially since a large part of the renewable energy in the country is solid biomass, which accounts for a low share of renewable energy consumption (14.8%). Solid biomass constitutes 59% of renewable energy, and 11% comes from liquid biofuels, see **Figure 5**. (IEA 2022). Research has investigated the status, prospects, and challenges of forest biomass (Garay et al. 2012; Kohlheb et al. 2015; Titov et al 2021; Vargovics and Nagy 2023). All studies conclude that the importance of woody biomass, often mentioned as dendromass[12] in several studies, will continue to dominate the Hungarian energy mix, but there is no complete consensus on whether this will be sustainable

[12] Dendromass is defined in a related article as „ligneous biomass that can be used as raw material and energy source but without the quality required for traditional high-level uses of wood such as furniture and construction." (CABI 2023, https://www.cabdirect.org/cabdirect/abstract/20073162668)

in the long term. Therefore, research conclude that the establishment and use of energy wood plantations is a possible solution for the future in HU (Czupy et al. 2012; Molnár et al. 2013; Vágvölgyi 2014).

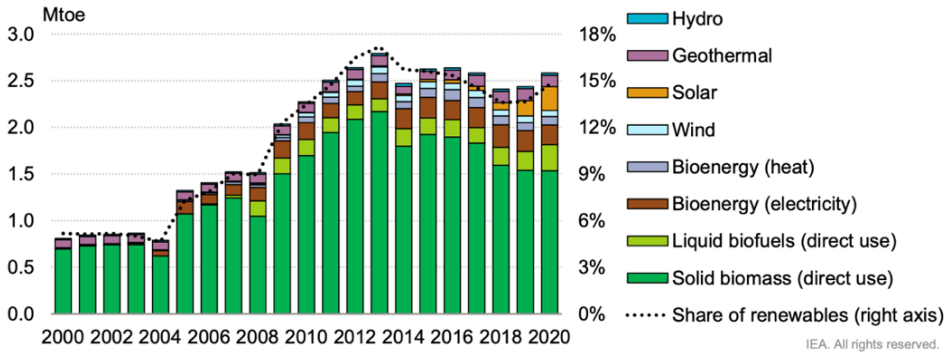

Figure 5: Share of renewables in total final energy consumption in Hungary, 2000-2020. (Source: IEA 2022, 68).

3. Theoretical framework

The concept of ecosystem services and their value has become increasingly important in the last twenty years to demonstrate to policymakers and, of course, to the business and social sectors the importance of nature in the life and existence of humanity and its inestimable value. An analysis of the valuation of ecosystem services can help us to understand their essential value and the diversity of their value. In examining these values, the most difficult question for decision-makers may be precisely how to value and, above all, prioritise the many ecosystem services that nature or in this case, an element of nature, forests, provides for people and non-human nature as well.

Since this thesis aims to analyse the ecosystem services provided by forests and to examine whether these ecosystem services are adequately reflected in current policy decisions according to forestry and forest conservation practitioners, especially about the use of forest biomass for energy, the thesis will use the IPBES 2022 assessment system on the value and valuation of nature. To understand the valuation mechanism of forest ecosystem services (FES) in policymaking, the concept of global forest governance is explored and used in this thesis.

3.1 Value of Nature

The ecosystem services provided by nature are essential for humans (Costanza et al. 1997, 2014; IPBES 2019a, 2019b; MEA 2005). These services provide humans not only with comfort and well-being, but also with survival (IPBES 2022). Although ecosystem services provided by nature have been observed in the past, interest in the topic started after the publication of the MEA in 2005. Between 2007 and 2010, the Economics of Ecosystems and Biodiversity (TEEB) report was produced under the leadership of the UN Environmental Programme (UNEP) (Costanza et al. 2014), and in 2012 the IPBES was established to strengthen the link between science and policy for biodiversity conservation and ecosystem services, human well-

being and sustainable development (Díaz et al. 2015b). One of its key tasks was to develop a conceptual framework for analysing the interactions between nature and humans (Díaz et al. 2015a). The key element of the framework is the benefits of nature for humanity, at individual, community, national and, of course, societal levels, which are linked to nature's ecosystem services (Díaz et al. 2015a). The framework developed in 2013 was based on the 2005 MEA but went beyond it by considering not only monetary and instrumental values, but also values such as spiritual, cultural or relational values (Díaz et al. 2015b). In the analysis of ecosystem services provided by nature, the relationship between nature and people is defined in six elements (see also **Figure 6** by Díaz et al. 2015a):

1. Nature
2. Nature's benefits to people
3. Anthropogenic assets
4. Institutions and governance systems and other indirect drivers of change
5. Direct drivers of change
6. Good quality of life

The 2019 IPBES assessment on the state of biodiversity and ecosystem services is the most comprehensive summary of the state of biodiversity and ecosystem services since the 2005 MEA (Piccolo et al. 2022). The IPBES report confirmed the drastic loss of biodiversity and thus the weakening and threat to the benefits of natural ecosystem services and introduced the Nature's Contributions to People (NCP) concept and phrase to raise awareness of ecosystem services (Díaz et al. 2015a; IPBES 2019a). NCP “refers to all contributions – beneficial and detrimental – that people, individually or collectively at various scales, derive or endure from nature” (Omare 2022, 1), and can be applied to i) identify and assess the status and trends of the contributions people derive from nature; ii) understand the impact of various policy,

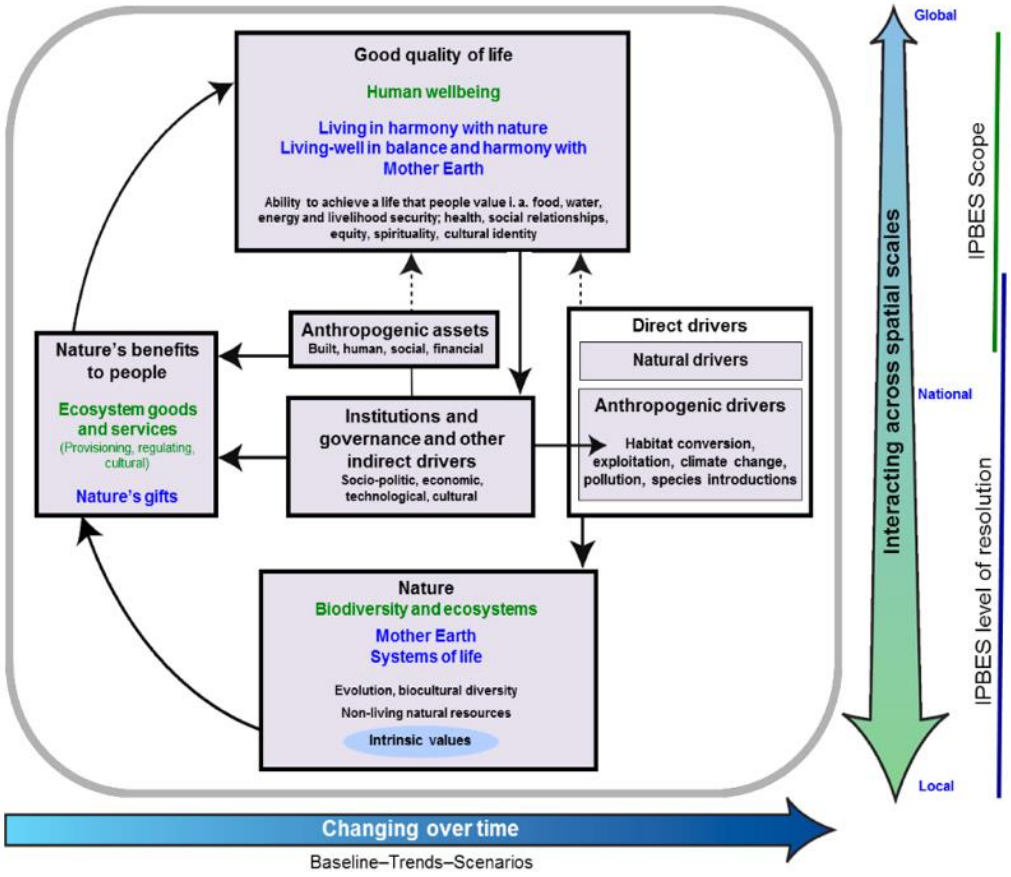

Figure 6: The relationship between nature and people.
The main elements and relationships for the conservation and sustainable use of biodiversity and ecosystem services, human well-being and sustainable development (IPBES 2013, 2). The main panel, bordered by grey, shows Nature, Nature's benefits for people and Good quality of life, and encompasses these world views. The texts in green represent science, so the blue texts represent concepts from other knowledge systems. Solid arrows indicate the influence between elements, and dashed arrows indicate non-central but still important relationships. Arrows below and to the right of the central panel indicate the scale of time and space. (Source: IPBES 2013, 2.)

governance and management measures; iii) widen the horizon of options when it comes to finding sustainable pathways forward; and iv) communicate and engage with stakeholders (Omare 2022, 2). In 2022, IPBES presented the assessment of the diverse values and valuation of nature with the aim "to navigate pathways for reconciling people's good quality of life with life on Earth and advancing the intertwined economic, social and environmental dimensions of sustainable development in a balanced manner" (IPBES 2022, XIV). For people and societies, the word value can mean "life goals, beliefs and general guiding principles", also "the opinions or judgements of the importance of specific things in particular situations and contexts" (IPBES

2022, 8). Value can therefore mean many things depending on the context. One of the flaws of the IPBES report is perhaps precisely that it focuses explicitly on how nature can contribute to the quality of life of humans but forgets about non-human nature (Piccolo et al. 2022). IPBES inclusively interprets nature when assessing values. This includes different understandings and perspectives of nature. In addition to the perceptions of nature and natural value that Western societies generally rely on material values, the analysis also incorporates the spiritual, symbolic and cultural perspectives of indigenous peoples and local communities, incorporating concepts such as Mother Earth (Díaz et al. 2015a). This is important because nature values vary from culture to culture and from group to group, and people's attitudes towards nature greatly influence their valuation (IPBES 2022). Successful implementation of evaluation, i.e. appropriate policy-making, depends on relevance, i.e. taking into account all possible values; financial, technical, time, human and political resources and methodological soundness. The decision-makers, their goals and priorities, strongly influence the values that are prioritised in decision making, which in turn affect nature and people's relationship with nature.

The diversity of nature's values can be realised through a typology of nature's values. The IPBES typology of values of nature, see **Figure 7**, has therefore put all the key concepts, aspects and their interrelationships into one system for understanding the different values of nature (IPBES 2022). The typology of values of nature illustrates the diversity of people's relationships with nature, these are "(i) world-views, the ways in which people conceive and interact with the world; (ii) knowledge systems, bodies of knowledge, practices and beliefs such as academic, indigenous and local knowledge systems embodied in world-views; (iii) broad values, the moral principles and life goals that guide people-nature interactions; (iv) specific values, judgements regarding the importance of nature in particular contexts, grouped into instrumental values (i.e., means to a desired end often associated with the notion of

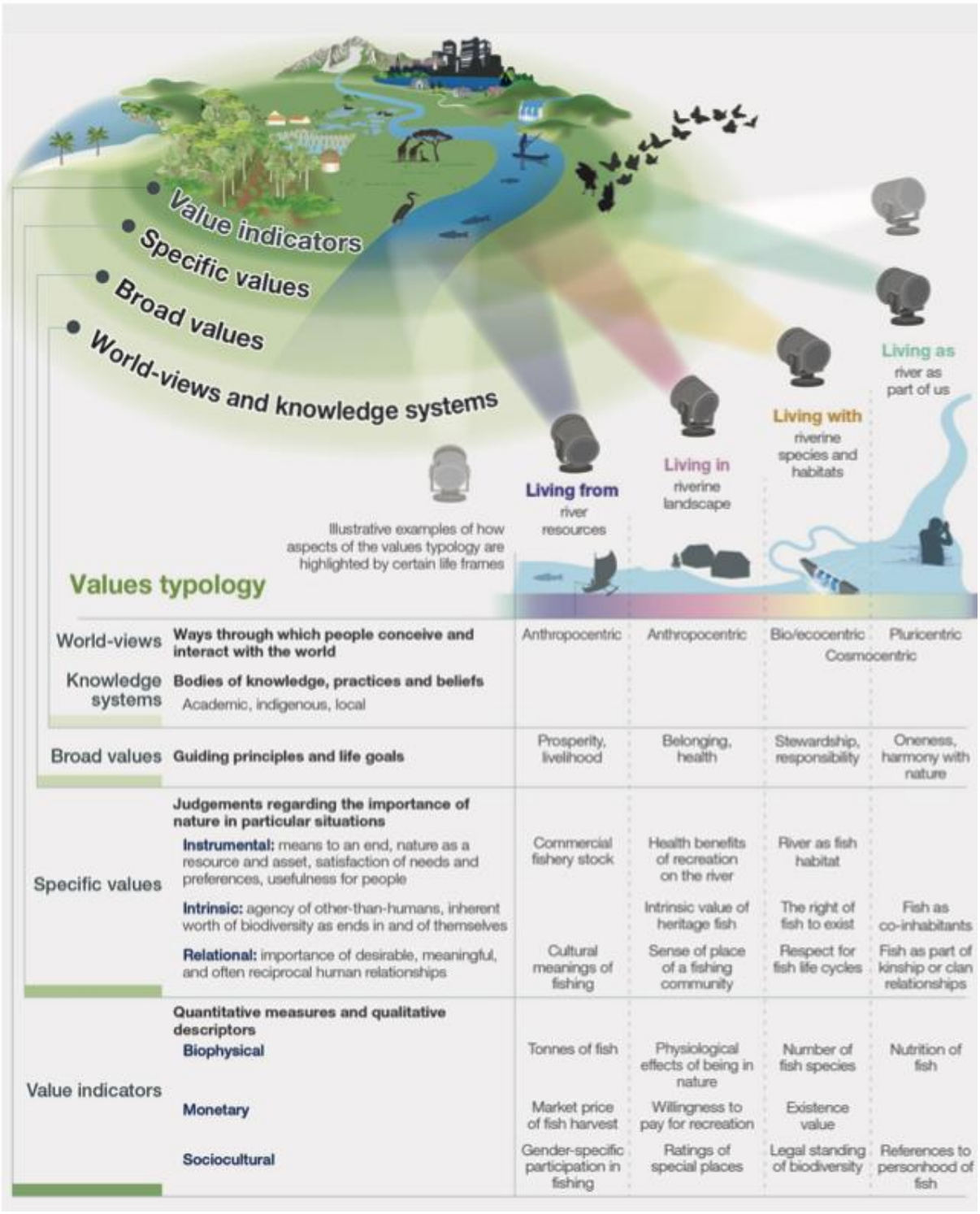

Figure 7: The values assessment typology.
It highlights key concepts and their interrelationships to understand the diverse values of nature. (Source: IPBES 2022, XXIII).

"ecosystem services"), relational values (i.e., the meaningfulness of human-nature interactions), and intrinsic values (i.e., independent of people as valuers); and (v) value indicators, the quantitative measures and qualitative descriptors used to denote nature's

importance in terms of biophysical, monetary or sociocultural metrics." (IPBES 2022, XV-XVI). In addition to instrumental and intrinsic values, which were previously generally used in environmental policy (74% instrumental, 20% intrinsic, IPBES 2022, 24), relational values are also there, as people base their decisions not only on considerations and views of personal and collective well-being, but also weigh up their choices in terms of their relationship with nature or with each other. **Figure 8.** shows the three specific values related to nature, NCP and good quality of life.

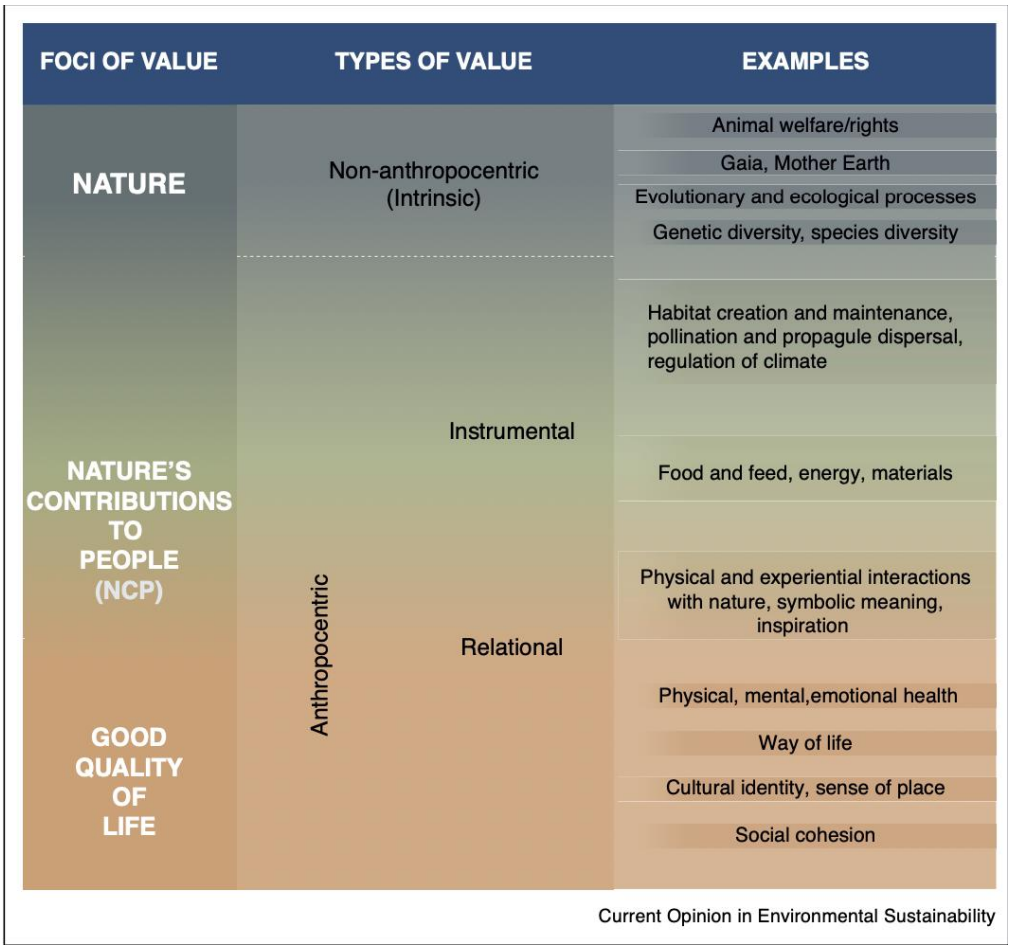

Figure 8: The relationship of specific values with nature, good quality of life and NCP.
The colours show that both instrumental and relational values are related to NCP and that they are linked to nature and good quality of life. (Source: Pascual et al. 2017, 11).

Relational values build on people's pre-existing relationship with nature and their collective and personal responsibilities (Chan et al. 2016), which the IPBES typology of values of nature links to good life, and NCP in the context of nature ecosystem services analyses.

However, critics of the analysis argue, if not in economic terms, that the concept still reinforces the instrumental values that are already prevalent (Maier & Feest, 2016; Piccolo et al, 2022). They oppose the IPBES explanation that the incorporation of relational values would make society more inclusive and accepting of non-human natural aspects in valuations. The NCP is therefore, in their view, anthropocentric and does not help to strengthen ecological justice and human responsibility towards nature in society and to make it more prominent in policy making (Piccolo et al. 2022). As an example, Piccolo et al. (2022) cite the Swedish forestry sector as an example of how, if relational values, i.e. the relationship of the people of Sweden with the forest landscape, are linked to logging due to the dominance of Swedish forestry, the result is a destruction of biodiversity and a weakening of FES, despite high human well-being and ecosystem stewardship. However, in addition to the already predominant instrumental values, relational values, in their opinion, also reinforce the anthropocentric approach in decision-making, so that intrinsic values such as biodiversity and ecosystems are even more weakened.

3.2 Global Forest Governance

Governance involves formal and informal interactions and influences between public and private actors in public and private institutional systems (Begemann et al. 2021). Environmental governance is the "set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes" (Lemos and Agrawal 2006, 298). Global forest governance includes biodiversity, climate, forest management, trade, energy, sustainability, and human rights, among others, and is driven by norms and rules developed by international institutions, and actors in different policy sectors (Begemann et al. 2021).

Until the 1970s, forests were centrally managed by the states, which led to massive deforestation, forest degradation and biodiversity loss. This led to protests worldwide

as part of environmental movements, and a loss of faith in the state as the guardian of nature and the manager of the economy (Lemos and Agrawal 2006). The state as the primary actor in environmental governance was eclipsed, and the era of forest governance began. In the process, forest governance has become decentralized[13], market and voluntary incentives have emerged, and communities have become part of forest governance managed through markets, see **Figure 9** which illustrates the mechanism of the new system (Arts et al. 2014).

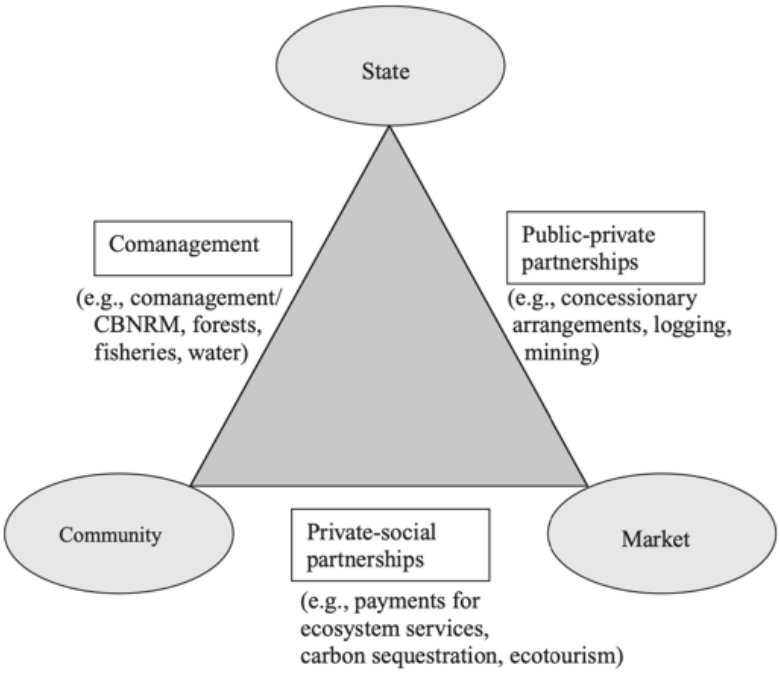

Figure 9: Mechanism and strategies of environmental governance.
Abbreviation: CBNRM, community-based natural resource management (Source: Lemos and Agrawal 2006, 310)

In market-driven governance, and in this case forest management, the business sector, NGOs and other transnational groups have decision-making powers alongside government agencies (Auld et al. 2009). This has led to the emergence of new governance systems such as community forest management, partnerships between NGOs and businesses, certification schemes, and other voluntary incentive schemes and agreements (Arts and Buizer 2009).

[13] Decentralisation is the transfer of administrative powers and responsibilities and/or political power from the state to the sub-national administration. It brings politics closer to the people and makes it more effective by involving local communities in governance and implementation and in democratic control itself (Arts et al. 2014).

Decentralized forest management has three goals in forest governance: 1) aim to increase the effectiveness of forest policies, 2) strengthen community participation in decision-making and accountability, and 3) protect local natural resources (Lemos and Agrawal 2006). The government sector, however, is increasingly taking on a new role in forest governance, for example, by participating in certification programmes and partnerships, setting national rules and standards, and strengthening market self-regulation systems through subsidies and tax exemptions (Arts and Buizer 2009; Arts et al. 2014; Auld et al. 2009).

Policymakers make decisions on forest management interventions using a combination of information, incentives and institutions, depending on the purpose of the natural resource interventions (Agrawal et al. 2018). Information is essential to raise awareness of sustainable practices in all government interventions. Examples of such interventions include information campaigns to educate and raise consumer awareness on supporting land rights of indigenous peoples and local communities, sustainable logging, and logging for plantations. It is difficult for producers and consumers to support more sustainable practices if they are too expensive to implement. In such cases, incentives can be used to encourage the choice of environmentally friendly products and services. Examples include investing in forestry certificates or buying land for conservation. Institutions use regulation, monitoring and sanctioning to achieve sustainable practices. In this case, institutions are not just government agencies that might impose fines and imprisonment, but also other non-government agencies that can also punish illegal loggers by denying certificates or by discrediting campaigns (Agrawal et al. 2018). These three strategies usually appear together in forest governance as a hybrid result of the three mechanisms, which possible gaps are illustrated in **Figure 10**.

Yet, although national and global forest management has launched several forward-looking and revolutionary initiatives over the past two decades (Agrawal et al. 2022), it has not achieved much in terms of reducing deforestation and biodiversity loss. This is due to the

institutional fragmentation of global forest governance, the lack of necessary forest conservation action in key forest states, the effective lobbying of the private sector, which influences policymakers in making decisions on forest conservation, and the inability to properly assess and prioritise forest ecosystem services (Begemann et al. 2021).

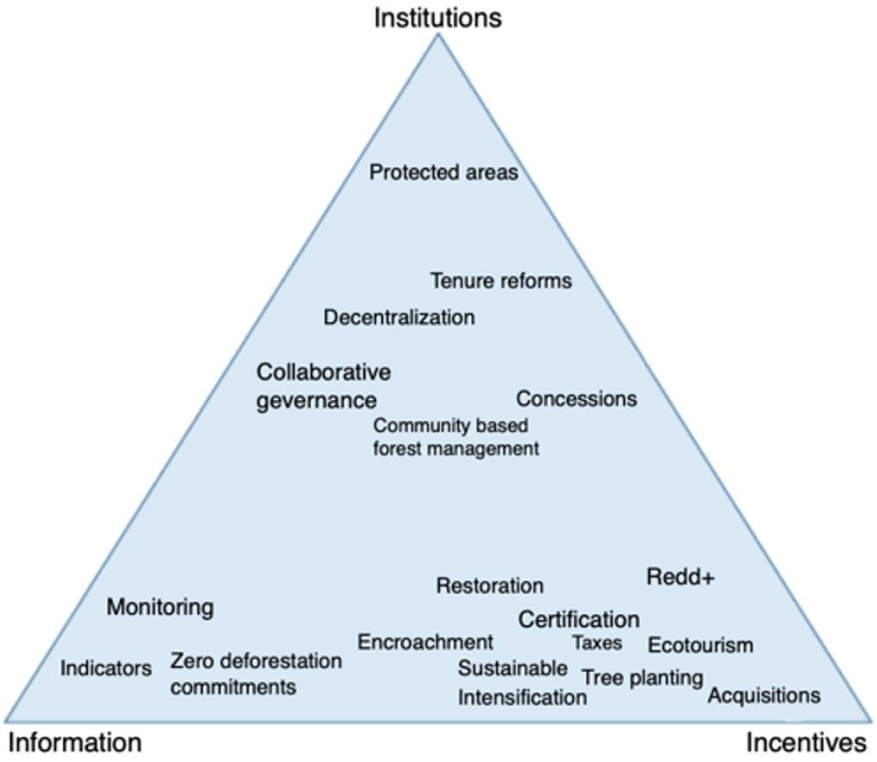

Figure 10: Triangle of governance dimensions.
Institutions, information, and incentives. (Source: Agrawal et al. 2018, A5)

According to experts from intergovernmental and non-governmental agencies, public administrations and scientific organisations, the biggest challenge to global forest management is deforestation and forest degradation, which is influenced by factors other than the forest sector, such as population growth and food shortages. Governments of sovereign states, including agricultural administrations and private sector actors, are best placed to address these challenges. Of particular importance is the international framework and structures that only states can provide. International organisations such as the FAO and the World Bank also have an important role to play. According to experts, global forest governance can achieve better

results in the future through different governance initiatives and stronger cooperation, especially as CC and biodiversity are becoming increasingly important issues. This can be achieved, among other things, through regional and interregional coalitions and bold sustainability-centred leadership and decision-making. Also, the involvement of local communities, civil society and the private sector alongside governments can help to build legitimacy for more effective global governance. (Begemann et al. 2021). Another problem of environmental governance, and thus global forest governance, is that it is exclusively concerned with the protection and conservation of the environment and natural resources necessary for human well-being, while the current unsustainable economic, social and environmental systems and functioning would need to be transformed to achieve effective results (Agrawal et al 2022). Hence, according to Agrawal et al (2022), a complete paradigm shift from environmental governance to sustainability governance would be required, requiring coordinated and cross-sectoral strategies and concerted action by government, non-government, community and corporate actors alike at national and global levels.

4. Methodology

4.1 Researcher's philosophy

The author of the thesis is aware that her research topic is guided by her personal belief systems and the knowledge she has gained through her research. Her worldview is pragmatic, as she aims to find a problem and propose a solution (Creswell and Creswell 2018). While she aims to learn about people's subjective opinions and draw conclusions from them, her thinking goes beyond a constructivist understanding of the problem, as her ultimate goal is to provide a possible solution to the problem thus identified.

The author acknowledges that, although she has conducted her research with an objective approach in mind, her thinking and her personal experience have an impact on the research and thus on the interpretation of the results of the research. Although the answers to the questions posed by the author are the personal views of the interviewees, and thus the results are a summary of and reflection on these personal views, the author's interpretation is influenced to some extent by her subjective opinion and the context. As a result of this, the author, and thus the outcome of the research, is inevitably influenced by her personal belief system and background in the research process, underlying assumptions, data collection, interpretation of the data and the resulting findings (Creswell and Creswell 2018, Strauss and Corbin 2008). However, the emergence of personal opinion in sustainable science is acceptable according to Kemp and Martens (2007), as they emphasize that sustainable development is based on social consensus on what is considered sustainable, thus sustainable development cannot be defined objectively and scientifically, and therefore requires a science that "can help to deal constructively with the ambiguity, complexity, and uncertainty central to sustainable development" (Kemp and Martens, 2007, 9). According to Strauss and Corbin (2008), the researcher might bring into the research his/her perspectives, biases, training or knowledge in case of focusing on the interviewees sensitively and involving in the research sensitively.

4.2 Conception of the research

The original idea of the research was a policy analysis, more specifically the assessment of ecological and environmental impacts of the revision of RED II (called RED III) (EC 2021a) on the health of European forests. However, the author decided to modify the original concept of research. The European Council and European Parliament reached a provisional agreement on RED III on 30 March 2023 (EUCO 2023a), therefore a preliminary policy analysis was no longer relevant which rendered the author's research objective and questions irrelevant. This made it necessary to modify the research area. During the first two interviews, however, interviewees, thanks to the use of the semi-structured interview technique, raised issues that particularly attracted the author's interest. Because of these considerations, the author modified the direction of the research, both in the subsequent interviews and in the literature review and policy analysis. The research questions were modified, because of which the author added additional questions to the guiding questions and changed the priority of the interview questions to some extent. The two countries selected earlier during the primary research topic and associated literature review did not need to be modified, also it was not even possible, given that the interviewees had already been contacted. The author chose HU and SWE because although they differ significantly in terms of forest cover, SWE has the highest proportion of forested land in Europe, close to 70%, while HU's forest cover is statistically 22% (Eurostat 2023), beyond this, the two countries show a similar pattern. Although the forestry industry constantly communicates that forest management in the countries is sustainable, NGOs, academia and society consider forest management in both countries to be unsustainable. In both countries, clear-cut technology prevails. The right-wing ruling parties in both countries have significantly weakened and continue to weaken the role and responsibilities of the forest authorities, making it impossible for them to carry out effective monitoring and regulatory functions. Both countries are heavily dependent on solid biomass in their renewable energy

mix, with 58% of bioenergy in SWE being solid biomass (Irena 2022), compared to 59% in HU IEA 2022). In SWE the majority of biomass is a by-product of the paper and pulp industry, it should be noted, however, that the forest industry often considers wood chips also a by-product that is not in reality. The situation is clearer in HU, which uses almost only primary woody biomass, given the country's insignificant wood and sawdust industry. As a final example, both countries' policy opposes any EU action that would hinder the use of wood for energy, so understandably, looking at recent policies, both countries were against a more strict RED II revision, and thus took the line that primary wood could continue to be used as renewable energy, and did not support the Nature Restoration Law proposal.

4.3 Data collection methods

Although the author follows a qualitative approach and relies mainly on in-depth interviews, the complexity of the topic has led her to use a mixed method, using a deep and comprehensive literature review and policy analysis besides the in-depth interviews. Document analysis was chosen as a complementary method of data collection as a support of triangulation and theory building (Cardno 2018). By using a mixed method, the author can gain a deeper and more complex picture of the problem (Roller 2016), considering the scientific view that a researcher must rely on more than one, but at least two sources of evidence in qualitative research to confirm the validity and reliability of her research with multiple sources of information (Bowen 2009). Besides interviews, document analysis is a more efficient and time-earning method than other research methods. However, Bowen (2009) highlights the importance of data selection to effective document analysis. The author also attended several workshops and a conference online to deepen her knowledge and to compare what is said at professional events with information from interviewees.

4.3.1 In-depth literature review

The author first conducted a comprehensive academic literature review to get a comprehensive picture of FES and their environmental impacts, the use of biomass in Europe, the EU's renewable energy and environmental ambitions, as well as the forest strategies and bioenergy usage in HU and SWE. The academic literature review aimed to provide a holistic picture of the issues of forest use, forest management, also the role of woody biomass in the European energy mix and its implications. The author conducted an initial literature search using the Central European University Library database, also Google Scholar and Google Search engines. Additional valuable literature was identified during the literature review using the snowball method (Hennink, Hutter & Bailey 2011) and later through recommendations from interviewees to identify keywords and topics useful for the research.

Papaioannou et al. (2016) argue that a systematic literature review is necessary to avoid the likelihood of bias and to have a comprehensive knowledge and understanding of the topic. Meanwhile, according to Tranfield et al. (2003), a systematic literature review helps to define the research question accurately by the researcher and subsequently helps policymakers to understand the problem accurately and thus facilitate decision-making. The collection, then synthesis and evaluation of relevant literature also played a significant role in contextualising and making the problem more understandable by utilizing Bowen's (2009) three-step technique of document analysis.

Due to the importance, complexity and actuality of the topic, there is a significant amount of literature available and therefore, the author concluded that the period under study will be reduced in the literature review and the goal of the literature review will be to introduce the different trends in the literature review. As the starting point of the literature review, the author decided to use the adoption of RED in 2009 (EC 2015). RED defined bioenergy as

renewable fuel, since then bioenergy has become the main source of renewable energy in Europe, with a share of almost 60% (Scarlat et al. 2019).

A policy document analysis was also carried out, as Cardno (2018) indicates such analysis is an established qualitative method to further understand and contextualise the issue. Moreover, policy documents usually signal and conclude political intentions based on the type of the policy document (Karppinen & Moe 2012). And in the case of forestry, biomass usage and nature protection stakeholder opposition often strongly influence the process of policy development and its outcome. **Table 1** summarises the policy documents analysed.

Table 1: List of EU policy documents analysed.

Biodiversity Strategy (2020)
Forest Strategy (2021)
RED III (2023)
LULUCF (2023)
Nature Restauration Law (2023)

4.3.2 Semi-structured in-depth interviews

The author chose the methodology of semi-structured in-depth (individual, group and go along) interviews with different experts in forest ecology and forestry in HU and SWE to understand the problem thoroughly from different viewpoints. An observation technique was also employed during data collection. The author chose the in-depth interview technique as a data collection method because it is an effective qualitative research method for gaining insight into the opinions, experiences and different perspectives of practitioners on a given research topic and then comparing them (Creswell & Creswell 2018). The interviewees were defined broadly because of the assumption that, despite or even because of their different interests, many differences and similarities could be found between their opinions. The selection of the areas, organisations and individuals contacted was based on the literature review, and the snowball method. Interviewees also recommended other professionals with a different perspective or greater knowledge of the subject. In total, 27 people within 14 organisations were contacted,

exclusively via official email. Each person was contacted only once. Those who did not respond were not contacted again, and if an interview date could not be agreed upon, the person was not contacted again, to ensure that the interviewee did not feel coerced.

In all cases, permission was sought from the interviewees to record the interview and use the material in the research, and all participants agreed to this. Interviews were conducted with four target groups: NGO representatives; foresters and conservationists working in national parks; professionals working in forestry authorities; and academic researchers. Before the interview phase, the author prepared an interview guide and sent the interviewees a few questions covering the topic, to ensure that the interviewees were aware of the interview topic and could prepare for the interview if necessary.

In total, eleven semi-structured interviews were conducted with seven different organisations. Of these interviews, four participants responded to questions in a group interview and one participant narrated their experiences and opinions in a full-day go-along interview. The group interview was conducted at the request of the interviewees due to time constraints. Although the author is aware that the individual in-depth interview is the preferred method for academic research (Gaskell 2000), the group interview was conducted in a similar way to the individual in-depth interviews. The go-along interview was a walking interview and observation in which the author accompanied the interviewee on an excursion in his natural environment (Kusenbach 2003). The same interview guide was utilized to obtain the responses during the excursion which, as in the case of the individual in-depth interview or group interview, was recorded and transcribed, however, other probing questions were also asked during the observation and walk (Kinney 2017).

The majority of the interviews were conducted face-to-face, and three interviews were conducted online at the request of the interviewees. The interviews were conducted between mid-April and the end of May 2023, with an average length of 90 minutes, but ranging from

38 minutes to seven hours due to the different interview methods. Information on the interviews is summarised in the Appendix.

Five out of the eleven interviewees requested complete anonymity, which was fully followed by the author during the preparation for the interview, the interview itself and the processing and saving of the data, and finally during the writing of the thesis, taking all necessary steps to ensure the anonymity of the interviewees in this thesis and in the future. Consequently, interviewees who allowed their names and positions to be mentioned are referred to by abbreviation in the thesis, while interviewees who requested anonymity are referred to by letter and number, as shown in the Appendix.

4.3.3 Workshop and conference attendance

In contacting the interviewees, the author was made aware of events related to the topic which the author had subsequently attended. These events were usually online events, so that they could be viewed online live and/or afterwards, and were audio-recorded and transcribed. As these events were public events and all but one can be accessed afterwards, the author refers to the speakers by full name and position, highlighting the event they attended. In one case, the event was organised as a hybrid event, but the presentations are not available online, so no transcript of the event was produced, therefore only the notes taken at the event were used for the essay. For this reason. **Table 2** summarises the professional events the author attended.

Table 2: List of events attended.

Organizer	Event	Date	Event type	Length of event	Link
Regional Centre for Energy Policy Research (REKK)	Forest biomass for decarbonisation - The trade-off between forest wood for biomass energy and as an instrument for carbon sequestration	20.Apr.23	Online	2 hours	https://rekk.hu/event/304/forest-biomass-for-decarbonisation
Fern	Insights into Sweden's forests	01.Mar.23	Online	1,5 hour	https://www.fern.org/publications-insight/insights-into-swedens-forests-2617/
WWF Central and Eastern Europe	The role of woody biomass for energy and the NECP revision	22.Jun.23	Hybrid	2 hours	https://www.youtube.com/watch?v=dY4UHqFASTU
National Forestry Association, Hungary	The potential and importance of energy production from dendromass in the light of the new EU Forestry Strategy (A dendromassza alapú energiatermelés lehetőségei és jelentősége az EU új Erdészeti Stratégiájának tükrében)	26.Apr.23	Hybrid	6 hours	

4.4 Data analysis

The author interviewed the Swedish interviewees in English and the Hungarian interviewees in Hungarian. The transcripts were thus automatically written in English for the Swedish interviewees and in Hungarian for the Hungarian interviewees. She used transcription software programs to transcribe the interviews and workshops she attended. For the Hungarian transcripts, she used the software Alrite, while for the English transcripts, she used the software Otter. In all cases, the transcripts were then checked and corrected. Correcting the transcripts, and thus listening to the interviews again, also helped to prepare for the subsequent content analysis. As the author used open-ended questions during the interviews, this allowed the interviewees to express their thoughts at greater length and in more depth, and the semi-structured interview structure also allowed them to express their opinions more forcefully, including questions and topics that were important to them. However, this resulted in long interviews, which made it difficult for the author to write the transcript, and often long answers from the interviewees, which meant that content analysis and the selection of relevant information for the research took more time.

According to Strauss and Corbin (2008), "analysis is a process of generating, developing, and verifying concepts" (Strauss Corbin 2008, chap. 3). For content analysis, the author used the coding technique, including open coding, which is "the process of breaking down, examining, comparing, conceptualizing and categorizing data" (Strauss and Corbin 1990 in Bryman and Bell 2011, 578). As a first step, the author defined keywords and concepts that fit the research question and then manually coded them. She considered manual coding important because it allowed her to find secondary keywords, which were brought up by the interviewees themselves while reading the documents carefully. Through the process of coding, the author was confirmed in the relevance of her research questions and also discovered new, unforeseen aspects of what the interviewees had said.

The citations from the Hungarian interviewees are translations made by the author, following exactly what the interviewees said in Hungarian.

4.5 Ethical considerations

The enquiries, interviews, data processing, writing of the paper and the storage of the data itself were all carried out following ethical principles (Henning et al. 2011). Potential interviewees were contacted by email, only once. Interviews were only arranged with those who responded to the email. Informed consent was sought from all participants, who were informed that they could stop the interview at any time and withdraw their statements before the paper was published. No questions related to political views or personal information were asked during the interviews. Nearly half of the interviewees requested anonymity, so they are identified by numbers in the thesis, and in addition, they have been identified by letters and numbers for recording, analysis and data storage. Therefore, their names and details are not given in any case of the research to preserve their anonymity. The interviewees were given a summary of the findings of the study, the discussion and conclusion sections of the paper were given to them for reading, and author approval was sought for quotes.

5. Discussion

No other natural resource has as many different values as forests do. This is why the proper use of FES is particularly important for both humankind and the planet. The problem, however, lies precisely in the recognition of these values by policymakers, society and individuals, and in the way, forests are managed. Therefore, over the last decade, the issue of forest management and governance has been addressed in several EU policies across different sectors. In this chapter of the thesis, the author summarises the complexity of the issue and the values of FES through grey literature, peer-review published studies, workshops and interviews. In the first part of the chapter, the problems arising from the definitions of the term at the EU level and the assessment of the EU forest policy are discussed. As emphasised by Winkel et al. (2022), the FES and the current major challenges facing the planet cannot be examined in isolation, as they are closely interlinked. The problem of FES is examined in the context of biomass as net zero and renewable energy and its ecological impacts considering the value of other FESs. One interviewee summarized the problem well by saying:

"The big question is how we prioritise. So, if we really consider the one and a half degree to be important, then biomass is clearly not renewable, and if we consider rural development and security of supply, then biomass is clearly good." (HÁ)

5.1 The concept of forest

The characteristics of forests vary considerably across Europe depending on the climatic zone in which they are located. The EU does not have a common forestry policy, as this remains a national concern. As a result, the very concept of forest and forest area is not uniform and is also a matter for each MS.

The United Nations Framework Convention on Climate Change (UNFCCC) proposed a definition of forest land as having a canopy cover of at least 10-30%, a tree height of at least

2-5 metres and a forest area of at least 0.1 hectares (FAO 2015). EU countries have chosen to define their forests within this threshold for reporting on land use and land use change (Ceccherini et al. 2020). On the contrary, the EU follows the FAO definition which defines forest as " land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use." (FAO 2018, 4). Compared with the definition of forest, other wooded land is a " land not classified as “Forest”, spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use." (FAO 2018, 4). The Convention on Biological Diversity (CBD), while following the FAO definition, accepts that there may be other forest concepts that reflect the diversity of forests and forest ecosystems (CBD 2006).

The system is, however, questionable in the long term, considering if the concepts themselves are not clear and uniform across EU countries, the legislation, reporting and monitoring itself is called into question. This thesis does not aim to analyse the definitions of forest and forest area used by European countries, which could be the subject of separate research. However, given the EU's commitment to strengthening biodiversity and afforestation, also protecting nature, which it intends to achieve, i.e., by building a strong reporting and monitoring system, one would think that common forest policy, including a common definition should be needed within the EU. Sweden[14] and Hungary[15] are good examples, as these two

[14] Even though Sweden also follows the FAO definition, another definition, the productive forest land concept, strongly determines its forestry and forest protection policy. Productive forest land is defined as land suitable for forest production that is not used for other purposes and that is producing more than 1 m^3 $hectare^{-1}$ $year^{-1}$. According to this definition, 58% of Sweden's land area, about 23.5 million hectares, is suitable for forest production (SLU 2022).

[15] Hungary follows a completely different strategy in defining forest and forest land. In Hungary, the forest is defined as any forest stand or open forest consisting of forest tree species, with a continuous stand of at least 50% canopy cover, an average height of more than 2 metres, a natural area of 0.5 hectares, and an average with

countries do not have the same definition of forest land, making any comparison difficult. Differences in the definition of forest between countries, which are considered insignificant, can have an important impact on the calculation of biomass or stored carbon as well as affect the economic, natural, climatic and social value of protected areas, biodiversity, and forest ecosystem services.

If we go further and look at the definitions of primary and old-growth forests, we also find differences in the EU MSs, even if the definitions adopted by international initiatives show many common aspects. A primary forest is usually a relatively intact forest of native tree species that is naturally regenerating and shows no signs of human activity. An old-growth forest is usually a late-successional forest that includes both dead wood and old trees at the end of its natural life span, in addition to more trees (Barredo et al. 2021). The EC and CBD follow the FAO definition of primary forest, which is in line with Forest Europe's definition of "forest undisturbed by man". The Carpathian Convention, of which HU is a member, uses the term "primeval forest" and only partially matches the FAO definition of primary forest. The UNESCO Initiative on Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe uses the terms "primeval forest" and "ancient (beech) forests" (Barredo et al. 2021). The European Forest Institute's 2021 report states that the definitions of primary and old-growth forests should not be too strict, given the very low proportion of forests with minimal human intervention and the high value of secondary forests for biodiversity conservation. Therefore, a flexible definition is proposed that includes forests that have some management legacy but are still of conservation value (O'Brien et al. 2021). **Figure 11** shows the basic concept of categorization.

of 20 metres between the edge trees. An exception is the open forest, where the exclusion is weak but at least 30%. Freehold forests are self-planted self-forest plantations, where the owner is free to manage and cut trees, and is not obliged to restore the land after felling (NFK 2022).

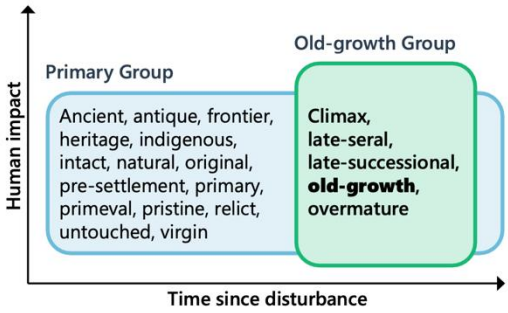

Figure 11: Categorisations of high-conservation value forests.
(Source: O'Brien et al. 2021, 16)

The varying terms used by different organisations and thus countries, as in the case of forests and woodlands, can cause problems in European environmental policy precisely because of the nuances of the differences, as several studies have pointed out (Buchwald 2005; Barredo et al. 2021), and therefore a common definition at EU level would be particularly important for an effective environmental policy. Remember here that the definition of primary and old-growth forests requires little or no interference from human activities, including any form of logging. Therefore, common rules are particularly important because the remaining primary and old-growth forests which make up only 3% of the EU's land area can only be preserved with strict protection (EC 2023e). However, more than half of primary forests, which are vital for forest ecosystem services, do not currently have strict protection status in Europe. Primary and old-growth forests, which now only remain in small patches and are isolated from each other, should therefore be protected if the forests in their immediate vicinity are also given strict protection (O'Brien et al. 2021). The EU, recognising the importance of primary and old-growth forests, and following the objectives set out in the Biodiversity and Forest Strategies, published two guidelines in 2023: guidelines on Biodiversity-Friendly Afforestation, Reforestation and Tree Planting and guidelines for Defining, Mapping, Monitoring and Strictly Protecting EU Primary and Old-Growth Forests (EC 2023e). It is important to stress, however, that these are only practical guidelines and do not constitute an obligation for MSs.

The complexity of the problem was also underlined by the majority of interviewees. Of the eleven interviewees, 9 mentioned the problem of the lack of a common forest definition as

a problem during the interviews, and 3 considered it particularly problematic. The latter are NGO experts and believe that the lack of common use of different forest concepts across all countries in EU legislation could jeopardise the EU's long-term objectives. The complexity of the problem and its likely negative consequences are well summarised by two interviewees' views expressed during the interview:

"The energy definitions are fine in the EU, the forestry definitions are not, because forestry as a forest management method is not an EU, but Member States competence. There is a huge problem linked to this, because foresters say that forest is a national competence. That is not true. Forests are not. Forestry is, but forests are not. Because the term forest means a habitat, and the EU has a say in it through a great many environmental regulations." (KZ)

"The different EU strategies for the environment, also the forest, biofuels and the carbon dioxide sequestration are stepping stones to get somewhere in the future. We want to make a change by using the strategy. When we put these together and use them, we will have a change in the future. But if we don't have common definitions, or a solid basis for what the stepping stones are, then the risk is very high that at least one of them will fail. And because they build on each other, and therefore are connected, they're interlinked. So, if we break one link, then all of them break, and there is a risk that the whole concept and the end goal falls apart. The chances are that in the end it will go in a different direction than where we were aiming in the beginning; it will go in the wrong direction. […] I think the most important task here is to define what a forest is. When you think about it, it could be so simple, to define what is a forest. But the problem now is that the whole question is polarised. […] If you have a solid base to stand on, in the beginning, to have a good definition of what is a forest and what is a biodiversity-rich forest, what is an old-growth forest, and what is a production forest, it cannot fail. The definitions need to be strict." (JA)

As one of the major problems related to forest biomass use identified by Lora Stoeva, Forest Research Institute, Bulgarian Academy of Science, in an online webinar on RED III[16] (The role of woody biomass for energy and the NECP revision), hosted by WWF Central and Eastern Europe, was the lack of clarity on the concepts. As she put it, clear definitions of certain concepts are needed, as well as national legislation that specifically defines these concepts. In her opinion, an example is the lack of a definition of a highly biodiverse forest, which raises many problems for various EU policies. For example, she cites Bulgaria, where no legislation defines the concept of old-growth or primary forests. She stresses that there is no agreement on a common definition in the EU level either, but that there is now an opportunity to address these gaps in national legislation during the transposition process of EU legislation. Clarification of concepts such as the link between the principle of sustainable forest management and soil and biodiversity conservation, or the definition of a dead wood threshold, for example, is also needed. If these are not clearly defined in national legislation, then the forest regulations need to be amended, i.e. the standards on which the subsequent certification process is based need to be clarified, as do the associated thresholds for clear-cuts (Stoeva 2023). Vidal et al. (2016) reach a similar conclusion, pointing out that without a European forest policy where the definitions, methods and information systems are not clear, it is not possible to make proper analyses from voluntary data from individual countries. It is, therefore, particularly essential that EU regulation, especially in different areas, is coherent and mutually reinforcing to achieve the EU's ultimate climate neutrality goals.

[16] On 22 June 2023, WWF Central and Eastern Europe held an online event on biomass sustainability and NECP planning. The event, organised in the framework of the LIFE BIO-BALANCE project, focused on the role of woody biomass in renewable energy production and the review of NECPs. The recorded webinar can be viewed here: https://www.youtube.com/watch?v=dY4UHqFASTU The author participated in the online webinar and transcribed the recording.

5.2 The concept of nature protection

The protection of natural habitats is the most effective means of conserving biodiversity (Lawrence and Beierkuhnlein 2023). Nevertheless, the problem is similar to protected areas (PA)[17] than forests, due to the lack of a precise EU-wide definition of what constitutes a PA, what criteria are used to classify land as protected, and what activities are possible or prohibited in a given PA. All these definitions and regulations are the responsibility of the MSs. The question arises, however, which aspects are taken into account when an MS is forced to comply with the EU's requirements. Although the ambitious Biodiversity Strategy objectives[18] for biodiversity conservation are not binding on the MSs, other nature conservation directives and laws are. All this raises a further problem, of which HU and SWE are good examples: how MSs calculate the proportion of protected forest. An excellent example is that when the topic of the current proportion of protected forests in SWE was raised, the interviewees themselves did not know what answer to give because, as they explained, the size of protected areas depends on how they count them. In 2021, the proportion of terrestrial PAs was 26.4% within the EU, of which 18.5% were Natura 2000 (N2k) sites and the remainder were other national PAs (EEA 2022). The size of PAs varies from country to country, largely because the definition of protection varies from one MS to another. For example, according to the EEA (2022) and

[17] According to the International Union for Conservation of Nature (IUCN), a PA is "a clearly defined geographical area that has been recognised, designated and managed by legal or other effective means for the long-term conservation of nature, together with associated ecosystem services and cultural values" (Dudley 2008, 3). The organisation distinguishes six categories of PA.
A strict nature reserve is a strictly protected area because of its biodiversity or geological features, therefore human visitation or impact is restricted and controlled. A *wilderness area* is a large protected area of natural character where human visitation is not significant. *A national park* is a large area of natural or semi-natural land that preserves ecological processes but provides spiritual, scientific, educational, recreational and visitor opportunities for people. A *natural monument or natural value* is an area designated for the protection of a particular natural monument. *Habitat/species management areas* protect habitats or species where active intervention is permitted to protect those species or habitats. *A protected landscape or seascape* is an area where the interaction of nature and humans has created a feature that is of value and where it is important to conserve this interaction. *Protected areas are areas that conserve ecosystems through the sustainable use of natural resources*, where non-industrial uses of natural resources compatible with nature conservation take place (IUCN 2008).

[18] The EU Biodiversity Strategy calls for 30% of the EU's land to be protected and X% of its seas. Within that, 10% of all land, 10% of all remaining primary and old-growth forests and 10% of the sea MS, it sets the objectives for future EU laws and directives.

BISE (2023b), SWE should significantly increase the proportion of PAs, which is currently around 15%. Meanwhile, SWE claims that it already has protected even more than the required 30% (Angelstam et al. 2020, 2023; Samuelsson et al. 2020), and according to Statistics Sweden the formally protected forest land is 27% (Statistics Sweden 2023). One of the interviewees summarizes the situation as follows:

"The formally protected forest is 5%. And then there are voluntary set-asides another 5%. So, these are already 10%, which are not used for production. I mean, it's voluntary. To be strictly protected, they should be transformed into formally protected maybe. Then you also have the unproductive forest, where the forest grows less than one cubic metre per hectare per year, which is not used. And that's 16% of the forest. And then you have the rest of the forest. When you do a clear-cut, you also leave some tree patches, that's another 7%. So, depending on how you count, some could say, 10% plus 16% which will be already 26%. Maybe they would even add the 7%, then we are at more than 30% which is already somehow protected, or not used for wood production. The rest, 67% is used for wood production. So, some organisations claim that we have already done the EU requirement. But, on the other hand, most of the formally protected forests are north-western Sweden, where productivity is low. So, it's cheap to protect the forest. And then you will have only a few percent in the other parts of the country. So, if you want protection and Biodiversity Strategy, if you want to be it to be representative of all the different ecosystems and forest types, then it's a different picture." (JE)

Although this was not an issue for the Hungarian interviewees, as the HU state precisely defines the different levels of protection[19], all interviewees emphasized that it is useless to have a PA

[19] Hungary defines different levels of protection.
Local protected areas are small protected groupings, such as a protected tree line or a protected park within a municipality, which are of particular natural value. A *natural monument* is usually a significant natural asset or formation and its associated area of protection, such as a spring or sinkhole. A *nature reserve* is a small contiguous area of special natural value whose primary function is to protect natural values. Examples include protected wetlands, and salt ponds. A *protected landscape area* is a larger, usually contiguous, area or part of a landscape that has a distinctive natural or landscape value. Its primary function is to conserve the landscape and natural value resulting from the interaction between man and nature (Interviewee P1; KSH 2021). *A national*

if invasive[20] tree species dominate the area or if there is no protection against logging or any type of investment, even in N2k PAs. **Figure 12** shows forestry practices through photos in one of the Hungarian national parks. One reason for weak protections is that different forestry regulations and rules conflict with each other, which puts forestry and nature conservation authorities in a particularly difficult position. Moreover, 2 interviewees highlighted the fact that, despite 22% of the country's territory being protected by EU or HU legislation, only 9% of the natural areas, an equivalent of around 849 thousand hectares in urgent need of being protected, are protected nature conservation areas. Hungarian Central Statistical Office also communicates this number (KSH 2021). One interviewee (KZ) also highlighted that HU has only 343 000 hectares of natural forest[21], not all of which are protected.

The base of the EU PAs is the N2k network. In 1992, the EU adopted the EU Habitats Directive and the LIFE programme, and the N2k network was created, consisting of sites designated under the 1979 Birds Directive and the 1992 Habitats Directive. Although it is the EU's largest ecological network in terms of PAs, it does not guarantee biodiversity conservation without effective management and requires a transnational network at the European level to function effectively. In many cases, nevertheless, PAs are not properly designated. However, PAs, if well planned and managed, can provide shelter for species despite the expected further habitat loss and fragmentation due to significant human pressure.

park according to Act LIII of 1996 on the Protection of Nature is "a large area of the country with a characteristic natural character, which has not been substantially altered in its natural features, whose primary purpose is to protect natural flora, fauna, geology, hydrology, landscape and cultural history values of special importance, to maintain biodiversity and the proper functioning of natural systems, to promote education, scientific research and recreation" (KSH 2021). *Strictly protected areas* may be designated in national parks and protected landscape areas where economic activity is severely restricted or excluded (Interviewee P1).

[20] An invasive tree is "a species undergoing unassisted spread in the wild, or described as an alien species in need of a control strategy" as formulated by FAO (FAO 2009).

[21] A natural forest is a "forest stands predominantly composed of self-sown native trees. They are in other words naturally regenerated and complementary to planted/sown stands and exotic self-sown stands. (After FAO 2001a). Comm: They range from undisturbed by humans (e.g. virgin forest) to heavily utilized for grazing, wood production etc. The degree of naturalness can be described by referring to more detailed levels or subclasses of natural forests. Stands which have natural processes or structures present are taken to be self-sown if no information indicates otherwise. "Natural forest dynamics" refer to the natural dynamics of natural forest undisturbed by humans. They often include a cycle of seral stages of growth." (Buchwald 2005).

Figure 12: Caption: ”Beech forest types”.
In A a section of the Duna-Ipoly National Park where clear signs of active forestry can be seen. Note the clear-cut in the lower centre section that is now covered with a young plantation. In B a tall beech tree is marked for logging, and in C another tree is marked for logging. In D a pile of beech logs and in E processed wood for domestic wood burning. The photos were taken inside the Duna-Ipoly National Park by the author.

The designation of protected forest areas requires the following three guiding principles: i) the biodiversity must be completely or in a large part represented in the area, i.e. they must be sufficiently representative; ii) the area must ensure the long-term survival of species through appropriate spatial definition; iii.) the site must ensure suitability in terms of habitat (Branquart et al. 2008). Yet, only a fraction of designated PAs take all three aspects into account, as in many cases spatial planning and site conditions are not taken into account in European countries (Branquart et al. 2008). This was confirmed by the interviewees. Five out of eleven interviewees stated that PAs were not properly designated in their country. In their opinion, the designation failures were that in many cases the conservation values and connectivity of sites were not the primary consideration. In some cases, for both nature reserves and N2k areas, there is a discrepancy in the legal and practical designation between the proclamation decision and the parcel number. As a consequence, the legal designation system has in many cases led to the designation of areas as nature reserves or N2k areas which are not necessarily of their natural value.

Although the percentage of N2k sites is significant, their inadequate designation and the ongoing climate change (CC) have led to the need to expand PAs to conserve natural ecosystems by increasing and linking PAs at the European level (Lawrence and Beierkuhnlein 2023). In future endeavours, to expand the level of nature protection in the EU, it is paramount that the designation of N2k networks should be done after thorough environmental assessments, in areas of high ecological quality and conservation relevance (EC 2020b). This requires that the conservation objectives and associated measures for the future designation of PAs are clear. Lawrence and Beierkuhnlein (2023) argue that a continental approach to conservation decision-making is needed, a first attempt at which is the EU Biodiversity Strategy. However, effective implementation is constrained by the EU's political structure, which leaves the implementation of conservation decisions at the European level to national

competence. **Figure 13 shows** boreal forest age classes in SWE and the consequences of clear-cutting.

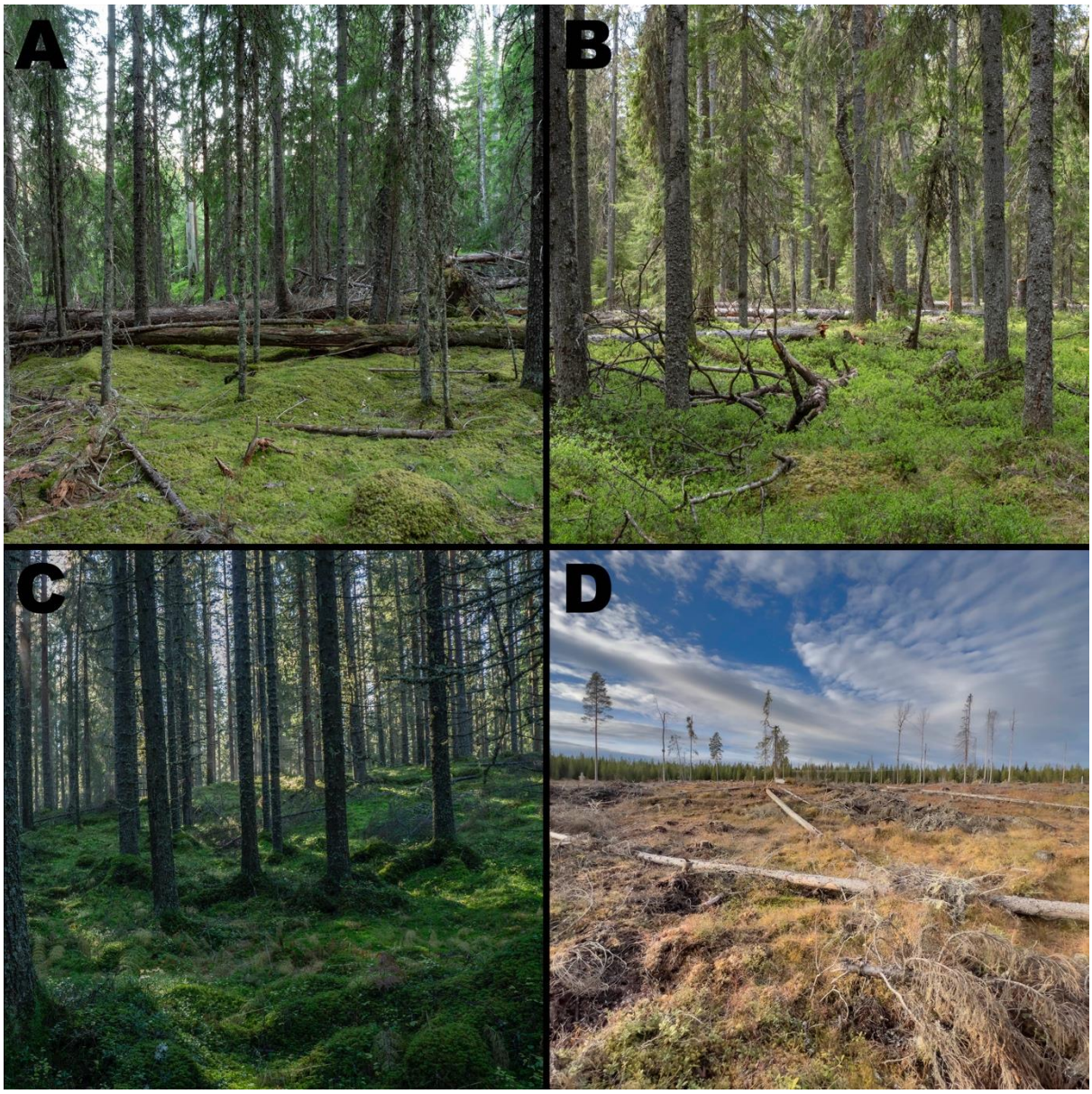

Figure 13: Caption: ”Boreal forest age classes”.
In A pristine spruce-dominated coniferous forest, in B old-growth spruce forest, in C a spruce plantation and in D a recently made clear-cut. The photos were taken in northern Sweden by the author and Jon Andersson.

It is emphasized that the implementation of the strategy also needs to consider the budgetary constraints of national governments in implementing high ecological quality conservation measures, as in many cases areas of high conservation value are located in countries where resources for conservation are limited, like Romania as an example. Nature

conservation is a priority not only at national levels but also at European levels and hence the economic burden of expanding for example the N2k network should be shared among MSs. Countries also differ in the proportion of current high nature conservation value areas in their territory, which interviewees and Lawrence and Beierkuhnlein (2023) argue should be taken into account by the EU. Less fragmented and larger protected areas have a higher conservation value than fragmented and small PAs. Nevertheless, large, and high-connectivity PAs are mainly found in the Nordic and Eastern European countries, as well as in the Mediterranean, therefore, an increase in PAs in these areas is strongly recommended, considering their high conservation value. Lawrence and Beierkuhnlein (2023) explain their suggestion with the assumption that it is easier to preserve and enhance conservation values in less fragmented areas. While PAs in Central and Western Europe are highly fragmented, an increase in PAs is also necessary in these regions, but without ambitious restoration efforts, it is likely to be possible only on a smaller scale due to the high fragmentation of the territory. Nevertheless, it is worthwhile to emphasise the need to halt further expansion of human activities into the small pockets of semi-natural areas in these parts of the EU (Lawrence and Beierkuhnlein 2023). This criterion was mentioned by the Hungarian interviewees, with a total of five interviewees highlighting the need to take into account the specificities of each country, emphasizing that HU is less able to define large-scale PAs and targets than countries whose high nature value areas with pristine primary and old-growth forests can be found in the country in a contiguous area. As they emphasized HU's size (93,028 km²), history (Treaty of Trianon), location (Carpathian Basin), climate (different climate zones, most of the territory in forest-steppe climate zone), population density (112 per km^2), and financial situation (Eastern Bloc) make it unsuitable for the large areas and high proportions of PAs that the EU would expect. In addition, 4 interviewees pointed out that there is a lack of appropriate expertise to manage a nature reserve requested by the EU. Also, strong forest management is always necessary in Hungarian

PAs, due to invasive tree species and the region's specific water, soil and climate conditions. On the other hand, 5 interviewees agree that HU is particularly rich in natural values, which makes nature conservation important in specific areas. All of the Hungarian interviewees highlighted that as a first step, the country should first properly protect and manage existing PAs which is not happening now. For this reason, they are all of the opinion that forests in HU are in a particularly bad state and that the consequences will be disastrous in the coming decades.

5.3 Forest ecosystem services in EU policy

Göran Persson, former Prime Minister of Sweden acting as the chair of the EFI ThinkForest science-policy forum, said in 2012 that the EU needed its forest policy. He argued that the EU was likely to have a stronger say in forestry and forest protection policy in the MSs through other policy instruments anyway, because of environmental, climate or energy policies. The proposal was opposed by several countries, especially those with a strong forestry industry, one of them was SWE (Hetemäki 2022). As Persson predicted, the EU has increasingly focused on FES in its regulations since then, and as a result has had a strong influence on the forest regulation of MSs. Examples of such soft laws and regulations announced by the EU that have an impact on forest use and protection among others are Common Agriculture and Rural Development Policy (CAP), RED I-II-III., Habitats Directive and Birds Directive (also known as the Nature Directives), Biodiversity Strategy and Forest Strategy, Forest Law Enforcement, Governance and Trade Policy (EC 2003), and the Land Use, Land-Use Change and Forestry (LULUCF) Regulation[22] (EC 2023f) .

[22] The LULUCF Regulation defines how the land use sector contributes to the EU's climate objectives. It was revised in 2023, setting a net land-based carbon dioxide removal target of 310 million tonnes of CO2 equivalent by 2030. Under the revised regulation, the rule that all Member States must offset their accounted emissions from land use by at least an equal amount of net removals between 2021 and 2025 will not yet enter into force, but the net removal target of -310 million tonnes of CO2 equivalent by 2030 will enter into force between 2026 and 2030, an increase of 15% compared to current levels (EC 2023f).

The question is, however, how consistent are these policies with each other, and what happens when they conflict? Which FES is the most important when countries are simultaneously facing problems such as CC, biodiversity loss, energy crisis, agricultural crisis, etc.? The FES connects the different forest functions, the values that forests provide to people, such as CCM, logging, energy, tourism, mental health, biodiversity, carbon sequestration, NWFP, to human well-being. For FES, five groups of services are defined, these are i) provisioning, such as timber, NWFP, water, and food; ii) regulation, i.e. water, soil, and climate; iii) support through pollination or nutrient cycling; iv) cultural services such as education, recreation, tourism; and v) biodiversity (Elomina and Pülzl 2021). As the various groups of services show, in addition to the tangible and therefore monetizable values, FES also represents a range of other values. This is well illustrated by the IPBES value of nature typology (IPBES 2022), which emphasizes the richness of the values that nature provides. People relate to nature in different ways, as they coexist with nature, use nature when they live from nature, are in nature, and see themselves as part of nature (IPBES 2022). The valuation of nature, and thus forests, is dominated by market (instrumental) values in the decisions of political and economic decision-makers, especially the material contributions provided by forests. As a consequence, relational values such as connection to nature and intrinsic values such as biodiversity and ecosystems are not sufficiently taken into account in decision-making (IPBES 2022). In forestry policy, all three specific values should therefore be reflected, and intrinsic values and relational values should be given equal weight alongside instrumental values.

The EU is in a particularly difficult position when it tries to address all these issues simultaneously through different policies, but their effectiveness is called into question precisely because of the lack of a common forest policy. Winkel et al. (2022), in their review of the state of FES, identified six challenges that the EU needs to address, these are i) inefficient alignment of supply and demand side in relation to ecosystems; ii) lack of ecosystem supply

and demand information and efforts to align them; iii) lack of policy integration; iv) inadequate and unclear regulatory frameworks; v) MSs limiting policy solutions at EU level; and vi) increasing pressures from CC. One of the tasks of EU forest policy would be to match the economic, political and social needs for FES with the supply of FES. The supply and demand for FES in EU policy need to be considered along three challenges which, although representing different FES, are fully interlinked. A well-coordinated and coherent forestry policy, which could properly address the FES in all cross-sectoral policy issues, thereby creating a compromise and balance with the values provided by the FES might be the answer to these challenges. The three challenges to be addressed by EU sectoral policies are: i) the need for a rapid transition of the European economy to renewable energy and feedstocks; ii) the ability of forests to adapt to CC; iii) the drastic loss of biodiversity. None of these challenges can be addressed without focusing on the other two, and therefore all three challenges must be equally reflected in the decision-making process of each policy (Winkel et al. 2022). At the moment, however, EU forest policy is rather fragmented and poorly institutionalised (Elomina and Pülzl 2021; Winkel et al. 2022). Hence, balancing the three specific values (instrumental, relational, intrinsic) of forest value, as emphasised by IPBES (2022), can ensure the coherence necessary for sustainability in sectoral policy decisions. Now, these values are not equally reflected in EU policymaking, resulting in regulations that weaken or even significantly contradict each other. However, balancing different sectoral perspectives on nature's values helps to create coherence between policy objectives.

Hetemäki (2022) and 8 interviewees alike stated that one of the obstacles to an effective forest policy is the lack of appropriate experts in the EC. There is a lack of experts in forestry and forest protection in the civil service and thus in decision-making, which is the reason why the EU does not have forest policy competencies and therefore does not have a group of experts. However, as other EU policies are interlinked with the issue of FES, the lack of appropriate

experts is one of the obstacles to ineffective and often contradictory FES-related policies. The solution would therefore be to create a Forestry Unit to improve the coordination of EU forestry policies and provide the EC with appropriate synthesis documents for decision-making.

Yet, if no changes are made in the MSs current forestry policies, recent research suggests that the ecosystem services provided by forests in Europe could be reduced by 15-23%. The decline could be as high as 70% in the Mediterranean, 14-24% in Central Europe and 8-12% in the Alps. Only in the boreal regions is a small increase in FES likely (Mauri et al. 2023). However, this decrease could be reduced by appropriate human intervention, i.e. by planting tree species better adapted to the expected climate conditions. Seven of the eleven interviewees mentioned the importance of researching and planting tree species that are adapted to CC in their country as a key issue. They believe that the solution is not to forcefully preserve forest stocks at all costs, but to adapt to the current and future situation of European forests. In HU, for example, it is clear that the solution in the eastern part of the Great Plain is not afforestation, but forest-steppe as the area belongs to the forest steppe zone, which was emphasised by 5 out of the 7 Hungarian interviewees. In addition, Prof Dr Fábián Attila, Rector of the University of Sopron, speaking at the Hungarian Forestry Conference[23], highlighted the role of universities in research. On the other hand, in SWE, all 4 interviewees believe that we should be prepared for the fact that oak will become more pronounced in the south of the country rather than spruce.

The EU Forest policy, the MSs, and the forestry industry have and will have an extremely important role to play in the maintenance and proper use of FES in the coming years. Regarding the Biodiversity and Forest Strategies, the interviewees highlight the most important

[23] The National Forestry Association in cooperation with the University of Sopron organized a thematic professional day on 23 April 2023 entitled 'The opportunities and significance of dendromass-based energy production in the light of the new EU Forestry Strategy (taking into account environmental health and economic rationality)'. The aim of the hybrid event is to inform foresters about possible future directions on the topic through presentations by experts from different perspectives. The event was not recorded, so the author has only used his notes from the event and the available presentations.

steps for the EU to take, including the urgent need to establish the following as a binding policy for all MSs at the EU level as part of a common EU forest policy or without:

- Define common EU-level forest and biomass definitions.
- Define different PA definitions.
- Establish strong and common reporting systems.
- Improve the controlling system of forest management.
- Improve the data on forestry or forest monitoring. Field surveys should be combined with sectoral monitoring.
- Monitoring of forests should be taken out of the hands of forest managers and left to forest ecologists.
- Screening of primary and old-growth forests should be done by independent experts.
- Strong and independent authorities in each MSs.

Although, at the moment, a common forest policy does not exist, MSs and the forestry industry have to consider many aspects when using their FES, as the EU regulates them with many other policies. To comply with all EU legislation, countries must make decisions in the order in which they prioritise the many FES, considering their specific energy, economic, industrial, environmental and conservation conditions and regulate the forestry industry accordingly. Although several studies and grey literature (Arold 2021; Bäck et al. 2017; Hanewinkel et al. 2013; Gustavsson et al. 2017, 2021; Jacobs et al. 2016; Waring et al. 2020; Winkel et al. 2022) have proven the long-term negative consequences of intensive forestry such as clear-cutting forestry methods still conducted in most European countries, MSs' forestry policies and forestry practices are still focusing on logging, including intensive clear-cutting of EU forests, rather than to give incentive and improve the use of other FES and their economic, social, ecological and cultural values. This is clearly reflected in the subsidies that unilaterally

sustain logging, while other FES are rarely taken into account. It would therefore also be advisable to include biodiversity conservation, climate protection, and cultural ecosystem services in future subsidy schemes (Primmer et al. 2021; Winkel et al. 2022).

5.4 Burning wood biomass as an energy and its ecological implications

Whether wood can be considered a renewable energy source is a matter of debate in science, politics, and society because the current methods used to harvest it impact the entire ecosystem, other ecosystem services and the climate. Opinions also vary considerably among interviewees. The EU in the Biodiversity Strategy stated that "the use of whole trees and food and feed crops for energy production – whether produced in the EU or imported – should be minimised." (EC 2020b, 8). In 2022 the EC decided to review RED II (RED III) (EC 2021a), also considering the EU's newer targets set in REPowerEU and "Fit For 55". These targets are, on the one hand, a pathway to make the EU independent from Russian fossil fuels, and on the other hand, a way to reduce EU emissions 55% by 2030 in line with the European Climate Act with a further goal to meet the European Green Deal target of becoming climate neutral by 2050 (EC 2023a, 2023d; EUCO 2023b). RED II and its provisions, i.e. what is considered renewable energy and how CO2 emissions from individual renewable energy sources are calculated, have a significant role to play in achieving these targets. The LULUCF Regulation was introduced in 2018 with the regulation of accounting biogenic emissions and revised in 2023 (EC 2023f). MSs have been tasked with reviewing the National Energy and Climate Funds by 30 June 2023 on the sustainability criteria for solid biomass and minimising the environmental impacts of bioenergy. The four criteria the MSs need to follow are harvesting, LULUCF, efficiency, and GHG emission criteria (Bódis et al. 2021). The EC will review and provide feedback on the review plans submitted by MS by the end of 2023. The questions are whether, how, under what conditions and in what proportions MSs can use woody biomass, in particular the emission

reduction rates per country in the LULUCF provision (BioScreen CEE 2021, 2022; CEEWeb 2022; Harmat 2022; Matthews 2020; Romppanen 2020). These questions are understandable, given that since the adoption of RED I, when bioenergy was defined by the EU as a net zero renewable energy, the share of biomass, and in particular woody biomass, has increased significantly. At the moment, 60% of renewable energy in the EU is biomass (Scarlat et al. 2019). More than half of woody biomass is used for domestic heating, in the form of logs and pellets. Power plants often use wood chips made from logs and wood shavings. Pellet production does not favour forest residues but rather dry debarked stem wood (Chamberlain et al. 2022). RED III pays particular attention to the use of primary and secondary woody biomass and expects the cascading principle[24] to be followed. Under the cascading principle, energy upcycling is the last possible step before disposal. Nevertheless, the use of primary wood biomass for energy purposes, including the use of perfect-quality logs, is allowed.

The revision of LULUCF Regulation, although for the period 2021-2025 follows the so-called "no-debit" rule, during this period, EU countries must ensure that emissions from the LULUCF sector do not exceed the amount removed. However, from 2026 the EU sets a net GHG removal target of 310 million tonnes of CO2 equivalent for LULUCF, which is 15% more than at present, so MSs will need to take concrete steps to reduce their CO2 emissions in these sectors or compensate in other areas. MSs can buy or sell credits to achieve their targets because there will be severe sanctions if the measures and results are not right. The issue and the MSs' decision are not easy, because although the EU RED III allows the use of solid biomass, including primary and secondary woody biomass, the LULUCF regulation does limit the quantity of forest biomass MSs can use, and hence their hands are tied. With the current demand

[24] The cascading principle was already part of the EU Forest Strategy 2014-2020. According to it, biomass uptake is more important than energy use, i.e. woody biomass use should be prioritised according to the highest economic and environmental added value. The cascading principle prioritises woody biomass use according to economic and environmental added value as follows: 1) wood-based products, 2) life extension of wood-based products, 3) reuse, 4) recycling, 5) bioenergy, 6) disposal or incineration only under appropriate emission controls.

for woody biomass and the likely future increase, especially in terms of wood harvesting, the LULUCF targets are unlikely to be met by MSs, as was pointed out by interviewees in both countries. All 4 NGO experts and 2 researchers highlighted that with current or even increasing logging, neither HU nor SWE will be able to meet the LULUCF targets, resulting in significant penalties. According to the Swedish interviewees:

"I think the only way to reach that is to decrease harvest level, because otherwise, I think Sweden will have to pay some fines. The industry doesn't like to say that, but I don't see another way. And if we want some insurance, then we should increase the carbon storage even more than what the current tree growth level is, because if we get more extreme years, tree growth may decline even further." (JE)

"Sweden cannot ignore LULUCF. […] They're not going to be able to achieve the national target unless they lower the current amount of annual felling. So, if they're clever, they would use carbon sequestration and storage in positive synergy with protecting biodiversity. This is what the European Green Deal is about it, climate and environment go together. […] So, *they need to either achieve the LULUCF goals or they need to buy from other countries emission reductions, which is going to be expensive, because other countries are also going to have problems. Or I suppose EU will impose some kind of penalty, e.g., fine." (PR)*

One of the Hungarian interviewees highlighted the problem during the interview, moreover, he wrote an article about the problem on the most relevant Hungarian climate change science website:

"The carbon-absorbing capacity of domestic forests is steadily declining and logging and forest use practices are pushing us further away from equilibrium, with the effects of climate change adding to the problem. Not only will this jeopardise our own statutory climate neutrality targets (which count on increasing carbon sequestration to compensate for remaining emissions), but we will also fail to meet the requirements of the new EU RED (RED III) and

the regulation setting carbon dioxide sequestration targets (LULUCF Regulation). Hungarian nature, energy and climate policies are not working in a coordinated way. If the current resource-focused approach is not complemented by climate protection and biodiversity conservation efforts, we will all be at a disadvantage in the medium term. Addressing this situation requires cross-ministerial planning that goes beyond the current crisis." (HÁ) (Harmat 2022).

This is all due to the carbon cycle and the carbon balance of European forests which is of course becoming more and more prominent with CC. Therefore, almost all interviewees (9 of eleven) agree that woody biomass, even if it can be considered renewable, should not be considered a net zero, low-carbon energy source. This view is supported by scientific research, and even the EC's scientific research team reached the result that the burning of fine wood waste can increase emissions for up to 20 years (Camia 2020). On the contrary, according to one interviewee (HÁ), it is not a problem that biomass is considered CO2 neutral as long as LULUCF targets are taken seriously by the EU and thus by MSs, however, there will be severe consequences if LULUCF targets are not met. As he and 3 other NGO experts point out, the current LULUCF regulation and the new, even more ambitious targets under revision from 2026 will tie the hands of European countries severely if they do not want to be penalised. In addition, not only they, but also experts working for the forestry authorities and national parks, emphasize that when trees are felled, the carbon sequestration capacity of the tree is lost, and that although carbon sequestration is restarted when a new tree is planted, the carbon sequestration of a sapling or young tree is much lower than that of an old tree. Many interviewees (8 of eleven) agree that the problem is not the use of biomass for energy, but the use of primary wood biomass. Their opinion is summarized well in this quote:

"Unfortunately, the consequence of the RED is that the wood that the forestry had previously considered useless and left in the forest can now be sold. However, that wood would be

important for carbon storage and biodiversity if it were left there. There are many forests where logging was not economically viable partly because the wood was not suitable for industrial use. RED incentivises felling for firewood and selling as wood chips. However, these forests and these trees would be very good for carbon sequestration and storage, for biodiversity. The logs that come out of thinning and clear-cuts should not be considered secondary wood biomass, as foresters are trying to interpret, primary wood biomass. Primary woody biomass should be excluded from renewable energy sources. Waste from other uses of wood should only be counted in the RED, because there is nothing to do with it anyway. Wood burning should not be counted as renewable energy because it encourages EU Member States to cut down trees. But cutting down trees reduces carbon production, which puts Member States and the EU itself in a fatal spiral." (KZ)

The same problem was highlighted by Alex Mason, WWF European Policy Office Climate & Energy Manager, at an online event organised by WWF on RED III. He believes that there needs to be a change in mindset that what has no commercial value has value in terms of CO2 emissions or biodiversity. Under RED III, the EU has created incentives for forest owners and managers to remove from the forest logs unsuitable for the sawmill industry or any other commercial use. However, these trees could remain in the forest in terms of CO2 emissions. And even if it is true that these trees will also decompose after a while, but that is a very long time, the CO2 storage of these trees is very valuable now. That is why even the JRC believes it is not worth burning large tree trunks from a climate point of view, because the CO2 is immediately emitted by the tree instead of being stored in the soil. The cascading principle, which has now been set as a brake in RED III, is therefore not, in his view, a way forward for bioenergy (Mason 2023). Markku Ollikainen, Professor of Environmental and Resources Economics at the University of Helsinki, Chair of the Finnish Climate Change Panel was also

of the same opinion at an online event organized by REKK Foundation[25] on April 20, 2023 (Forest biomass for decarbonisation). He states that burning wood is in fact, a reduction in LULUCF numbers without any reduction, which is not sustainable no matter how MSs count forest management and forest biomass use. The reason for this, he says, is poor pricing, i.e. it is more profitable for the forest industry to sell wood to the energy industry than to the sawmill industry. As he puts it, because bioenergy is considered as CO2 in the energy market, it impacts input prices, making wood cheaper than other energy sources (Ollikainen 2023). The problem was also highlighted by the majority of interviewees, nine of the eleven highlighted the problem of considering wood as a CO2-neutral and therefore, available and cheap renewable energy source. This is how one of the interviewees explain the problem:

"The EU communicates that the modern Energy mix is renewable energy. If I am very honest, wood burning is the oldest technology. Obviously, you can improve the efficiency of boilers. Cavemen did the same thing in the cave. They lit the wood and sat around the fire to warm themselves. What's happening now is that the oldest technology is being passed off as renewable, when in the 27 years we have, it's not being renewed. […] Because not even a fast-growing aspen will grow until 2050." (KZ)

Interviewee experts from the Forestry Authority also stressed *"that the forest owner has only one interest: to make money from the forest. If the energy industry pays him more, he will give it to them. The regulation is the wrong one that allows this." (P2-P4)*

However, a researcher states that as long as the amount of tree growth is higher than the amount of felling, forest management can be considered sustainable. As he highlights,

"Swedish forest owners harvest less than the growth (including mortality). All clear-felled areas are regenerated according to the forestry act. Thus, Swedish forestry, in production

[25] The online event ' Forest biomass for decarbonisation - The trade-off between forest wood for biomass energy and as an instrument for carbon sequestration' was organized by REKK Foundation on April 20, 2023. https://www.youtube.com/watch?v=NZtDzKQTAGU&t=5488s

forest, is sustainable. There is also a minimum age for final felling in the forestry act. A fact is that the demand of forest products increases to substitute fossil-based alternatives, and the harvest has increased in recent years and the net uptake has thereby decreased. Tops and branches were also harvested for bioenergy after final felling, but probably due to the import of waste, this market has almost collapsed. The amount of dead wood has increased in Sweden, at least since the NFI (Swedish National Forest Inventory) began monitoring in the mid-1990th. The increase was probably due to a wish to save more dead wood for biodiversity reasons but now bark beetles have killed a lot of spruces after the drought in 2018 that also is an input to the dead wood pool. Deadwood is decomposing and emits carbon into the atmosphere. On the other hand, deadwood is an important habitat for biodiversity. There are different views about sustainable forestry in Sweden. Stump extraction does not occur in Sweden. The amount of dead wood in stumps is around five times larger than in lying and standing dead wood. In summary, in the production forest, it is better to produce 100% than 90%, and we can never forget that it is done instead of fossil-based emission." (HP)

Despite this opinion, the other researcher says that besides all the logging and forestry industry's technologies, residue removal is not the biggest problem, the whole technology should be modified.

"Then when it comes to bioenergy, I've done a review about the impact of residue removal on biodiversity and other ecosystem services, and I don't think it's a huge problem. I think the bigger problem is that I don't think forestry is sustainable in Sweden as it is now. But if you any way do a felling and take off the stems, then taking off the harvest residues is such a minor problem compared to all the rest, that I'm not very concerned about it. And based on this literature review, my conclusion that I made was, well, while residue and stump removal have a negative impact, landscape-level extinction risks are low as long as residue removal is down or less than 50% of the forest and stump removal on less than 10 to 20% of the clear cuts in

the landscape. That's based on all the reviews that I've read. So, I think residue removal is not the big problem." (JE)

Also raises the share of forest biomass in the energy mix is that to addition to households, the EU's wood-fired power plants also use significant amounts of wood, according to the Forest Defenders Alliance 2022 report (Chamberlain et al. 2022), which was also highlighted by interviewees. Even though secondary woody biomass, sawdust and other milling waste, are said to be used, according to reports and communications from the facilities, there is ample evidence that entire trees, aka. primary woody biomass is also used in power plants. Indeed, there have been numerous newspaper articles and reports showing that valuable old-growth forests in Eastern and Central European countries in nature reserves are being felled only to produce wood pellets to meet the wood pellet needs of Western European countries such as Denmark, the Netherlands and Germany (EIA 2022; Zimmermann and Guillot 2022; Hurtes 2022). These wood pellets are used both in biomass power plants and for residential use. Meanwhile, biomass power plants benefit from significant European and public subsidies, which, as 4 interviewees pointed out, are highly distortive and inefficient. The EU spent €16 billion on bioenergy subsidies in 2020, down from €17 billion in 2019, see **Figure 14** (EC 2021d). In 2021, ten European countries spent a total of €6.3 billion on bioenergy subsidies, a 33% increase in subsidies compared to 2015 (Hammel and Pepper 2022). According to NGOs, the majority of these subsidies go to wood power plants, even though they could be used for clean technologies and energy efficiency devices that reduce both energy bills and GHG emissions for the population (Rankin 2022). NGOs especially believe that bioenergy cannot operate independently without subsidies, as highlighted by 2 NGO interviewees. All NGO interviewees and forestry experts agree that the subsidy the EU gives to biomass power plants should be used for energy efficiency investments for residence use, which would achieve much greater results.

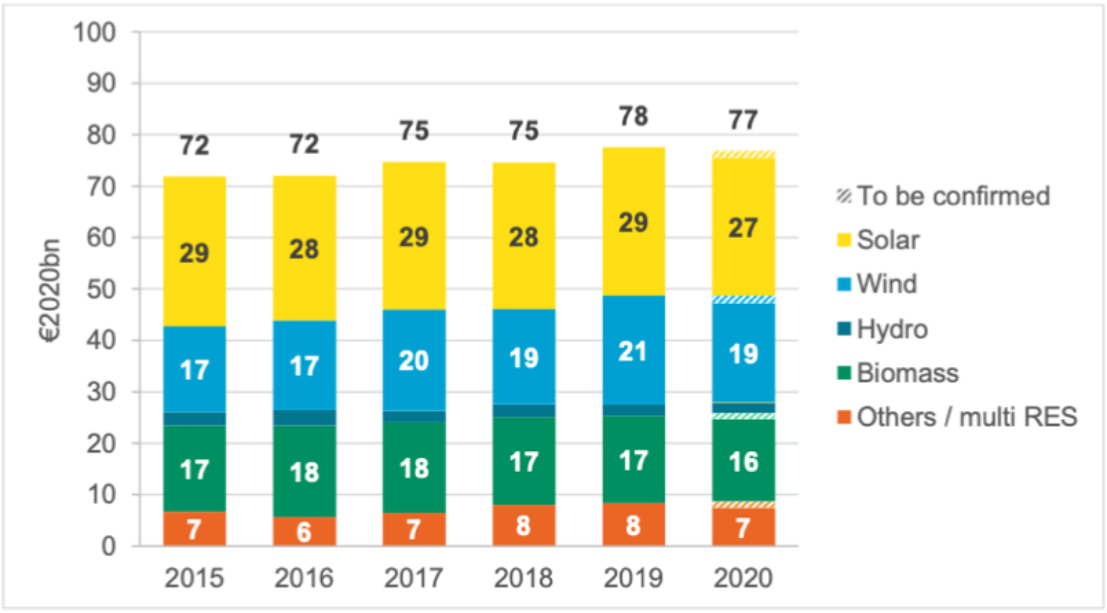

Figure 14: Renewable energy sources subsidies by technology.
Subsidies shown between 2015-2020 in the EU. (Source: EC 2021d, 35).

"The NRDC (Natural Resources Defense Council) produced a report in 2019 and found that 15 EU countries spent €17 billion to subsidise large power plants to burn wood. This money, which is currently spent on subsidies for power plants, should be spent on energy modernisation for households. There, we would have to achieve a huge reduction, paying market prices for everything. [...] I think there is an awful lot of potential in this energy reduction. We should focus on energy modernisation and on those energy sources that have a relatively low carbon footprint. I'm not saying that they are zero, but wind power, solar power, heat pumps, for example, they work with much better efficiency than wood, wood combustion." (KZ)

The problem is that the time needed to reabsorb the CO2 released from logging is long, which is not available for the 2030 or even 2050 climate targets. For the same reason, current policies that support woody biomass as a climate-neutral renewable energy source (and thus logging) will not reduce or slow CC in the long term, but will exacerbate and accelerate it, as many scientific and grey literature pieces have pointed out (Booth 2018; Harmat 2022; Ter-

Mikaelian 2018). Of course, all this was also emphasised by the interviewees, 7 of whom referred to previous scientific findings on the topic and expressed their personal opinions:

"There are all these classic pro arguments for biomass, that if you leave the wood in the forest, it's going to decompose anyway. It doesn't take into account that it will take decades or centuries, which is very, very important for climate change, now, if we look to 2050 or 2100." (HÁ)

"The problem of substituting fossil fuels by using biofuels is that it takes too much time for the benefits of substitution to kick in and that we therefore will be jeopardizing our climate goals that need to be fulfilled by 2030 or 2050. A safer, however less economically beneficial strategy, is to let our forests grow and accumulate the carbon released by our activities at the same as we try our best to decrease our energy consumption." (JA)

5.5 The value of forest in climate change mitigation

FES has several intrinsic values that are vital, such as maintaining ecosystems and conserving biodiversity. Beyond these values, the role of forests in mitigating CC and reducing the impacts of CC is increasingly important. Forests remove CO2 from the atmosphere through photosynthesis and store significant amounts of carbon in soil and biomass. There is an ongoing debate about whether and when it is necessary to cut down trees to maximize carbon sequestration, and how much carbon is sequestered in old forests. But old-growth forests' carbon sequestration is necessary because of the large quantity of carbon sequestration in the soil which was highlighted by 8 of eleven interviewees during the interviews.

"Forest managers have communicated that old-growth forests no longer sequester carbon. But this is not true. Old forests sequester carbon. They may not do so with the intensity of a middle-aged forest stand, but that is not the point, it is the huge amount of carbon they store, which at the moment is very significantly underestimated by the IPCC's accepted values. So, in Europe,

in temperate forests, but even in the forests in the north, the IPCC is very much underestimating the amount of carbon that is stored in forests, both in above-ground biomass and below-ground biomass. And what foresters also tend to underestimate, or don't really take into account, is how much the organic carbon stored in the soil is damaged by end-use, which is shown by several studies to be a huge amount of carbon released when the soil is cut down and immediately exposed to light. According to Tamás Rédei, a botanist at the Hungarian Institute of Ecology, the conversion of forest soils in Hungary has released more carbon into the atmosphere in the Danube-Tisza area alone than in the entire industrialisation of Hungary. So the carbon stored in the soil is terribly important, and this is not really being studied." (KZ)

However, one interviewee doesn't agree, as he says:

"Climate reporting (accounting) gives a misleading picture of forestry. All felling is always accounted as an emission in the forest sector (LULUCF). The positive aspect of forest products replacing fossil products and energy in other sectors is difficult to understand in an accounting context because the positive substitution effects are not reported separately. It is perhaps even more difficult to imagine that old forests stop growing and that from a climate point of view, it is better to cut down mature forests and plant new ones. Observe I am still talking of the production forest –not forests for biodiversity that also is important". (HP)

Daniel Reinemann, Bioenergy EuropePolicy Officer, expressed a similar view, who believes that forests are indeed the most efficient drivers of CO2 absorption. However, the extent to which forests absorb CO2 depends on their age, as young forests absorb more carbon than older forests. Similar to the previous interviewee, he believes that since most of the forests in Europe are used for logging and are now reaching the age at which they are ripe for cutting, they should be cut down because if forests are not regenerated, they will not be able to absorb the much higher levels of CO2 that they used to. He adds that it is vital to think about what is important because, in his opinion, optimising biodiversity in a forest can reduce the carbon

sequestration capacity of the forest. In other words, you cannot have a forest producing the maximum material, maximum carbon sequestration and maximum biodiversity benefits, because these objectives are not always perfectly aligned. So, we need to have a very clear picture of what different forests are trying to achieve. Therefore, he believes it should be left to the Mss to decide on these issues (Reinemann 2023). While all four experts working for the forestry authority agreed that not all FES can be met by a forest at the same time, and that it is important to decide which value to focus on in which areas, they disagreed that it should always be left to Mss to decide. The majority of the other interviewees agreed with this, with four out of seven interviewees sharing this view.

An integrated systems approach to forest management is needed, taking into account both the changes in carbon stocks of forests, soils, and harvested wood products and avoided fossil emissions through substitution. It is especially important how the carbon sequestration capacity of forests evolves with other uses than logging, and with the focus of these other FES, how the adaptive capacity of forests responds to CC (Gustavsson et al. 2017, 2021; Leskinen et al. 2018). The importance of properly calculating carbon sequestration is illustrated in **Figure 15**. When the forest is harvested, some of the carbon is released, while the rest continues to be stored in the wood. Therefore, it makes a difference what happens to the harvested wood, i.e. whether it continues to sequester carbon as a wood-based product or burns up, which not only means that the carbon sequestered in the wood is lost, but also that additional CO2 is released back into the atmosphere as a result of the burning of the wood. In addition, by using a higher proportion of wood-based products, not only will some of the carbon remain sequestered in the end products, but other high GHG-emitting and fossil fuel-intensive feedstocks and products can be substituted, again reducing overall CO2 emissions.

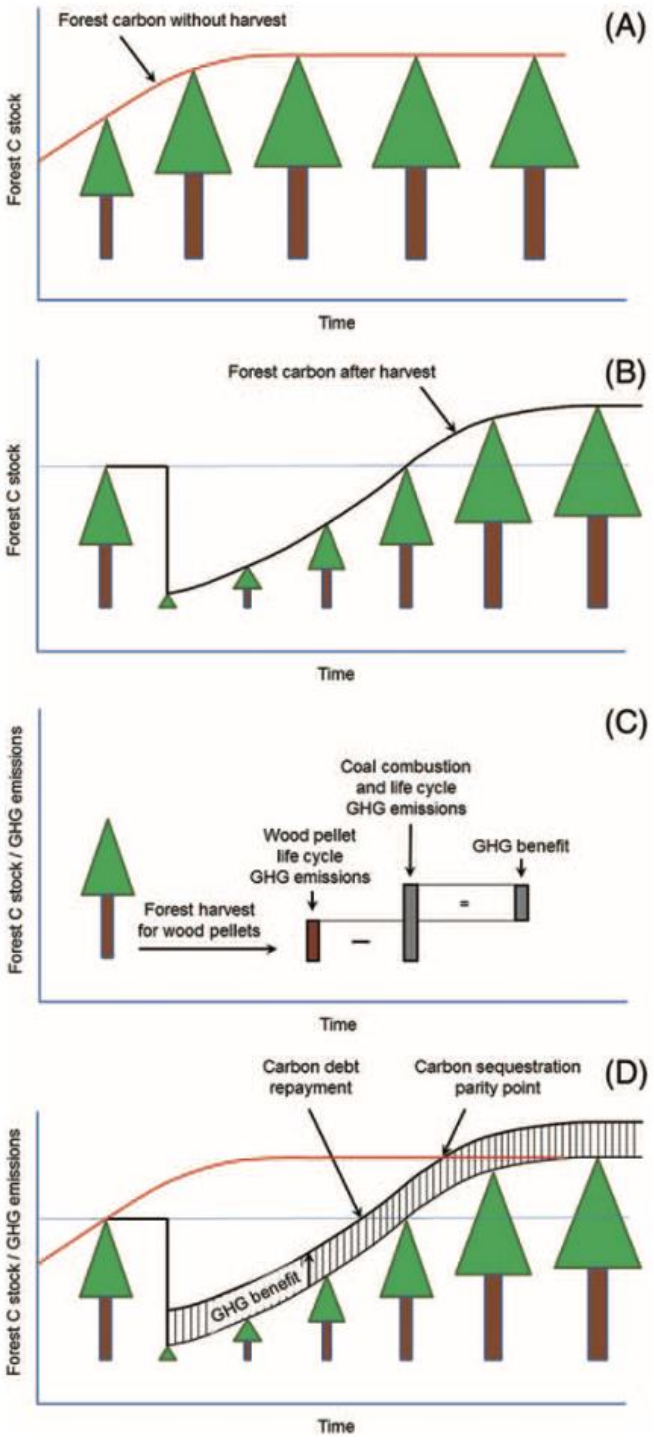

Figure 15: Carbon sequestration illustration.
As Ter-Mikaelian et al. (2015) explains "Effect of harvest for bioenergy used to replace coal on forest carbon stock changes and total greenhouse gas (GHG) emissions (stand level, from Ter-Mikaelian et al. 2014b). A. Accumulation of carbon in an unharvested forest stand. B. Carbon in the stand regenerating after harvest. C. Harvested biomass is used to produce wood pellets; life cycle GHG emissions from obtaining and producing wood pellets are lower than life cycle and combustion emissions of coal, resulting in a GHG benefit of using wood pellets to replace coal. D. Carbon sequestration parity is achieved when the sum of carbon in the regenerating stand and the GHG benefits of using wood pellets to replace coal reaches the amount of carbon in the stand if it had remained unharvested; carbon debt repayment is achieved when the sum of carbon in the regenerating stand and GHG benefits of using wood pellets to replace coal reaches the preharvest amount of carbon in the stand." (Source: Ter-Mikaelian et al. 2015, 95).

The substitution effect shows how much GHG can be avoided by using one wood-based products instead of another fossil-based product. Leskinen et al. (2018), in a study for European Forest Institute, reviewed 51 studies and found that using wood-based products has significantly lower fossil and process emissions compared to non-wood products, with an average substitution effect of 1.2 kg C/kg C. Hetemäki et al. (2017) argue that a shift towards a circular bioeconomy is necessary for CCM and sustainable development. It is no coincidence that in the EU Forest Strategy, the EU places an important emphasis on the future preference of MS for wood-based products rather than products made of other materials with high GHG emissions, including in the construction sector, but also in other industries (EC 2021b).

According to Leskinen et al. (2018), in the coming years, wood substitutes will also appear in other industries besides construction and furniture, such as textiles, packaging and chemicals. **Figure 16** shows the different ways wood can be used at present and **Figure 17** shows the material flows of wood products.

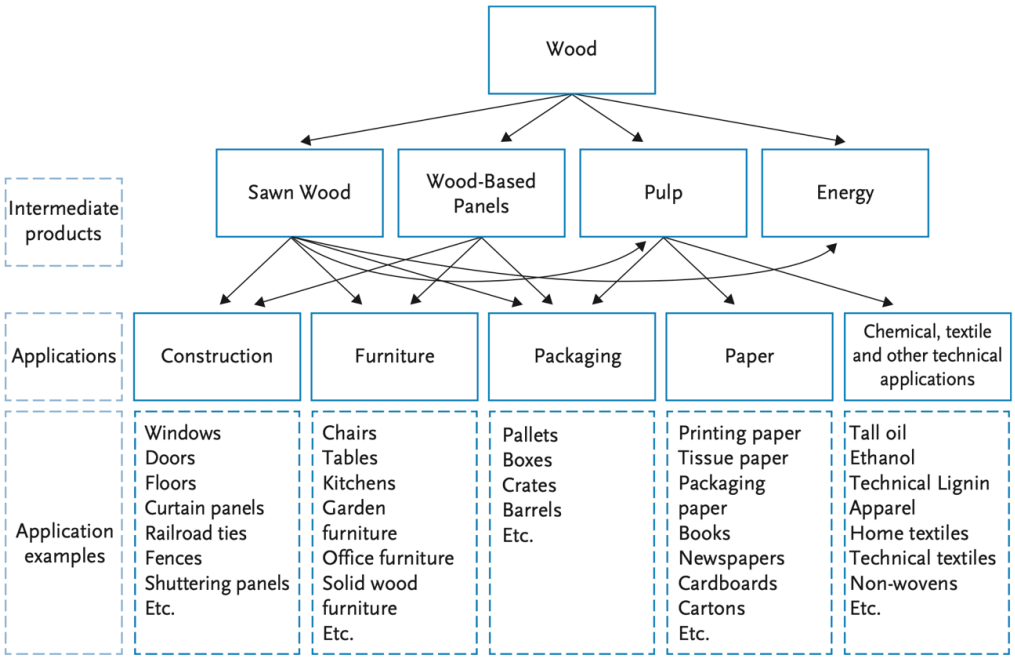

Figure 16: Wood utilization paths.
(Source: Leskinen et al. 2018, 15).

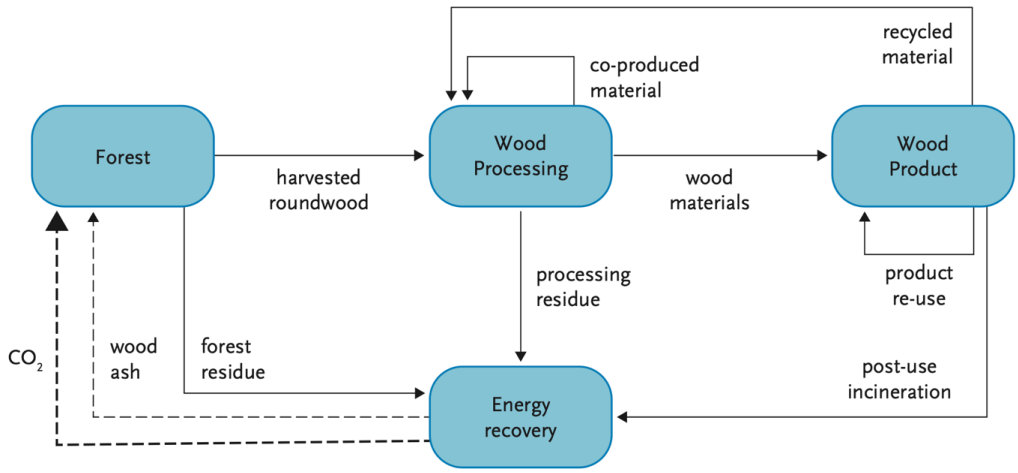

Figure 17: Material flows of wood products.
System-wide integrated material flows of wood products (Dodoo et al. 2014) causing GHG emissions. These should be taken into account in the calculation of SFs. In addition, specific material flows related to non-wood products with similar functionality and their GHG emissions should be assessed (Source: Leskinen et al. 2018, 9).

However, it should not be overlooked that the increased deforestation resulting from the use of wood products is counterproductive to the carbon sequestration goals of forests (Schulte et al. 2022). In particular, research has shown that only in the long term, which can last from 30 years to several hundred years, is the use of wood-based products worthwhile compared to the carbon sequestration potential of forest land (Skytt et al. 2021; Gustavsson et al. 2021). In the short term, however, the carbon sink capacity of forests is preferable in mitigating CC (Skytt et al. 2021). Dr. Borovics Attila, Director General of the Institute of Forestry Sciences, University of Sopron also highlighted the problem during his presentation at the Hungarian Forestry Conference on the potential of dendromass-based energy production. To mitigate CC, CO2 emissions, all sectors of the economy must be reduced immediately. Here there are four possible pathways: i) carbon storage in forest ecosystems; ii) carbon storage in wood-based products; iii) replacement of products made from higher-emitting materials with wood-based products (substitution effect); iv) bioenergy. However, it is not by chance that the fourth and last option is bioenergy, as bioenergy is not an option at any price, nor is the use of

wood-based products. Using the right type of wood and in the right quantities, at a price that calculates the value of the wood as providing all the FES is necessary to consider in any case of wood use.

The question of the substitution effect is particularly important among the forestry industry and forest ecologists in SWE, given the country's significant role in the global timber industry. Understandably, therefore, all Swedish interviewees brought up the issue of the carbon sink effect. The two researchers explain the questions of substitution effect from the Swedish forestry industry's point of view well:

"Sweden is among the top five exporters of paper wood and other wood products. This makes it very complex because there's a risk that if Sweden did decrease its harvest levels, due to different reasons, the market pressure will force other countries to harvest more. […] From a climate perspective, burning harvest residues, of course, it releases CO2, but leaving it on site would release much of the CO2 in 15 years anyway because it decomposes. From a climate perspective, it's ok as long as it substitutes fossil fuels. And it does substitute fossil fuels to a large extent in Sweden because it's used for heating and electricity production. Of course, these could be done in other ways, but that takes time to convert." (JE)

"In the short term, some argue that it is better for the climate to stop logging. But then you assume a low or no substitution effect. In the longer term, it is always better from a climate point of view to harvest mature forests, because mature forests stop growing. In the short term, you can fertilize, which increases the uptake of carbon dioxide from the atmosphere. The potential of increasing growth is much more important than trades of between harvest storage. If we expect to reduce the harvest in Europe and substitute fossil, there is also a risk of leakage (that we import forest products from areas with non-sustainable forestry." (HP)

One of the reasons why industrial logging is considered unsustainable by scientists and NGOs is that it is a lose-lose scenario CCM itself. Ten of eleven interviewees agree that current

forest management is not sustainable in the long term and that, among other things, CC would in any case require a rapid change in current forest management technology.

5.6 The value of forests for biodiversity conservation

Alongside CC, another challenge that needs to be addressed immediately is the conservation of biodiversity. Just as mitigating CC, preserving forest biodiversity is only possible with healthy forests which are varied fauna and flora. In fact, biodiversity is found mainly in primary or virgin forests and in old-growth forests, of which there are fewer and fewer in the EU. Healthy forests are needed, but the current state of European forests is not healthy. Ten of the eleven interviewees gave a unanimous and strong response that the condition of Hungarian, Sweden and European forests is very poor. This is also confirmed by the EEA, with only 14% of habitats in good conservation status. Agriculture is responsible for 21% of biodiversity stressors related to habitat's health condition and logging for 11%, but 50% of stressors are pollution coming from agriculture. In addition, in some areas, including HU, invasive alien and tree species pose an increasing threat to biodiversity (EEA 2023c). However, CC, in addition to human-induced ecosystem degradation, is accelerating and exacerbating biodiversity loss. For humanity's well-being, we need healthy ecosystems and a stable climate, which requires healthy forests, which can be achieved with a well-targeted and EU-wide conservation strategy promoting sustainable agricultural and forestry practices (Pörtner et al. 2021, 2023). This requires a complete overhaul of forest management practices. Sadly, nevertheless, according to ten of the interviewees, it is not likely to happen any time soon. However, 4 of the 3 Swedish interviewees see positive changes and practices by the Swedish forest industry.

"Research shows that as long as you create monoculture like systems, you decrease resilience. And this is what has happened within Swedish forests. So now forest industry is talking about having more mixed forest. But we're just in the beginning of that discussion. They need to adapt,

otherwise, they will face forest damage and lose wood anyway. So, even the industry recognises that we need to have more resilient forests. […] The industry and majority of parliament have not embraced an ecosystem adaptive management thinking since it is not aligned with the current industry infrastructure. However, there is a positive movement in part of the forest sector towards more resilient and closer to nature forest management." (PR).

In December 2022 during the fifteenth meeting of the Conference of the Parties (COP 15), the EU adopted the Kunming-Montreal Global Biodiversity Framework, which aims to achieve living in harmony with nature. As one of the targets, countries, including the EU, have committed to restoring at least 30% of degraded ecosystems by 2030 (CBD 2022). One step towards this and the EU Biodiversity Strategy is the Nature Restoration Law. This requires restoration measures to be put in place on 20% of the EU's land and marine area, and across the whole of its territory by 2050, to restore ecosystems. This, according to the EC, will result in a long-term benefit of between €8 and €38 for every €1 invested (EC 2023c). For forest ecosystems, it sets the following headline target: "forest ecosystems - achieving an increasing trend for standing and lying deadwood, uneven aged forests, forest connectivity, abundance of common forest birds and stock of organic carbon." (EC 2023c). Therefore, the change is inevitable. Of course, each region and country will have different challenges, depending on the natural conditions of the country, but what ten out of eleven interviewees believe should be the first and most important step is the effective and appropriate protection and management of existing PAs. The latter is important because in much of Europe, primary and old-growth forests also require forest management, but a different kind of management, which is called nature conservation.

"Conservation management includes scientific research, monitoring, tourism, visitor management, interpretation services, law enforcement, so all of these things, these forests are managed. It's just different. No, we don't manage them for timber provisioning." (KZ)

"Nature conservation is not about getting the most out of the benefits or money that can be extracted from the forest, it is about meaningful forest management. […] I have been working in conservation for a long time, we are protecting the crumbs, and every day we are confronted with the fact that we need even the crumbs. [...] So we should be fighting for every single tree. We are doing that, and a lot of times people don't understand us because in their eyes it's just one simple tree. But when you have a hundred of them, that's 100 trees. We're talking about 100 black thrushes. We've destroyed 100 habitats with 100 trees that had entire ecosystems [...] When you cut down a forest, you're destroying a bio-system. You can start all over again with what has been there for 100-150-200 years. But it will take 150 years again to rebuild in the same way. It's not as if we take a trailer of biodiversity there, knock it down and then start all over again." (P1)

However, this requires legislation at both EU and MS levels and independent authorities with the right powers, competencies, staff and financial backing. In many countries, however, these conditions are not guaranteed, which not only causes extreme damage in the short and long term in relation to nature conservation, but also in terms of forest management and, indirectly, water and soil protection.

"Since 2012, the Forest Act and its implementing regulation have been continuously amended to make the forest a free-for-all, with the exception of certain forests, where the forest manager can do what he wants. Inspectors do not have enough tools to prevent this. They do have powers, but the regulations do not always support them, or even hinder them, because they are not clear. And they don't have the time or the resources, there are far fewer of them than there should be. There is no control. In addition, the state is imposing expectations on forest holdings that are not conducive to sustainability.". (P4)

"The authorities are struggling because, authorities need funding to be able to work. If they don't have the funding, then they can't work with it. So that's one thing. Then the monitoring, the legal compliance is being undermined." (PR)

The problem varies from country to country. In Hungary, the most serious problem is the spread of invasive tree species and water scarcity, which was mentioned by 5 out of 7 Hungarian interviewees, experts working for the forestry authority and the national parks. Taking into account that all five of them have been working in the field for decades, they have been monitoring the deterioration of the health of Hungarian forests and the deterioration of forest protection in Hungary since then.

"If we do nothing about it, in a hundred years fifty percent of HU's forests will be common hackberry. And American ash tree. And that's the positive estimate. [...] If we let a forest grow by itself, it would become a common hackberry forest. Which, if you look at it, makes a nice forest picture, but it's no good for anything. It's a dead forest. There's nothing there. There's no biodiversity in a forest like that. [...] it's practically irreversible. It's just a question of time. Because it is also deteriorating exponentially. Because the more you have the faster it gets. They grow fast. They suppress everything." (P2)

"In national parks, invasive tree species must be eradicated with fire and brimstone. They cause serious problems and are costly to eradicate. In most places you can't eradicate them, you can only fight them." (P1)

In Sweden, the main problem for preserving forest biodiversity is current forestry practices. Given the economic importance of forests in SWE it is perhaps understandable. Change is happening, albeit slowly, which may result in further loss of biodiversity in the country. In fact, given EU regulations, it is feared that forest owners in SWE are rapidly cutting down primary and old-growth forests, which are valuable for biodiversity and CCM, to avoid the risk of having their forest land declared protected.

„In Sweden right we continue to cut forests with high conservation values and practice forestry, which does not preserve biodiversity. Important forest ecosystems that never have been clear cut are lost in combination with that we're not doing sufficiently to restore the structures and the functions in already harvested and managed forests. You can't justify logging old growth forests if you don't have a strategy on how to preserve biodiversity." (PR)

The EU's objective is to protect primary and old-growth forests, as set out in the Biodiversity and Forest Strategies, as these forests provide the greatest biodiversity. However, to preserve these forests, it is first of all necessary to know exactly where they are, which requires screening by independent experts, followed by monitoring, and an appropriate compensation policy to ensure that the forest that is protecting biodiverse nature has value for the forest owner. Precisely so that it does not happen that a forest owner cuts down a forest of conservation value because he needs the area for logging.

5.7 The (in)compatibility of values of forests and development

Whether conservation, protection of ecosystems, preservation of biodiversity and mitigation of CC are compatible with development, whether sustainable development exists, humanity is trying to find the answer and the solution. According to all eleven interviewees, and a well-united force of researchers the biggest problem is continuous development and continuous increase in production and consumption. The issue of forests as a value could also be solved if humanity were to stop consuming and stop demanding continuous development.

"Let us acknowledge that development has always been at the expense of natural values and natural areas. There is no SD. Development is not sustainable. Development is never on the side of nature." (P1)

"This market is based on consumption. It's not the forest industry that's bad, it's we consumers." (HP)

"The two problems cannot be separated, because biodiversity loss and CC go together, but at the same time, and where you can best capture this is the climate itself, is simply by reducing consumption." (KZ)

"The climate problem is not a biomass problem. It's primarily a consumption and distribution problem." (PR)

"I think the problem is much broader. It's our economic system, capitalism, economic growth, and that we all the time try to grow the economy and increase our material consumption, which comes with GDP growth. The forestry is a part of that, they try to grow, and that's only natural. Wood demand is also rising globally." (JE)

One of the eleven interviewees was of the opinion of humanity might need to accept degrowth[26] as the only chance to save biodiversity and mitigate CC.

"Overconsumption is the biggest force. With this constant consumption level we have, it doesn't matter what we try to do, we will still over-consume the resource, and over-utilise it. So, it's it doesn't matter what we do. The only way to get around this is to lower the consumption pressure. That's the only way." (JA)

All of this leads naturally to what is considered sustainable and what is considered sustainable biomass, for example. At an online event organised by WWF, one of the interviewees, Adam Harmat, said, that sustainable biomass "*is low carbon and low impact biomass. Low carbon, of course, in terms of climate perspective, and low impact in terms of biodiversity. […] I really don't like the terms of sustainability because it can have different meanings. So, for forester it can mean to keep the long-term productivity on the forest. But it doesn't necessarily mean that it's low carbon and low impact."* (Harmat 2023).

[26] Jason Hickel defines degrowth as. Degrowth is the reduction of resource use and energy use, which is the pursuit of balance for the economy, for wildlife, for humanity. Degrowth aims to develop policies that reduce ecological impacts and eliminate inequalities at national and global levels. It aims to reduce polluting and socially irrelevant production while focusing on socially important sectors. This is achieved, inter alia, by increasing employment, reducing the working week and introducing job guarantees. (Hickel 2021).

5.8 What the NGOs can do without consistent EU forest policy

RED III foresees the continuation of a strong use of woody biomass for energy in MSs renewable energy mix. A large part of the scientific community and NGOs oppose the decision and are looking for ways to steer policymakers, the forestry industry, and society towards responsible forest use. Most of the interviewees agree on the following:

- Other methods than lobbying are needed to achieve effective results. The power of forestry industry's lobby is stronger, therefore has managed to get the RED II revision accepted in the EU without significant changes.
- There is a need for forest ecology to communicate more clearly because, unlike the simple communication messages of the forestry industry (that wood regrows and therefore is renewable), the messages of forest ecology are difficult to understand for policymakers and society.
- Since the amendment of RED III failed at the EU level, and since the directive will then be taken to the MS level, it is necessary to lobby effectively at a national level to weaken RED III, as MS can decide for themselves to set stricter criteria.
- Also at the MS level, NGOs can demand the enforcement of national laws and other EU-level directives and legislation (e.g. Habitats Directive, Birds Directive, Environmental Impact Assessment Directive, Nature Restoration Law, Deforestation Law) against states and operators through legal means, thus limiting the amount of wood available for MSs to harvest and thus forcing them to manage their forests more responsibly.
- By opening up to the business sector, through effective communication, education, and a cooperative approach. Thus, making the market itself aware of the need to change the current forest management for their benefit and to help the business sector to make the transition. A good example is the reform of the paper and pulp industry in Sweden in

the 1970s. If the market recognises the need for change to survive, NGOs can help the sector to recognise this and make the necessary changes.

- To raise awareness and mobilise society, if possible, as there is a lot of scepticism in this area, not only among NGO professionals, but also among all interviewees. In their opinion, it is becoming increasingly difficult to raise people's awareness and especially to stimulate any kind of lifestyle change or action.
- Achieving these goals requires a complete change of approach and strategy on the part of NGOs, as the main focus in the last decade has been on lobbying. While lobbying remains, communication is coming to the fore, not only towards society but much more towards the business sector.

While all NGO experts said that the entire NGO sector is looking for possible solutions at MS level to protect forests after the adoption of RED III, they agree that effective forest management can only be achieved through strict EU-level regulation. As they put it, the real option for effective forest and nature conservation, biodiversity conservation, and CCM is to tighten forest protection laws and regulations to the point where they affect logging itself. However, MSs may not do this of their free will, but if the EU forces MSs through directives and legislation, they will have no choice but to transpose them into their local legislation. This requires a change of approach within the EU, so that intrinsic and relational values are included in EU-level legislation, in addition to or instead of instrumental values. At the moment, however, these values are being pushed into the background, not only in policymaking but also in scientific research. Only 20% of the research reviewed by IPBES dealt with intrinsic values and 6% with relational values (IPBES 2022). Both science and policy need to turn to all three specific values in order to effectively address biodiversity loss and CCM. The first step in this process is, as one interviewee put it, to reconnect humanity with nature:

"I think we humans have to repair our relationship to nature, and see ourselves as a part of it, and realise we are totally dependent on it, and we are in the network, and we're not on top of the pyramid. But we're a long way from that." (JE)

6. Conclusions

In his thesis, the author presented the shortcomings of EU forest policy, first through the concepts of forest, forest area and different types of forest, and then in a similar way through the concept of PAs. The research showed that since the EU does not have a common forest policy, there is a lack of coherence and consistency between the different EU sectoral policies regarding the importance of FES. The reason for the lack of a common forest policy is that the EU doesn't have a necessary group of forestry and forest protection experts, which has an impact on policymaking, in most cases in a negative direction. If the EU wants to be effective in mitigating CC and achieve the climate targets set in the European Green Deal, i.e. 55% emission reduction by 2030 and climate neutrality by 2050, a more coordinated and coherent policy at a sectoral level on FES or, more importantly, a common forest policy and effective forestry and forest protection experts within the EU are needed. This would prevent contradictions between different policies.

All the RED I-II-III have opted for biomass as renewable energy. However, the fact that forest biomass, including both primary and secondary wood, is seen as climate-neutral renewable energy under EU legislation has led all EU MSs to take the easy way out and turn to forest biomass instead of other modern renewables such as wind or solar power. The use of forest biomass involves less financial investment and development, and produces immediate results, in this case firewood or wood pellets. However, using wood for heating comes at a very high price. Not in an economical sense, but for example in drought, floods, heat and the damage it causes, and the loss of biodiversity caused by CC. The EU and the MSs must therefore consider whether to take the quick and easy way out and burn their forests now, or to focus on the other values of FES, such as CCM or biodiversity conservation, rather than energy, when they think ahead to the next 27 or perhaps 77 years to 2050 and 2100. Of course, this makes the goals set out in RePowerEU and the European Green Deal, goals like affordable energy and

climate neutrality, harder to achieve and at a higher price. However, most scientists believe that the EU's climate goals can be achieved only by focusing on other FES than energy. Burning forests for energy doesn't take the EU to climate neutrality goals, they say.

The high carbon sequestration capacity of forests is needed in the EU because no other solutions or technologies are yet available that outcompete trees as means of sequestrating carbon. By using wood for energy, the EU is reducing the carbon sequestration potential needed to fulfil our common climate goals. Burning wood does not only hamper the carbon sequestration potential in forests, it also releases significant amounts of CO2 into the atmosphere. This is a multiple loss in GHG reduction that the EU cannot afford in this late hour of looming climate change. The EU can build on increasing the use of wood-based products and even substituting wood-based products for high GHG-emitting feedstocks, but in a short term these solutions are also causing negative effects. The EU must accept the fact that leaving our forests in place is the most effective and only short-term strategy and solution for mitigating the current ongoing CC.

The same is true for biodiversity conservation. This is also important because it is now known that mitigating climate change, increasing biodiversity and having large numbers of healthy forests go hand in hand. Without one, the other two are not possible. But Europe's forests are in a critical state, and so is biodiversity. The EU policies that address this issue, the reporting or monitoring behind them, and the penalties for non-compliance by MSs, are not strong and robust enough to achieve real results, according to NGOs. In addition, the ecological and environmental impacts of directives such as the RED or RePowerEU, cannot be offset. The EU Biodiversity Strategy and the Forest Strategy represent a promising way forward for biodiversity. The question is whether the EU can translate the objectives set out in the strategies into legislation. The debate in the European Parliament over the Nature Restoration Law calls

into question the EU's ability to incorporate these objectives into EU legislation and then force EU countries to include the objectives into national legislation.

The reason for the negative trend related to FES and nature protection is the need for continuous development, which, as the interviewees highlighted, is always in conflict with nature conservation. Still, development is only and exclusively possible at the expense of nature. This is illustrated by millennia of European deforestation and what has been ongoing ever since, and is still happening until this day. Nature is not valued for its intrinsic value, only the products and monetary values that can be harvested and produced from forest ecosystems. Instead, we could put a price tag on biodiversity the same way we do on a highway, a piece of cloth, food, a boardwalk, etc. In that way, forests could be preserved instead of being destroyed.

That is why, if the EU is to make a real difference, it needs a radical change of mindset, politically, economically and socially. And for science to help bring about change, science must also shift its focus to look at forest ecosystem services in terms of their proper values.

There is an urgent need for either the development of a common forest policy and associated expertise within the EU, or for sectoral policy towards FES to be coordinated across the EU. The EU should reflect on whether it is possible to talk about any common EU forestry and forest protection policy, as long as each MSs can decide on their policies. It is indeed difficult to treat forests in the different climate zones of the EU in a uniform way, but what is considered a forest, how each country counts or reports the proportion of forest, can be made uniform. Likewise, what forests are considered primary forests or virgin forests, old-growth forests, and so on, can be consistent. And in the same way, what is considered a protected area can be standardized, what categories are protected and what is allowed or prohibited in each protected area, so-called strict protection etc. By making such common and uniform definitions, countries which try to singly focus on forestry couldn’t play with the proportion of protected areas in their own country. It could prevent a country's national parks from being

filled with clear-cut areas, and the trees older than 100 years that are most valuable for CC and biodiversity, shouldn't be felled, even if it is done by selective logging. It has to be admitted that MSs are in most cases not interested in rigorous screening, reporting and monitoring. To prevent a lack of interest to reflect on the possible outcome of forest screening, monitoring and reporting, these tasks should be delegated to independent experts. On the other hand, as long as MSs find that there are no consequences if they cut down forests that are valuable for biodiversity and climate change mitigation, they will not change their practice. Furthermore, for the changes that are needed to protect forests for biodiversity and CCM to be made, several MSs need extra financial support. However, while giving such support, strict rules and a strict monitoring system are needed to make sure that the subsidies are used properly and for the right purpose.

The role of NGOs is vital in achieving change in valuing FES by politics, businesses, and society as well. The NGOs should be given the task of developing the reporting system, as well as monitoring. An NGO will not conceal the primary and old-growth forests of a country, but there is a risk that forest owners, the forest industry, and the government insisting on economic growth might do so. In addition to typical lobbying activities, NGOs would also need to educate politicians within the EU and MSs as well with clear, and easy-to-grasp communication messages. Equally, there is a need to reach out to the business sector. The NGOs need to change their negative bias, i.e. 'the forestry industry is always influenced by their strive to make more money, therefore will never appreciate the importance of other FES'. The prejudiced mindset is not fit for the purpose of valuing FES differently but with the education of forest owners and timber companies change is possible. It is also in the forest owners' and timber companies' interest to plan not only for the short-term, but also for the long-term, with the revenues generated by forests and timber. They too should have an interest in the long-term, all-round, truly sustainable management of forests. It is essential to demonstrate

to them the other ecosystem services that forests provide in addition to timber production, and the benefits of close-to-nature practices, to show that a just transition in forest management, as demonstrated by the NGO Fern, is possible. NGOs have an important role in education of the forestry industry. This will, however, require a change of strategy within the NGOs and a change of communication goals and messages. It would be necessary to achieve a convergence of communication between forest ecologists and forestry professionals, which could lead to significant policy results as well.

Policymakers and NGOs have a crucial role to play in bringing about change, and science has an equally important role to play in facilitating and amplifying change. Science should also focus on relational and intrinsic values besides instrumental values, to avoid a strong research bias towards the economic approach. More academic research on the relational and intrinsic values of forest ecosystem services would also increase the chances of these values being more strongly reflected in policy-making and in the economic sector.

The topic and this thesis itself offer many opportunities for further research. The interviewees themselves have raised the need to explore the differences between forest ecology and the forestry industry at a scientific level in order to understand the communication differences. It would also be worthwhile to investigate in which cases and how the forestry industry uses scientific research to strengthen its unsustainable operations by highlighting snippets of scientific results in complex scientific communication. A separate study could be to analyse the policy implications of the fact that forest and forestry are easily confused in the English language. The implications of unclear concepts of forest or protected areas in EU policy and in MSs' Forest policies would also be worth further investigation. Unwittingly, the author chose two countries for her research that are currently governed by "right-wing" politicians. Forest protection, the use of FES, and the sustainability of forest management in the different political systems of the countries are also worth investigating, so that predictions

can be made about what can be expected at the EU level if a strong shift to the right or left is observed in the EU MSs. The value of FES is usually assessed in economic terms, but other values need to be considered. Even if these studies are unlikely to produce quantitative results, they are still valuable, since the essence of relational and intrinsic values is precisely that they cannot be quantified, yet they are just as important. Just as the topic itself is complex and multifaceted, so are the other possible areas of research, and precisely because of the importance of the role of FES, it is impossible to research them enough. Therefore, the author encourages everyone, whatever their perspective and approach to forest ecosystem services and their value, to investigate how to better understand and appreciate what forests can provide future generations of EU citizens and humankind as a whole.

Appendix

List of interview participants and information about the interviewees.

Nr.	Interviewee	Organization and position	Interview method	Interview date	Interview length
1.	Zoltán Kun (KZ)	WCPA member, nature conservation specialist. Head of conservation of Wild Europe Foundation and Forest policy expert at Forest Defenders Alliance	Online	25.Apr.23	70 min
2.	Ádám Harmat (HÁ)	Climate and energy programme leader at WWF Hungary	Online	26.Apr.23	38 min
3.	Interviewee #2 (P2)	Forest planner at forest authority	Group personal	05.May.23	195 min
4.	Interviewee #3 (P3)	Forest planner at forest authority			
5.	Interviewee #4 (P4)	Forest planner at forest authority			
6.	Interviewee #5 (P5)	Forestry officer at forest authority			
7.	Interviewee #1 (P1)	Forester and conservationist working in a National Park	Personal	08.May.23	135 min
8.	Peter Roberntz (PR)	Senior Forest Advisor at WWF Sweden	Personal	12.May.23	80 min
9.	Hans Petersson (HP)	Head of department, Researcher at the Department of Forest Resource Management; Division of Forest Resource Analysis, Swedish University of Agricultural Sciences	Personal	15.May.23	89 min
10.	Jon Andersson (JA)	PhD in Biology, GIS expert, forest expert, conservationist at Protect The Forests Sweden	Go-along	16.May.23	420 min
11.	Jeannette Eggers (JE)	Programme Director at the Department of Forest Resource Management; Division of Forest Planning, Swedish University of Agricultural Sciences	Online	25.May.23	47 min

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