Promoting Closer-to-Nature Forestry in the EU through voluntary forest certification schemes

Assessing the suitability and gaps of existing certification standards in implementing the EU Closer-to-Nature Forest Management Guidelines

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Some of the national standards examined in the comparative assessment for the FSC and PEFC schemes, have been updated during, or following the analysis underpinning this report while some others are under review since then.

For PEFC, more recent versions either adopted or in preparation now exist for:

- Poland and Sweden now have newer standards in force (PEFC PL 1003ver2EN:2024 and PEFC SWE 002:5, respectively) compared to the versions assessed and presented in this report; and

- France, Italy and Romania have newer standards that are publicly available but not yet in force at the time of writing (PEFC/FR ST 1003-1:2023, PEFC ITA 1001-1 2023 and PEFC-RO ST 8001:2024, respectively).

In the case of FSC, an updated Polish national standard (FSC-STD-POL-02-2024) has been released and is also in force since the initial assessment period, while a new national standard for France has since been approved by FSC international but is not yet publicly available at the time of writing.

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Executive Summary

Introduction and Scope

The **EU Forest Strategy 2030** commits to develop a voluntary certification scheme for **Closer-to-Nature Forest (CNF) management**. To support this development, the European Commission published **Guidelines on Closer-to-Nature Forest Management** in July 2023, outlining key principles, objectives, and intervention tools for biodiversity-friendly forest management. This report assesses whether existing **voluntary forest certification schemes (VFCS)** could provide a pathway towards CNF-aligned certification, following a three-fold approach.

First, it assesses the compatibility of existing certification schemes (FSC, PEFC, and Ekoskog) with the main objectives and intervention tools of the CNF guidelines. Second, it explores the potential for developing graded certification schemes for forest management. Third, it investigates potential criteria and methodologies for evaluating and scoring CNF practices.

Compatibility of Existing Certification Schemes with CNF Guidelines

Overall, the comparative assessment reveals **partial to inconsistent implementation** of the CNF guidelines across the certification schemes in the countries examined.

The assessment finds that the **Ekoskog scheme** incorporates most key elements of CNF management, with minor gaps such as the lack of requirements for managing ungulates at carrying capacity. The explicit requirements for biodiversity protection, prohibition of clear-cutting except in small areas, and emphasis on natural regeneration align with CNF principles.

Both **FSC and PEFC** standards show strengths in certain areas but demonstrate significant variability across their criteria and Member States. Strong alignment is found in their approach to **increasing structural complexity**, with national standards in countries such as Germany, Poland, Romania, and Slovenia effectively promoting diverse forest structures and species composition. They also demonstrate a thorough approach to **soil and water protection**.

However, persistent gaps were identified across the certification schemes. Most standards lack **specific, measurable targets** for many key aspects of the CNF guidelines, such as deadwood retention and set-aside areas. This absence of quantitative benchmarks makes it difficult to assess progress towards CNF objectives. Many standards also provide **insufficient guidance** for implementing CNF practices, particularly for intervention tools such as ensuring respectful harvest interventions and managing ungulate species at natural carrying capacity. A notable pattern observed is that both FSC and PEFC standards often emphasise **maintaining existing biodiversity** rather than actively enhancing or increasing structural complexity as advocated by the CNF guidelines, limiting both schemes' potential to strengthen biodiversity and ecosystem resilience.

Potential for Graded Certification Schemes

The analysis of existing graded certification schemes from other sectors demonstrates the potential effectiveness of a graded approach to forest certification. Schemes such as the **EU Energy Label**, **Nutri-Score**, **UK Food Hygiene Rating Scheme**, and **USDA Beef Quality**

Grades provide valuable insights into how performance-based certification can influence consumer behaviour and drive further improvements in the standards themselves.

Graded certification schemes provide consumers with a more granular view of product quality or performance, allowing for informed decisions that go beyond simple compliance with minimum standards. Rather than simply indicating whether a product meets a baseline standard, these schemes differentiate based on how well a product performs or the level of standards utilised during production processes. Evidence suggests that consumer behaviour is positively influenced by score-based or graded labels. For instance, studies show that products with higher ratings often command price premiums and increased market share.

In terms of forest management, a graded certification scheme could **guide consumer choices towards products from forests managed using CNF aligned** practices, and it could also drive gradual improvements in forest management practices through market incentives, as producers compete to achieve higher scores to remain competitive. Additionally, it would allow for the differentiation between varying levels of compliance with CNF principles, potentially rewarding forest managers who go beyond minimum requirements with higher price premiums.

However, the **implementation of such an approach faces several challenges**. These include the need for clear, measurable criteria that can effectively assess forest management performance, concerns about consumer confusion with multiple sustainability labels on the market, and questions about the voluntary nature of participation by forest managers and between existing certification schemes.

Criteria and Methodologies for Evaluating CNF Practices

The report identifies **potential criteria and indicators for evaluating CNF practices** that align with the objectives and intervention tools outlined in the CNF guidelines and could form the basis of a scoring system for a graded certification scheme.

For assessing **structural complexity**, potential indicators include tree species composition, tree species diversity, and the share of broad-leaved species. These could be quantified using structural complexity indices or by setting minimum requirements for species diversity. **Natural forest dynamics** could be measured through indicators such as the share of native species and minimisation of alien species, with quantitative thresholds for the percentage of native species required. Moreover, for **natural tree regeneration**, indicators may include the abundance of natural regeneration and specified regeneration periods. Quantification could involve measuring tree seedlings per unit area or calculating a Natural Regeneration Index that combines multiple measurements. In addition, **respectful harvesting conditions** could be assessed through indicators relating to sustainable harvesting levels and selective logging approaches, with quantified differences between pre- and post-logging inventories.

Other important criteria include **deadwood retention**, with indicators for the volume of standing and lying deadwood, as well as **set-aside areas**, measured by the proportion of forest set aside for biodiversity conservation, and **scale-specific approaches**, assessed through age heterogeneity and canopy structure diversity.

Two main approaches to scoring are proposed: a single indicator-based system measuring forest management intensity or naturalness, or a multiple indicator-based system converting several quantified indicators into a final grade.

Potential Next Steps for Implementation

Drawing on the key findings of the five main chapters of the report, three potential pathways have been identified for the establishment of CNF-aligned certification in the EU:

1. **Collaboration with existing schemes** (FSC, PEFC, or Ekoskog) to align their international benchmarks and national standards with CNF principles. This leverages existing infrastructure and market recognition but may result in compromises.
2. **Establishing a new EU-level voluntary scheme** directly linked to CNF guidelines. This provides the European Commission with full quality control over the standard's development, but faces challenges in market uptake, requiring substantial investment.
3. **Creating an EU standard for certifying existing certification schemes** as CNF-aligned. This combines the advantages of working with existing schemes while maintaining control over the ultimate ambition of the standards.

1. Introduction

This chapter provides the policy context and background for this report, establishing the wider framework for Closer-to-Nature Forest management and voluntary forest certification schemes. The introduction outlines the three-fold aim of this report and sets out the current state of play on existing voluntary forest certification schemes in the EU as well as emerging alternatives that may offer pathways to closer-to-nature-compliant certification. Following the introduction, the structure of the subsequent chapters and methodological approach for the comparative assessment of voluntary forest certification schemes is provided, including the selection criteria for the eight EU Member States that are examined in this report.

1.1. EU Forest Strategy 2030 and the Closer-to-Nature Forest Management Guidelines

The **EU Forest Strategy 2030** (the Strategy), published in July 2021, includes a commitment to develop voluntary certification for Closer-to-Nature Forest (CNF) management ([1]). The certification shall build on the European Commission **Guidelines on Closer-to-Nature Forest (CNF) management** (the Guidelines) published in July 2023 ([2]), which outline key principles, objectives, intervention tools, and best practices for biodiversity-friendly and adaptive forest management.

Voluntary forest certification schemes (VFCS) have played an important role in incentivising sustainable forest management (SFM) practices in Europe since the 1990s. The **Forest Stewardship Council** (FSC) and the **Programme for the Endorsement of Forest Certification** (PEFC) ([3]) are the most widely implemented certification schemes across the EU, with both schemes playing a significant role in promoting SFM through their respective certification processes and standards.

Emerging forest certification schemes such as the **AEFC** (Alliance for European Forest Certification), **Ekoskog** and **Preferred by Nature** are gaining attention for promoting forest management practices that focus on biodiversity-enhancing outcomes. While the AEFC, a newer initiative, is still actively developing what it envisions as an elevated standard for sustainable forestry in the Nordic and Baltic regions, and Ekoskog is promoting more ambitious environmental requirements in Swedish forestry, both initiatives aim to be aligned with CNF management practices, promoting continuous cover forestry, the avoidance of clearcutting and the importance of strictly protected areas. The Preferred by Nature initiative, an international association, aims to complement existing certification schemes such as FSC and PEFC by providing an add-on forestry certification in line with CNF principles.

As the European Commission explores pathways to develop a CNF-aligned VFCS, it is crucial to first better understand the potential of the most widely implemented VFCS in Europe and to consider the potential of new and emerging schemes for certifying CNF-aligned management as presented in the Guidelines. This is particularly important given that the CNF guidelines are the basis upon which a CNF-aligned VFCS would be built. The analysis of such schemes in relation to the Guidelines can help to determine whether existing or emerging VFCS can

([1]) European Commission (2021). Communication: New EU Forest Strategy for 2030. Accessed here.

([2]) European Commission (2023). Guidelines on closer-to-nature forest management. Accessed here.

([3]) Gutierrez Garzon, A.R., Bettinger, P., Siry, J., Abrams, J., Cieszewski, C., Boston, K., Mei, B., Zengin, H. and Yeşil, A., (2020). A comparative analysis of five forest certification programs. Forests, 11(8), p.863. Accessed here.

provide **a pathway towards a CNF-aligned voluntary forest certification** scheme for use in the EU, or **whether a different approach and new tools are required to meet respective ambition of the EU Forest Strategy 2030**.

1.2. Aim and structure of the report

The aim of this report is three-fold. First, it aims to assess **the extent to which existing certification schemes like FSC and PEFC standards, as well as the new Ekoskog scheme, are compatible with the various objectives and intervention tools as they are presented in the CNF guidelines**. By assessing the strengths and weaknesses of these certification schemes in relation to the objectives and toolbox interventions contained in the CNF guidelines, this report seeks to identify whether there are areas where the schemes are already effectively supporting CNF practices through the Guidelines' objectives and intervention tools, and whether there are consistent gaps and opportunities for improvement that, if brought in line with the level of ambition sought by the Guidelines, could result in a CNF-aligned VFCS for use in the EU. The report also considers emerging certification schemes such as Preferred by Nature (PbN) and the Association for Ecological forestry certification (AEFC), although these are not assessed to the same extent as FSC, PEFC, and Ekoskog due to their comparatively early stage of development or implementation at the time of writing.

Second, the report aims to explore the **potential for developing graded certification schemes for forest management approaches**, with a particular focus on their compatibility with closer-to-nature forest management. The report will examine existing graded certification schemes from other sectors to understand how such approaches could be applied to forest certification.

Third and finally, the report will investigate **potential criteria and methodologies for evaluating and scoring** closer-to-nature forest management practices.

To achieve these aims, the report is structured over six chapters. Following the introduction, **Chapter 2** presents a detailed background on **FSC, PEFC, and Ekoskog certification schemes**, as well as their key principles, criteria, and indicators. **Chapter 3** contains the findings of the **comparative assessment of these certification schemes'** alignment with the CNF guidelines' objectives and intervention tools across the eight selected Member States.

Chapter 4 examines the **suitability of forest certification schemes for promoting closer-to-nature approaches**, analysing strengths and weaknesses and exploring potential pathways for implementation.

Next, **Chapter 5** provides an **analysis of non-forestry certification schemes with performance grades** to understand how such approaches could be adapted for forest management certification. The chapter investigates potential approaches and criteria for grading forest management performance, drawing on both scientific literature and existing policy frameworks.

Finally, **Chapter 6** presents **conclusions and possible next steps** to be considered by the European Commission on approaches to certification that could better support the implementation of closer-to-nature forest management in the EU.

The report is **complemented by a separate document** with Technical Annexes A & B: Comparative Assessments of National FSC and PEFC Standards.

1.3. Methodology

The methodology for the comparative assessment of FSC and PEFC national standards for Chapter 3 involved the development of a **standardised comparative assessment template** highlighting an identical set of **two main objectives and eight intervention tools** from the CNF guidelines. ([4]) The analysis of the Ekoskog standard was based on an assessment comparing Ekoskog criteria to relevant CNF objectives and intervention tools as per the Guidelines. ([5])

While both FSC and PEFC establish **international benchmarks for their forest management standards** upon which their participating member countries' **national forest management standards must be based**, this report **focuses on the national standards of both schemes**, including their specific criteria and indicators, as they provide measurable, real-world examples for how key aspects of the EU's CNF guidelines may be operationalised through these widely adopted and globally recognised VFCS. In order to capture the diversity of approaches that can be observed in different ecoregional contexts in the EU, the comparative assessments that were carried out for this reported examined the national FSC and PEFC standards of **eight EU Member States**: Germany, France, Italy, Poland, Romania, Sweden, Slovakia and Slovenia.

A full description of the methodological approach, including the detailed comparative assessment framework, the three-level rating system used (Yes/Partial/No), and the specific selection factors for Member States, is provided in **the technical annexes to this report.**

It is also important to note that this report focuses specifically on the assessment of national FSC and PEFC standards and **does not examine the national, regional or more local legislation** that binds relevant forestry actors operating in the Member States concerned. However, it is important to note that both FSC and PEFC certification schemes complement such legislation, often by going beyond the established legal minimum requirements in the country where they operate. This more targeted approach is in line with the primary objective of this report, to assess the potential of VFCS to promote and more widely operationalise CNF practices across the EU.

The analysis of potential graded certification approaches was then based on case studies of existing schemes in other sectors, scientific literature on forest management assessment, and consultation with forestry experts.

Table 1: General principles, objectives, and intervention tools from the Closer-to-Nature Forest Management Guidelines

General principles
Learning from and permitting natural processes to develop
Maintaining the heterogeneity and complexity of forest structures and patterns
Integrating forest functions at different spatial scales

([4]) The comparative assessments for both FSC and PEFC national standards, which formed the basis for the results presented in Chapter 3, are presented in Annex A (FSC national standards) and Annex B (PEFC national standards).

([5]) Other newer certification schemes have not been included in this comparative assessment, including Preferred by Nature and the Association for Ecological Forestry Certification. The Preferred by Nature (PbN) standard was not included in the comparative assessment due to the difference in methodology, since the standard is an add-on based on a positive/negative list. The Association for Ecological forestry certification (AEFC) standard has not been included in the detailed comparative assessment due to the fact that the guidelines are still in early stage of development.

Using a variety of silvicultural systems based on natural disturbance patterns of the region
Low-impact timber harvesting with equal attention being paid to what is retained in the forest and what is removed, thus preserving habitats, forest soil and forest microclimates.
Main Objectives
Increasing structural complexity
Promoting natural forest dynamics
Toolbox interventions
Promoting natural tree regeneration
Ensuring respectful harvest conditions
Minimising other management interventions
Preserving and restoring forest soils and water ecosystems
Optimising deadwood retention
Setting areas aside
Taking a scale-specific approach
Managing ungulate species at natural carrying capacity

Source: Guidelines on Closer-to-Nature Forest Management (2023).

2. Voluntary forest certification schemes in the EU

Voluntary certification schemes have been established for decades as an important market-based instrument for promoting sustainable forest management in the EU and beyond. The aim of voluntary forest certification schemes (VFCS) in particular is to address public concerns about deforestation and biodiversity loss in global and Europe's forests by assessing forest management practices against a set of pre-defined international or national standards, criteria and indicators ([6]). These standards cover a wide range of environmental, social and economic considerations in order to ensure that certified forests are managed responsibly and with the ecological integrity of the forests at the forefront.

While certification schemes can vary, the **certification process** typically involves an **independent, third-party evaluation and verification** of forest management practices ([7]). By meeting the standards set by certification schemes, forest managers can demonstrate their commitment to sustainability and potentially gain a competitive advantage in a market that often rewards products that can indicate to consumers that they have been developed in accordance with a minimum set of standards for sustainability.

The **benefits of forest certification** are manifold, including improved operational efficiencies and greater market access, as well as better working conditions, forest conservation, and overall sustainability of forest management practices ([8]). At the same time, pursuing certification can result in additional **costs for forest managers**, both direct (e.g. fees for

([6]) Food and Agriculture Organization of the United Nations (n.d.). Sustainable Forest Management (SFM) Toolbox: Forest Certification. Accessed here.

([7]) Ibid.

([8]) Ibid.

assessments, audits) and indirect (e.g. training, equipment), to meet the necessary requirements for certification.

There are a number of forest certification schemes in the EU, some more widely used than others, each with its own certification processes, standards and underlying criteria and indicators, the details of which may vary between schemes. While a fundamental objective of all forest certification schemes is to provide a framework for sustainable forest management that forest managers can comply with to improve forest conservation outcomes and communicate those outcomes to their consumers along the supply chain ([9]), the extent to which such schemes actually achieve these objectives varies ([10]).

The two **most prominent and widely implemented** VFCS in the EU are **FSC and PEFC**. FSC is the first global certification scheme initiated by the WWF, while PEFC was developed by the Confederation of European Forest Owners (CEPF) to primarily serve small forest owners. By 2013, the FSC and PEFC had collectively certified approximately 400 million hectares of forest, representing over 10 000 certificates in total, with the vast majority of these certified forests, around 90%, situated in Europe and North America ([11]). In Europe, approximately 7% of the total forest area (or 86 million hectares) is certified under PEFC ([12]), and nearly 6% (or 70 million hectares) certified by FSC ([13]).

The following sections provide an overview of these schemes, including their certification processes, the key principles, criteria and indicators that underpin their international standards, and the process by which they develop national standards for use in their participating member countries.

2.1. Forest Stewardship Council (FSC)

2.1.1. Background and Certification Process

FSC was founded in 1993 as an international non-profit organisation in response to the 1992 Earth Summit in Rio de Janeiro. Its primary mission is to promote responsible management of the world's forests by ensuring that forestry practices are environmentally appropriate, socially beneficial, and economically viable ([14]).

According to FSC, **environmentally appropriate** forest management aims to maintain biodiversity, productivity and ecological processes while providing timber, non-timber products and ecosystem services from forests. **Socially beneficial** forest management focuses on providing long-term benefits to local communities and society more broadly, while **economically viable** forest management seeks to ensure that forest operations are

([9]) Ibid.

([10]) Gutierrez Garzon, A.R., Bettinger, P., Siry, J., Abrams, J., Cieszewski, C., Boston, K., Mei, B., Zengin, H. and Yeşil, A., 2020. A comparative analysis of five forest certification programs. *Forests*, *11*(8), p.863. Accessed here.

([11]) Ibid.

([12]) Maesano, M., Ottaviano, M., Lidestav, G., Lasserre, B., Matteucci, G., Mugnozza, G. S., & Marchetti, M. (2018). *Forest certification map of Europe*. iForest - Biogeosciences and Forestry, 11*(4),* p. 526-533.

([13]) Ibid.

([14]) FSC (n.d.). Our History. Accessed here.

sufficiently profitable without compromising the integrity of the forest resource, the affected ecosystem, or the communities on which they depend ([15]).

FSC operates a voluntary accreditation and independent third-party certification scheme that allows certificate holders to market their products and services as having been derived from responsible forest management. Furthermore, FSC also develops standards for the creation and approval of their Stewardship Standards based on the international benchmark FSC Principles and Criteria. Additionally, FSC establishes accreditation standards for certification bodies that verify whether FSC standards have been adhered to ([16]).

2.1.2. Key principles, criteria, and indicators

First published in 1994 and most recently updated in 2023, the FSC Principles and Criteria serve as a 'performance-based, results-oriented' ([17]) global standard for sustainable forest management. The principles and criteria, which focus on field performance rather than management systems, forms the foundation of the international FSC certification standard. The principles and criteria in particular are more concerned with the actual impacts and outcomes of forest management (e.g., how well forests are conserved, protected, and used sustainably) than with the internal processes or systems that a company may use to manage forests. The FSC Principles (Table 2) outline the essential aspects of an environmentally appropriate, socially beneficial, and economically viable system of forest management as per FSC, while the criteria provide a means of assessing when a principle has been achieved.

Table 2: FSC's international principles as of 2023

The FSC principles
Principle 1: Compliance with laws
Organisations are legally recognised entities with documentation of their legal rights, (e.g. boundaries, tenure, operational and use rights). They ensure legal protection of the forest area from unauthorised activities, forbid bribes, comply with anti-corruption laws, transportation and trade of forest products laws, and respect rules on dispute resolutions.
Principle 2: Workers' rights and employment conditions
Organisations comply with the ILO Declaration on Fundamental Principles and Rights at Work, promote gender equality, implement health and safety practices, and pay fair wages. Organisations provide training and supervision and implement mechanisms for resolving grievances and providing compensation when needed.
Principle 3: Indigenous peoples' rights
Indigenous peoples are identified, as well as their rights of tenure, access to and use of forest resources and ecosystem services, their customary and legal rights and obligations. Sites with special (cultural, ecological, economic) significance shall be recognised and/or protected. Delegating of control over management activities requires, their Free, Prior, and Informed Consent. Organisations shall respect the United Nations Declaration on the Rights of Indigenous Peoples and ILO Convention 169. Utilisation of traditional knowledge of Indigenous Peoples shall be compensated.
Principle 4: Community relations

([15]) FSC (n.d.). FSC Standards. Accessed here.

([16]) FSC (n.d.). Forest Management Certification. Accessed here.

([17]) FSC International (2023). FSC Principles and Criteria for Forest Stewardship (FSC-STD-01-001V5-3). Accessed here, p. 9.

The FSC principles
Local communities within or affected by a forest management unit are identified, as well as their tenure, rights of access to and use of forest resources and ecosystem services, customary and legal rights and obligations. Sites with special (cultural, ecological, economic) significance shall be recognised and/or protected. Delegating of control over management activities requires their free, prior, and informed consent. Organisations provide employment, training and other services and implement activities contributing to the social and economic development. Organisations identify and mitigate negative impacts of their operations and implement mechanisms for grievances and compensation if needed. Utilisation of traditional knowledge of traditional peoples shall be compensated.
Principle 5: Benefits from the forest
Organisations identify, produce, or enable the production of, diversified benefits and/or products. Harvesting must be done at levels that can be sustained long-term. Organisations include external impacts of their operations in their management plans. Local processing and services shall be used, and, if unavailable, organisations should assist in establishing these. Organisations demonstrate commitment to long-term economic viability.
Principle 6: Environmental values and impacts
Organisations assess and protect environmental values within and around the management unit affected by their activities. They identify conservation measures and monitor impacts. Special protections must be given to rare and threatened species and native ecosystems. They safeguard the quantity and quality of watercourses, water bodies, and riparian zones. The management of forest landscapes promotes diversity in species, age, and regeneration cycles. Conversion of natural forests or High Conservation Value (HCVs) areas to plantations or non-forest land is prohibited, with exceptions.
Principle 7: Management planning
Organisations implement management plans in line with their policies/objectives, ensuring environmental, social, and economic sustainability. The plans describe the natural resources, set verifiable targets, and are regularly updated based on monitoring and stakeholder engagement. A summary must be made publicly available.
Principle 8: Monitoring and assessment
Organisations demonstrate that they monitor and evaluate progress, the impacts of activities, and the condition of the management unit, to support adaptive management. This includes tracking the implementation of the management plan and monitoring environmental and social impacts. Summaries of the results shall be made publicly available.
Principle 9 High conservation values
Organisations maintain or enhance HCVs within the management unit by applying the precautionary approach. This includes assessing and recording HCVs such as species diversity, landscape-level ecosystems and mosaics, critical ecosystem services, community needs, and cultural values. Strategies must be developed to protect and enhance these values, then implemented and monitored. They are adapted to ensure ongoing protection, with engagement from stakeholders and experts.
Principle 10: Implementation of management activities
Organisations must ensure that management activities align with their economic, environmental, and social objectives as well as all FSC Principles and Criteria. Vegetation must be regenerated promptly after harvest. Alien species are only used if invasive impacts can be controlled. Genetically modified organisms are prohibited. Silvicultural practices must be ecologically appropriate, with minimal use of fertilisers or chemical pesticides. Organisations must manage natural hazards, protect water resources, and prevent damage to rare species and ecosystems. Harvesting and infrastructure activities must conserve environmental values, reduce waste, and ensure proper disposal of materials.

Source: FSC International (2023). FSC Principles and Criteria for Forest Stewardship (FSC-STD-01-001V5-3). Accessed here.

The principles and criteria apply jointly and independently at the level of individual management units, and together they form FSC's international standards ([18]). Additional guidelines, directives, and other documents issued and approved by FSC, as well as a number of standards (e.g., FSC Forest Stewardship Standards) complete the FSC standards framework.

As a performance-based standard, the FSC principles and criteria have clearly defined responsibilities. While the principles and criteria recognise that the manner in which an organisation achieves compliance with the standard may vary depending on the scale and intensity of management activities and the risk of negative impacts, certificate holders are responsible for ensuring compliance with each principle and criterion, including all decisions, policies and management activities. Organisations must also ensure that other persons or entities authorised or contracted by the organisation to operate on behalf of the forest management unit also comply with the principles and criteria. In case of non-compliance the organisation must also take corrective measures ([19]).

However, it is important to note that, as per their international benchmark, FSC does not necessarily insist on perfection in meeting its principles and criteria ([20]). For example, FSC recognises that occasional failures in performance may occur due to unforeseen changes in the cultural, environmental, economic and social environment. Certification decisions are therefore based on two main factors: how well the organisation's management practices meet each FSC criterion, and the significance and impact of failing to meet that criterion. In addition, if the certification bodies find any shortcomings during their assessments, these can lead to either minor or major Corrective Action Requests (CARs), depending on the severity of the non-compliance ([21]).

2.1.3. Setting national standards from the international benchmark

FSC uses a multi-step process to develop its National Forest Stewardship Standards (NFSS), which adapt its international principles (Table 2) and criteria to specific country contexts. This process is designed to ensure that FSC's global standards are implemented in a way that is both locally relevant and internationally consistent ([22]). The development of NFSS is facilitated through a collaborative and consultative approach, overseen by a Standards Development Group (SDG) in each country. The SDG consists of six to nine in-country representatives, with a balanced composition reflecting economic, social and environmental perspectives. According to FSC, this multi-stakeholder approach is in line with their commitment to inclusive decision-making and helps to ensure that the resulting standards address diverse local needs and concerns ([23]).

Throughout the standard setting process, FSC staff support the SDG with the primary aim of ensuring that FSC's ten international principles are accurately translated into country-specific

([18]) Ibid.

([19]) FSC International (2023). FSC Principles and Criteria for Forest Stewardship (FSC-STD-01-001V5-3). Accessed here.

([20]) Ibid.

([21]) Ibid.

([22]) FSC International (n.d.). National Forest Stewardship Standards. Accessed here.

([23]) Ibid.

indicators and verifiers. FSC maintains that this bottom-up approach to national standard development allows for grassroots input at the country level, ensuring that the resulting NFSS are both practical and relevant to local conditions. At the same time, the oversight provided by FSC International throughout the process helps to maintain consistency with the global FSC framework ([24]).

2.2. Programme for the Endorsement of Forest Certification (PEFC)

2.2.1. Background and certification process

PEFC is a **global, non-profit organisation** promoting sustainable forest management through the endorsement of national forest certification systems and labelling of forest-based products ([25]). Based in Geneva, Switzerland, it was founded in 1999 by small- and family forest owners in Europe who sought a certification system that would allow them to demonstrate the quality of their forest management. The founders initially aimed to establish a system able to address their specific needs while **promoting sustainable forestry practices globally**. In the years that followed, PEFC has developed international standards and sustainability benchmarks, and endorses national forest certification systems based on those standards. Now, PEFC is the largest forest certification scheme in the world, covering approximately 325 million hectares of certified forests and including more than 20 000 certified companies ([26]).

2.2.2. Key principles, criteria, and indicators

The official documentation provided by PEFC includes its international standards, benchmark standards, procedural documents and guidance documents. For example, its international standards include Chain of Custody, Requirements for certification bodies providing Chain of Custody, PEFC EUDR Due Diligence System and PEFC Trademark Rules, while its benchmark standards include Sustainable Forest Management, Group Certification, Standard Setting and Requirements for Certification Bodies operating certification against PEFC endorsed forest management. However, in the context of the specific objectives of this study, we will focus in particular on the PEFC international benchmark standard for Sustainable Forest Management (SFM).

The SFM benchmark standard (the benchmark standard) describes the criteria and indicators considered by PEFC as 'vital for the sustainable management of a forest' and one of their most important standards ([27]). More precisely, the benchmark standard contains the basic requirements that local-level entities must comply with to become PEFC certified, with these requirements being applicable to forest owners, managers, contractors, and other relevant forestry-related operators in PEFC-certified areas. Critically, the international benchmark standard is then tailored to different country contexts for the process by which PEFC member countries establish their own national SFM standard. At a minimum, PEFC requires that all

([24]) Ibid.

([25]) PEFC (2020), Chain of custody of Forest and Tree Based Products and Related Standards – Guidance for use, first edition. Accessed here.

([26]) PEFC (n.d.). 'Discover PEFC'. Accessed here; PEFC (n.d.), 'About PEFC'. Accessed here.

([27]) PEFC (n.d.). 'Standards and Guides'. Accessed here.

national implementations of their SFM benchmark standard must comply with or, ideally, go beyond their international requirements, which include 6-criterion pertaining to the *operation* of forest management (Table 3).

Table 3: PEFC's international criterion as of 2018

The PEFC's management criteria for forest certification
Criterion 1: Maintenance and appropriate enhancement of forest resources and their contribution to the global carbon cycle
Require that management aims to maintain or increase forests and their ecosystem services and economic, environmental, cultural and social values. It includes measures to prevent deforestation, forest degradation and depletion of forest resources. It establishes sustainable levels of harvesting and promotes afforestation, reforestation or natural regeneration to ensure continuity of forest cover.
Criterion 2: Maintenance of forest ecosystem health and vitality
Promotes the rehabilitation of degraded forests, emphasises the maintenance of genetic, species and structural diversity to strengthen the resilience of forests to environmental stressors, and promotes the minimal use and strict control of pesticides.
Criterion 3: Maintenance and encouragement of productive functions of forests (wood and non-wood)
The ability of forests to produce (non-)wood products and services on a sustainable basis shall be maintained and a sound economic performance shall be pursued. Requires that harvest levels are sustainable in the long term.
Criterion 4: Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems
Mandates the identification and protection of ecologically important forest areas, forbids the exploitation of protected, threatened and endangered species, promotes the use of native species for reforestation and afforestation, and forbids the use of genetically modified trees. It encourages the preservation of traditional management practices and requires minimal ecological damage from management operations and infrastructure development.
Criterion 5: Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water)
Areas with recognised protective functions shall be mapped and managed to maintain or enhance these functions. Special attention is mandated for forestry operations in sensitive or erosion-prone areas, and in areas with potential for excessive soil erosion into watercourses. The standard calls for careful construction of infrastructure to minimise environmental impacts.
Criterion 6: Maintenance of other socioeconomic functions and conditions
Requires forest management planning to respect all the socio-economic roles of forests and to ensure adequate public access for recreation. It mandates the protection of sites of historical, cultural or spiritual significance and promotes the long-term well-being of communities near forests. Management should contribute to research and give due regard to the role of forestry in local economies.

Source: PEFC Council (2018). Sustainable Forest Management – Requirements (PEFC ST 1003:2018). Accessed here.

2.2.3. Setting national standards from the international benchmark standard

According to PEFC, the process by which national standards are developed is not top-down, but instead developed locally through multi-stakeholder processes to reflect national priorities and specificities ([28]). In this case, stakeholders may include public or private forest owners, local communities, indigenous peoples, forest industry labour unions, as well as environmental and social NGOs ([29]).

More concretely, the development of national standards is facilitated by a standardising body, typically the PEFC national member ([30]), and is divided into three phases ([31]). The process begins with a notification phase, which is a public invitation to relevant stakeholders to participate. The decision-making process that takes place during the participation phase is inclusive and participatory and requires consensus among all interested parties before standards are finalised. Accordingly, PEFC states they are the only global forest certification scheme that mandates open participation of all stakeholders at the national level and requires consensus ([32]). During the consultation phase, draft standards are then subject to public consultation to allow for additional feedback.

Once developed, national forest certification schemes undergo what PEFC describes as a rigorous assessment process to ensure that they meet the various benchmarks required. Included as part of this assessment process are independent third-party assessments and public consultations. Finally, once a forest is certified, its products can carry the PEFC label, providing assurance that the forest is managed in accordance with high environmental, social and economic standards that, according to PEFC, balance people, planet and profit ([33]).

To ensure continued compliance with PEFC standards beyond the initial point of certification, all certificate holders are visited annually, with an average of 50 audits per day globally ([34]), and with failure to meet PEFC requirements potentially leading to suspension or withdrawal of the certificate ([35]). A review process must be carried out every five years, at the end of which the standards are revised or reaffirmed based on feedback received, gap analysis and consultation with national stakeholders ([36]).

([28]) PEFC (n.d.), 'Discover PEFC'. Accessed here; PEFC (n.d.), 'About PEFC'. Accessed here.

([29]) PEFC (2021), Brochure: Enabling Sustainability in Forest Management – PEFC's unique approach to forest certification, Accessed here.

([30]) PEFC (n.d.), 'Developing national standards', Accessed here.

([31]) PEFC (2021), Brochure: Enabling Sustainability in Forest Management – PEFC's unique approach to forest certification, Accessed here.

([32]) Ibid.

([33]) PEFC (2021), Brochure: Enabling Sustainability in Forest Management – PEFC's unique approach to forest certification, Accessed here.

([34]) PEFC, 'Assuring compliance with our standards', Accessed here.

([35]) PEFC (2018), Sustainable Forest Management – Requirements (Benchmark Standard), Accessed here.

([36]) PEFC (n.d.), 'Revising national standards', Accessed here.

2.3. Ekoskog (SE)

2.3.1. General information

Ekoskog is a Swedish non-profit organisation which developed a forest certification scheme focused on “supporting and developing ecologically sustainable forestry by creating a certification of clear-cut free, continuous cover forestry and labelling of products from these certified forests”. This label, named ‘Ecoforestry’, was created in 2020.

The surface area of Ekoskog-certified forests is not widely reported or tracked in the same way as larger, more globally recognised certification schemes such as FSC or PEFC. Ekoskog is a smaller, more regionally focused certification scheme, and detailed data on the specific surface area covered by Ekoskog-certified forests is not yet publicly available.

2.3.2. Certification criteria and processes

Ekoskog’s standard is based only on environmental criteria, compared to FSC and PEFC, which is a deliberate choice from the organisation: “*Ekoskog has chosen to focus on the aspects that most clearly distinguish forestry from today's prevailing forestry models [in Northern Europe] and from existing certification systems.*” The Ekoskog forest certification standard is built on four key principles. First, it ensures that forestry practices are aligned with the natural conditions and processes specific to each area. Second, it aims to manage forests, so they closely resemble their natural state, with restoration efforts focused on enhancing ecosystem complexity and biodiversity where needed. Third, it preserves the continuity of forest structure, function, and biological diversity before and after any interventions. Finally, it requires that all forestry activities are timed to occur at ecologically appropriate intervals, promoting the long-term health and resilience of the forest ecosystem.

Criterion 2 requires the certified forest to have a precise management plan. The plan, to be reviewed every 20 years, must contain objectives and target conditions for the forest, as well as measures to be taken during the plan period to achieve them. The plan also requires information on key ecological parameters (timber stock, deadwood volume, occurrence of threatened species, information on high nature value areas, heritage trees, etc).

The forest certification criteria for forest regeneration (criterion 3) requires sustainable practices that prioritise natural processes and ecological integrity. Reforestation after felling should primarily occur through natural regeneration, with planting allowed only if natural tree species are unavailable nearby. In such cases, planting material of local origin should be sought. Non-native tree species must be eliminated to preserve the forest's natural composition. Soil preparation is limited and should only occur in exceptional cases, using shallow, patch-based methods to avoid disturbing the mineral soil, and must be justified in the forest plan. The use of chemical or biological pesticides is prohibited, and fertilization with any type of fertilizer is not allowed to prevent contamination of the soil and water. Ditching in peatlands or wetlands is banned, with existing ditches maintained only when necessary to prevent infrastructure damage. Clearing of young forests is only permitted when necessary for accessibility or harvesting. Stand development management measures are delayed until trees reach a maturity of 20 cm in diameter at breast height, focusing on favouring high-quality target trees by removing inferior competitors.

The forest certification criteria for harvesting (criterion 4) requires careful and sustainable timber extraction practices. Timber harvesting should be conducted by removing individual trunks or small groups of trees, with gaps in the canopy kept as small as possible, never exceeding 0.2 hectares. Larger gaps may be allowed only when restoring young plantation forests. Additionally, new gaps should not be created next to previous ones until the canopy of the earlier gap has fully closed. Felling residues are to be left in place, and stump grinding is prohibited to preserve the natural ecosystem.

Ekoskog's criteria 5 details conditions for areas excluded from forestry for protecting and enhancing biodiversity. Areas with high nature values, or those likely to host threatened species (categories VU, EN, and CR on the Red List), should be left for natural development or managed to preserve or enhance their ecological value. This includes key biotopes and other designated sites with nature values, which should generally be free from forestry activities. Timber harvesting may only occur if it aligns with conservation goals, and such exceptions must be justified in the forest plan. Additionally, at least 10% of productive forest land must be set aside for free development to promote biodiversity, selected with an emphasis on maximising conservation benefits and considering landscape ecology. Areas protected under other regulations or receiving state compensation cannot be included in this 10%. Forests above the mountain forest boundary are entirely excluded from forestry activities.

Criterion 6 on deadwood focuses on retaining and enhancing deadwood to support biodiversity. Existing deadwood, including that from natural disturbances, must be preserved unless otherwise required by law. Deadwood may be moved for access but not removed. The goal is to achieve at least 20 cubic meters of deadwood per hectare, reflecting the natural composition of the forest, with further increases over time to approach levels found in natural forests.

Criterion 7 on heritage trees requires that, on average, at least 20 trees per hectare be left for natural development. Priority should be given to old trees with high ecological value or those likely to develop such value. Suitable trees include those with nest holes, broad-leaved deciduous trees, old deciduous trees in coniferous stands, and old coniferous trees in deciduous stands.

The forest certification criterion 8 for riparian and wetland protection zones requires that these areas be clearly delineated based on site conditions and documented in the forest plan. Riparian zones should also be established near small watercourse outflows. Forestry operations, including timber harvesting, are allowed only if they align with the conservation or enhancement of the area's natural values, with any exceptions needing justification in the forest plan. Protection zones must remain undisturbed, especially those previously left during clear-cuts, until they reach their intended ecological condition.

The forest certification criterion 9 for threatened or vulnerable species requires that forestry operations avoid damaging or destroying known occurrences of such species. If operations are necessary, they must be adapted to prevent harm. When active measures are needed to conserve these species, they must be detailed in the forest plan and carried out accordingly.

The forest certification criteria 10 and 11 focus on forest roads and off-road driving. Forest roads should only be built if they are financially justified and must avoid wetlands, natural watercourses, and creating migration barriers for aquatic organisms. Upgrades to existing roads should address any culverts that disrupt natural flows. Off-road driving should primarily occur on frozen or firm ground to prevent soil damage. Precautions like scarifying or using ground cones are required when there is a risk of damage, especially near wetlands and watercourses. Driving in areas designated for conservation (criterion 5) is prohibited. Any damage that affects land hydrology must be repaired to restore natural functions.

Finally, the forest certification criterion 12 for diked wetlands focuses on restoring and managing peatlands to promote natural forest conditions. In nutrient-rich peatlands in southern Sweden, existing ditches should be filled, and the forest managed to create natural conditions. For other drained peatlands, the goal is to maintain a high groundwater level without harming existing forests, either by allowing ditches to regrow or through active measures like filling or plugging. The management approach aims to create a natural forest suited to the moist soil conditions, in line with the standard's principles.

2.4. Preferred by Nature (PbN) – add-on for Closer to Nature forest management

Preferred by Nature (PbN) is an international non-profit organisation dedicated to promoting sustainable land management and business practices. Founded in 1994 in Aarhus, Denmark, the organisation provides sustainability certification services, awareness raising initiatives and capacity building programmes.

Preferred by Nature offers a 'Forest & Farm Manager' certification, developed in 2023, which includes add-on options to enhance sustainability in forestry practices. This outcome-focused add-on checklist is to be applied to FSC or PEFC with the aim of alignment with CNF. Therefore, it is not intended to be a standalone certification. The principles for the PbN add-on are based on guidelines developed by the European Forest Institute in 2022 ([37]), and aim to ensure compliance with the CNF guidelines. The add on checklist includes **19 commitments or requirements**, encompassing forest operators' vision and direction to move the forest closer to nature and the actions to be implemented.

Criteria 1 and 2 require the demonstration of commitment to CNF from the forest operator, including a description of motivation, reasons for undertaking the transition, long-term vision and proof that the forest management staff understands CNFs principles. The long-term vision should be contextualised and specific to the management unit and include targets for the future condition of the unit, considering future climate scenarios.

To support the long-term vision, the add-on requires a written transition plan (criteria 3), with a definition of the area of application (criteria 5) and a description of the staff skills development strategy (criteria 6). Criteria 4 requires a monitoring system to track progress of the plan implementation. The transition plans (1 page minimum) detail the operational 'how' and must include a summary of motivation, a list of forest management principles, forest management goals, key steps to be undertaken and challenges to be faced, and a description of the general timeline.

Criteria 7 to 19 detail requirements for transitioning towards CNF. Criteria 7 requires the evaluation and implementation of remediation (or at least partial restoration) actions of impacts from past management activities (including drainage, peat extraction, introduction of exotic species, etc). Criteria 8 and 9 focus on assessing the potential impacts of climate change on species composition. Criteria 8 requires the planning of potential required changes in species composition and silvicultural decisions. Criteria 9 relates to the desired species composition, considering resilience to climate change and increasing the biodiversity value of the forest.

([37]) Larsen, J.B., Angelstam, P., Bauhus, J., Carvalho, J.F., Diaci, J., Dobrowolska, D., Gazda, A., Gustafsson, L., Krumm, F., Knoke, T., Konczal, A., Kuuluvainen, T., Mason, B., Motta, R., Pötzelsberger, E., Rigling, A., Schuck, A., 2022. Closer-to-Nature Forest Management. From Science to Policy 12. European Forest Institute.

While favouring the selection of native species, the standard does not preclude the introduction of non-native species, provided that the options have been carefully considered, the species are site-adapted and carefully screened, and a clear justification and rationale are provided.

Criteria 10 requires the selection of a forest management approach that best supports biodiversity, forest health, stability and resilience to climate change, while taking local knowledge into account.

Criteria 11 requires the grouping of areas according to the priority of actions required for the transition towards CNF: a short-term priority area with actions implemented over 2-3 years, a medium-term priority area with actions implemented over 3-10 years, and a long-term priority area with actions implemented beyond 10 years).

Criteria 12 on grazing management focuses on the management of potential damaged by domestic and wild animals so that grazing pressure does not prevent natural regeneration.

Criteria 13 promotes the implementation of sustainable soil management soil measures to support soil health and prevent damage. Such measures include using permanent trails for machinery and choosing appropriate harvesting times based on weather conditions (e.g., dry weather, below-freezing temperature). The removal of roots and stumps must be avoided and is generally not allowed. Soil preparation is permitted only when necessary to support natural regeneration. Soil treatment should be avoided in sensitive areas and when employed, limited to pointwise and row-wise methods.

Criteria 14 details that clear cuts should be minimised, and exceptions should be justified (ex: transition from even-aged monoculture to CNF might require some small clear cuts).

Criteria 15 requires the implementation of natural regeneration by default. Supplementary planting may be allowed for areas not regenerating well naturally or to increase species composition diversity.

Criteria 16 supports the preservation of dead wood, at various stages of decay, including during harvesting, without specifying thresholds.

Criteria 17 requires the identification and protection of retention trees to support biodiversity and habitat complexity, with a preference for trees likely to survive for a long time (large diameter and wind-resistant).

Criteria 18 and 19 focus on the preservation of water ecosystems. Criteria 18 mentions that drainage operations should be avoided to maintain natural hydrological regime and preserve natural forest site types and habitat. Criteria 19 requires the implementation of measures to protect existing wetlands and water bodies, such as creating permanent buffer zones around water bodies.

2.5. Association for Ecological forestry certification (AEFC)

The Association for Ecological forestry certification (AEFC) was established in 2023 in Finland by a network of NGOs and businesses in the pan-Nordic and Baltic regions. Its main task is to develop and sustain a system for certifying and labelling timber and wood products (under the label ‘EverCover timber’), in line with the CNF guidelines’ key principles. The forestry principles of the certification are **currently in development** and will be based on Continuous Cover

Forestry (CCF) and mimic the FSC declination system of national standards, with 3rd party verification. The first national standards are expected to be operational in Estonia, Finland and Sweden by 2025, with an objective to expand the standard to the rest of the EU in following years.

The certification aims to elevate current standards for sustainable forestry in an economically efficient way. The certification aims to contribute to reversing the decline of forest biodiversity and carbon storage capacity loss, paying particular attention to minimising clear cuts, setting areas aside and establishing a system for protecting high conservation value forests.

According to the AEFC, forest owners can be contracted through a 50-year carbon supplement offering guarantee that their management will remain under continuous cover management without clear cutting and allows for carbon credits to be generated from such contracts.

The AEFC also plans to provide additional contracts (with an additional payment) for forest permanent strict protection that can be used in the framework of a biodiversity compensation schemes or biodiversity offsetting mechanism.

3. Assessing compliance: FSC, PEFC, Ekoskog and closer-to-nature forest management

This chapter presents a comparative assessment on how the selected FSC and PEFC national standards and Ekoskog align with the objectives and intervention tools presented in the European Commission's CNF guidelines. The assessment aims to identify areas of compatibility, gaps, and opportunities for aligning these widely adopted VFCS to better support the operationalisation of CNF practices across the EU. The Preferred by Nature (PbN) standard was not included in the comparative assessment due to the difference in methodology, since the standard is an add-on based on a positive/negative list. Similarly, the Association for Ecological forestry certification (AEFC) standard was not included in the detailed comparative assessment as their standards are still in an early stage of development. By examining the specific criteria and indicators within each national standard, this chapter offers insights into how existing certification schemes can contribute to the promotion of closer-to-nature forestry. Moreover, it highlights areas where these schemes may need to evolve to fully embrace the CNF approach.

3.1. Bridging the gap: the CNF Guidelines and existing voluntary forest certification schemes

The CNF guidelines and national standards under the FSC and PEFC schemes, in addition to the Ekoskog scheme, represent distinct approaches to forest management. For example, while FSC and PEFC schemes focus on promoting sustainable forest management, largely based on the conceptualisation of the term as defined in 1993 ([38]), the CNF guidelines specifically aim to promote biodiversity-friendly and adaptive forest management practices. Although they may share some common elements, broadly speaking, they differ considerably in their aims, structure, specificity and application.

([38]) European Commission (n.d.), Sustainable forest management, Accessed here.

The CNF guidelines, developed as part of the EU Forest Strategy 2030, provide a framework for closer-to-nature forest management practices. They outline general principles, objectives and intervention tools for forest managers, practitioners, and landowners, none of which are tied to a specific location, either country or biogeographical region. In contrast, the national standards of both the FSC and PEFC schemes present detailed, in some cases quantifiable criteria and indicators, the implementation of which is a prerequisite for the certification of the forest area concerned. Moreover, these standards have evolved over decades of practical implementation and refinement, likely reflecting more closely the complex realities of forest management and the forestry sector in terms of its operations on the ground. This fundamental difference in nature and purpose presents both challenges and opportunities when comparing and assessing criteria against one another.

Beginning with section 3.1.1 on *Increasing structural complexity,* the sub-sections of this report that follow offer a **comparative assessment of FSC and PEFC national standards** against the ten **objectives and intervention tools** as outlined in the CNF guidelines, aiming to assess the extent to which these widely adopted VFCS align with and support the implementation of CNF practices across the EU.

However, it is important to recognise the inherent **limitations of this comparative exercise**: Exact, one-to-one comparisons are not always possible due to the **different structures and levels of specificity** between the two types of documents as represented by the Guidelines and the national standards. In some cases, the spirit or intent of one aspect of the CNF guidelines may be reflected in one of the VFCS criteria without using identical language or terminology. Conversely, there may be cases where one of the VFCS criteria assessed appears to align with the CNF guidelines on the surface, but the practical implementation or real-world interpretation of such a standard may in fact deviate considerably from how it was originally written or intended.

Despite these limitations, which are inherent to the nature of the documents assessed, this comparative assessment provides valuable and novel insights into the **potential of existing VFCS to support the voluntary uptake of CNF management practices**. For each of the Guidelines' ten objectives and intervention tools (Table 1), the **assessment highlights areas of alignment** between the national standards, identifies weaknesses and gaps, and ultimately, offers a **foundation** for considering how **these widely used certification schemes could be adapted to better support and more closely align with a CNF approach** for application in the EU in the future.

As we proceed through the following subsections, each of which deals with the results of a specific CNF objective or intervention tool, it is important to bear in mind these inherent limitations and to consider the results as indicative rather than definitive. The comparative assessment is intended to provide a starting point for further exploration and recommendations on how to achieve VFCS that are consistent with and promote closer-to-nature forestry practices across the EU.

3.1.1. Increasing structural complexity

Description of the CNF objective

The first main objective detailed in the **CNF guidelines** is to **increase the structural complexity of forests** as a key component of sustainable forest management. The aim is to

create more diverse and mixed forests ([39]). Structural complexity in particular encompasses several dimensions, including vertical stratification, horizontal patchiness and diversity of tree species, age and size. The purpose is to develop forests that better mimic the conditions of naturally occurring ecosystems. It seeks to promote a mix of denser and sparser parts according to the natural mix of species and structures, depending on the type of forest and its phase of development ([40]).

By promoting vertical stratification, mix of denser and sparser areas, as well as tree species richness, the guidelines aim to reflect the natural heterogeneity that is found in undisturbed forest ecosystems. This complexity is key to strengthening biodiversity, as it can result in the creation of a variety of ecological niches that are conducive to supporting a wide range of species. In addition, structurally complex forests are generally more resilient to disturbance and threats to the forest, such as pests, invasive species, diseases, fires, and the impacts of climate change. By increasing structural complexity, the guidelines aim to strengthen not only the ecological value of forests but also their long-term productivity, resilience and ability to provide a wide range of ecosystem services ([41]).

Table 4: Specific examples from the FSC and PEFC national standards and Ekoskog on *increasing structural complexity*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Increasing structural complexity: Closer-to-nature forest management strives to create more diverse and mixed forests in terms of height, diameter, age and species. It seeks to promote a mix of denser and sparser parts according to the natural mix of species and structures, depending on the type of forest and its phase of development.	The **German FSC** standard exemplifies strong alignment with CNF guidelines. It requires the maintenance of a varying mosaic of species, sizes, ages, and spatial scales and mandates thinning concepts suitable for developing **structurally rich stands**.	**6.8:** The Organization* shall manage the landscape* in the Management Unit* to maintain and/or restore a varying mosaic of species, sizes, ages, spatial scales and regeneration cycles appropriate for the landscape values* in that region and for enhancing environmental and economic resilience* ([42]). **10.1.2: '**Thinning concepts are suitable for the development of structurally rich stands intended for a later individual to groupwise* harvesting of stems ([43]).
	The **Italian PEFC** standard sets a specific target, requiring **more than 50%** of the total forest area to be covered by **ecologically adapted forest types**, aligning well with the CNF guidelines' emphasis on diverse and mixed forests.	**Indicator 4.3.a:** Change in the proportion of mixed forests composed of 2 or more species. (Forest surface covered with forest types which are ecologically adapted to the site, according to composition and structure, should be more than 50% of the total area.) ([44]). **Indicator 4.3.b:** Change in the proportion of mixed forests which are not single-stratified ([45]).

([39]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

([40]) Ibid.

([41]) Ibid.

([42]) FSC (2018). *Deutscher FSC-Standard 3-0.* Accessed here.

([43]) Ibid.

([44]) PEFC (2015). *Annex 2: ITA 1001-1 CRITERIA AND INDICATORS FOR SUSTAINABLE FOREST MANAGEMENT CERTIFICATION ON A INDIVIDUAL AND GROUP SCALE.* Accessed here.

([45]) Ibid.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
	The **Romanian FSC standard** recognises structural complexity as a feature of natural forests and operationalises species diversity through **High Conservation Value (HCV)** areas. The Romanian PEFC standard includes indicators for levels of naturalness but lacks specific indicators for species richness and diversity.	**Criterion 9.1.:** The Organization, through engagement with affected stakeholders, interested stakeholders and other means and sources, shall assess and record the presence and status of the following High Conservation Values in the Management Unit, proportionate to the scale, intensity and risk of impacts of management activities, and likelihood of the occurrence of the High Conservation Values: **HCV 1 – Species diversity.** Concentrations of biological diversity including endemic species, and rare, threatened or endangered species, that are significant at global, regional or national levels ([46]).
	Ekoskog integrates structural complexity requirements by preserving native ecosystems, protecting key habitats, and ensuring the survival of vulnerable species, all of which contribute to diverse and resilient forest structures.	**Criterion 3** excludes the plantation of non-native tree species. **Criterion 5** excludes from forestry areas of high conservation values or that contain vulnerable species and requires that they are managed in a way that increases their conservation value. **Criterion 7:** 20 trees with high conservation value by hectare are left to develop freely. **Criterion 9** limits forestry operations which could have an adverse effect on threatened and vulnerable species.

Key findings

- FSC standards in the majority of countries assessed (e.g., Germany, Poland, Romania, Slovenia) explicitly address the maintenance and promotion of diverse mosaics of species, sizes, and ages, aligning closely with this objective of the Guidelines.
- PEFC standards in several countries (e.g., Italy, Poland, Romania, Slovenia) demonstrate strong alignment with this objective of the Guidelines as well, in particular by promoting mixed stands and diverse forest structures.
- Both FSC and PEFC standards in compliant countries often emphasise natural regeneration and species diversity as key components of structural complexity.
- While many national standards align with CNF objective, most of them lack quantitative benchmarks that could be used to measure levels of structural complexity.
- Some national standards (e.g., France, Sweden, and Slovakia) focus more on maintaining existing diversity rather than actively increasing structural complexity.
- Ekoskog requires taking measures to approach the state of nature in terms of the complexity of the ecosystem, such as structure, variation, processes and biological diversity of the forest.

([46]) FSC (2017). *The FSC National Forest Stewardship Standard of Romania.* Accessed here.

The results of the comparative assessment find that **FSC, PEFC and Ekoskog certification schemes demonstrate considerable alignment** with the approach of the CNF guidelines towards **increasing structural complexity**, with the majority of countries assessed for both certification schemes showing full or partial alignment with the Guidelines (Table 5. This alignment is particularly evident in countries such as Germany, Poland, Romania and Slovenia, where the national standards for both schemes are largely conducive to actively promoting diverse forest structures and species composition. This suggests that certain aspects of the national standards of these certification schemes can provide a strong basis for the implementation of closer-to-nature forestry practices. However, a **notable gap** revealed by the assessment relates to the CNF guidelines' emphasis on actively increasing structural complexity and the approach taken by some of the national certification standards. This discrepancy is particularly evident in countries such as Sweden, France and Slovakia, where both FSC and PEFC standards focus on **maintaining existing diversity** rather than promoting increased complexity.

Table 5: Assessment of national standards' contribution to *increasing structural complexity*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	Yes	Partial	N/A	Yes	Yes	Partial	Partial	Yes
PEFC	Partial	No	Yes	Yes	Yes	No	Partial	Yes
Ekoskog	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A

Despite these areas of alignment, a common theme that emerges across both aligned and partially aligned standards is the **lack of specific, measurable targets or quantitative benchmarks** that could be used to assess progress towards achieving structural complexity of the forest.

Strengths and suitability of all standards

FSC standards are particularly strong in addressing key aspects of structural complexity. The German FSC standard requires the maintenance of a varying mosaic of species, sizes, ages and spatial scales, which closely aligns with the approach of the CNF guidelines. The Polish FSC standard prioritises diversity in plantation composition, including factors such as size, spatial distribution and age classes. The inclusion of High Conservation Value areas in the Romanian FSC standard contributes significantly to structural complexity at the landscape level, which is well aligned with the multi-scale approach of the CNF guidelines.

The PEFC standards also show notable strengths in promoting structural complexity. The Italian PEFC standard, for example, sets a concrete and ambitious target of having more than 50% of the total forest area covered by ecologically adapted forest types. The Romanian PEFC standard includes clear indicators for the degree of naturalness, while the Polish PEFC standard explicitly mentions the objective of structural diversity in forest management, including uneven-aged and mixed stands.

All three certification schemes strongly emphasise natural regeneration and species diversity as key components of structural complexity, which is particularly evident in the Slovenian standards for FSC and PEFC. Ekoskog has a slightly higher level of ambition on increasing structural complexity, taking measures to respect the complexity of the ecosystem, such as structure, variation, processes and biological diversity of the forest. Specifically, criterion 9 on the protection of threatened and vulnerable species and criterion 3, which excludes the

planting of non-native tree species, are important guarantees for maintaining structural complexity. In addition, criterion 5 excludes areas of high conservation value or areas containing vulnerable species from forest management.

Weaknesses and gaps of all standards

A common and key weakness across all schemes is the lack of clear, quantitative benchmarks for achieving desired levels of structural complexity. This absence of specific targets is evident in nearly all PEFC/FSC national standards examined, including those of Germany, Poland, Romania, and Sweden. The same remains true for Ekoskog, which lacks quantitative targets or thresholds for achieving structural complexity.

In addition, some of the national standards assessed, particularly in countries like France, Sweden and Slovakia, focus more on maintaining existing diversity rather than actively increasing structural complexity. Additionally, some standards, such as the Polish PEFC, frame the implementation of diversity-enhancing measures as contingent on economic feasibility, potentially limiting their application and effectiveness in increasing structural complexity.

3.1.2. Promoting natural forest dynamics

Description of the CNF objective

The second main objective detailed in the **CNF guidelines** addresses the **promotion of natural forest dynamics** as crucial aspect of forest management in line with the first principle of CNF. The Guidelines advocate for forest management practices that harmonise with and enhance the innate processes of forest ecosystems. By embracing natural dynamics, forest managers can foster increased biodiversity, strengthen ecosystem resilience, and better maintain ecological integrity. The Guidelines encourage a nuanced approach, which, for example, recommends making light but regular interventions tailored to specific site conditions. These interventions aim to modify habitat complexity and enhance the variety of ecosystem services provided by the forest ([47]).

Central to this objective is the recognition that forests are not static entities, but rather dynamic systems. In turn, the Guidelines emphasise the importance of maintaining and promoting conditions that reflect the natural range and distribution of existing and potential species within a given area. More naturally dynamic forests can have multiple benefits, such as reduced long-term management costs by leveraging natural processes rather than relying heavily on artificial interventions, while also resulting in resilient forest ecosystems that are better equipped to withstand environmental stresses and adapt to changing conditions. By better promoting natural forest dynamics, the Guidelines seek to create forest landscapes that more closely resemble their natural counterparts, while still allowing for sustainable use of forest resources ([48]).

([47]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

([48]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

Table 6: Specific examples from the national standards on *promoting natural forest dynamics*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Promoting natural forest dynamics: Closer-to-nature forest management relies as much as possible on natural dynamics and by embracing and directing those dynamics. As much as possible, closer-to-nature forest management involves making light but regular interventions specific to the site to increase habitat complexity, community diversity and ecosystem service variety.	The **German FSC standard** demonstrates strong alignment with CNF guidelines, requiring that forest managers effectively **maintain the existence of naturally occurring native species and genotypes**, and prevent losses of biological diversity, especially through habitat management.	**6.8:** The Organization* shall effectively maintain the continued existence of naturally occurring native species and genotypes, and prevent losses of biological diversity*, especially through habitat management in the Management Unit*. The Organization shall demonstrate that effective measures are in place to manage and control hunting, fishing, trapping and collecting ([49]). **6.5:** The Organization* shall identify and protect representative sample areas of native ecosystems* and/ or restore* them to more natural conditions*. Where representative sample areas* do not exist or are insufficient. The Organization* shall* restore* a proportion of the Management Unit* to more natural conditions ([50]).
	The **Swedish FSC standard** demonstrates partial alignment with the Guidelines by requiring that only a minimum of 5% of forest area be set aside and exempted from measures other than conservation measures. While this promotes **natural processes in some areas**, this limited approach falls short of the CNF guidelines' emphasis on promoting natural dynamics as much as possible.	**6.5.1:** A selection of the productive forest land area is set aside and exempt from measures other than management to maintain and promote natural biodiversity or biodiversity conditioned by traditional land use practices. The selection of areas: a) covers a minimum of 5 % of the productive forest land area, b) is based on forest conservation values, landscape representativeness and biodiversity ([51]). **6.5.2:** At least 5 % of the productive forest land area is managed with long-term protection and enhancement of conservation values and/or social values as the primary objective. The following can be included, exclusively or in a combination: a) further areas set aside to maintain and promote natural biodiversity or biodiversity conditioned by traditional land use practices, in addition to the 5 % that is set aside according to 6.5.1, b) areas with enhanced nature consideration and specific nature conservation measures, c) areas with long-term management in the form of continuous cover forestry or group felling with natural regeneration ([52]).

([49]) FSC (2018). *Deutscher FSC-Standard 3-0.* Accessed here.

([50]) Ibid.

([51]) FSC (2020). *The FSC National Forest Stewardship Standard of Sweden.* Accessed here.

([52]) Ibid.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
	The **Slovenian PEFC standard** provides a positive example by stipulating that natural forest regeneration must strive for the **maximum share of natural processes**, aligning with the CNF guidelines' emphasis on relying on natural dynamics as much as possible.	**4.5:** Natural forest regeneration must strive for the maximum share of natural regeneration of stands in a manner most similar to natural processes, while at the same time ensuring that species, which are suitable in terms of commercial demand, and the stand design of high quality is observed Indicator 4.5.b – Natural regeneration compared to total forest regeneration ([53]).
	The promotion of natural forest dynamics is embedded in Ekoskog's core criteria.	**Criterion 1** stresses that "ecological forestry manages and conserves forest in a way that is as close as possible to a natural forest on each site. Where conditions in the forest differ significantly from the natural conditions, all measures are taken to restore the complexity of the ecosystem – its structure, variety, processes and biodiversity – to its natural state." ([54])

Key findings

- Both FSC and PEFC standards show varying degrees of alignment with CNF guidelines on promoting natural forest dynamics across different countries.
- Several national standards (e.g., Germany, Poland, Romania for FSC; Italy, Poland, Slovenia for PEFC) demonstrate strong alignment with CNF objective on promoting natural forest dynamics.
- Some countries' standards (e.g., France, Slovakia) lack explicit references to promoting natural forest dynamics or light interventions.
- There is a general trend towards emphasising natural regeneration and species diversity in both FSC and PEFC standards.
- National standards generally lack specific, quantitative benchmarks for assessing the promotion of natural forest dynamics.
- Ekoskog outlines some of the underlying principles of forestry to favour natural dynamics, including the key principle of managing forests, "*so they closely resemble their natural state, with restoration efforts focused on enhancing ecosystem complexity and biodiversity where needed*". However, there is a lack of quantitative benchmarks for promoting natural forest dynamics.

The comparative assessment reveals a **mixed picture** of **moderate-to-weak** alignment with the CNF guidelines on promoting natural forest dynamics across both FSC and PEFC national standards. While there is a general trend towards incorporating elements into both schemes that promote natural forest dynamics, the degree of alignment varies considerably across countries and between the two certification schemes. The national FSC standards generally demonstrate stronger alignment with the CNF guidelines, with four out of seven countries (Germany, Poland, Romania, and Slovenia) demonstrating alignment with the Guidelines. For instance, the German FSC standard requires the maintenance of 'the existence of naturally

([53]) PEFC (2021). *Criteria and Indicators for Sustainable Forest Management at the Regional Level.* Accessed here.

([54]) Ekoskog (April 2024). *Environmental standards for ecological forestry.* Accessed here.

occurring native species and genotypes, and prevent losses of biological diversity, especially through habitat management'. On the other hand, the national PEFC standards assessed are less consistently aligned with the CNF approach, with most countries showing only partial alignment (Germany, Italy, Poland, Sweden, Slovenia), while two others (France and Romania) are not aligned.

More generally, once again we see that many standards from both schemes lack specific quantitative benchmarks to assess whether or to what extent natural forest dynamics are promoted. This is evident, for example, in the national FSC standard for Sweden, which prescribes conservation efforts for specific habitats, but does not require these practices for all forest areas. Similarly, the Slovenian PEFC standard lacks specific guidelines on the frequency and intensity of harvesting interventions to better mimic natural disturbance patterns.

Table 7: Assessment of national standards' contribution to *promoting natural forest dynamics*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	Yes	Partial	N/A	Yes	Yes	Partial	No	Partial
PEFC	Partial	No	Partial	Yes	No	Partial	Partial	Partial
Ekoskog	N/A	N/A	N/A	N/A	N/A	Partial	N/A	N/A

Another common trend in both certification schemes is an emphasis on ensuring natural regeneration and species diversity. While this is in line with this particular aspect of the CNF guidelines in a broad sense, the depth with which both schemes implement this in terms of concrete criteria and indicators often falls short of the more comprehensive approach to promoting natural dynamics as outlined in the Guidelines. This is particularly evident in the national French standards for both FSC and PEFC, which focus more on maintaining existing diversity rather than actively promoting increased complexity and natural dynamics.

Strengths and suitability of all standards

The national FSC standards generally performed well in their approach to promoting natural forest dynamics, particularly in Germany, Poland and Romania. These national standards often went beyond corresponding elements of the CNF guidelines, but rather actively encouraged the development of complex forest structures and processes. For instance, the German FSC standard mandates the identification, protection, and restoration of native ecosystems back to more natural conditions. In addition, in Poland the FSC standard provides detailed guidance on the design and layout of plantations to protect, restore and conserve natural forests, as well as explicit references to maintaining 'natural forests', increasing habitat complexity and emphasising wildlife corridors alongside a mosaic of stands of different ages. This approach is not only consistent with the CNF guidelines but often goes beyond them, demonstrating a strong commitment to promoting natural forest dynamics.

The national PEFC standards assessed, while generally less comprehensive and consistent with the Guidelines, still have notable strengths in promoting natural forest dynamics in several countries. Notably, the Polish PEFC standard stands out as an exemplar approach by emphasising the importance of sustaining forest resources in the medium and long term, with a focus on balancing harvesting and growth rates. The Italian PEFC standard focuses on limiting the harvesting of both timber and non-timber products to sustainable levels that do not damage the renewal capacity and natural restoration of the goods themselves, thus helping to ensure the preservation of the forest's natural renewal capacity and restoration processes.

Another example of good practice can be found in the Slovenian PEFC standard, which not only requires that management and harvesting operations minimise damage to the ecosystem, but also stipulates that natural forest regeneration should maximise natural processes as well.

The Ekoskog standard requires forests to be managed "so that they closely resemble their natural state, with restoration efforts focused on enhancing ecosystem complexity and biodiversity where needed". The standard further requires the preservation of forest structure, function and biological diversity before and after any interventions and requires harvesting activities to occur at ecologically appropriate intervals, which supports the promotion of natural forest dynamics. Criterion 4 on harvesting conditions includes quantified requirements limiting canopy gaps. Ekoskog also requires a management plan with information on key ecological parameters, including timber stock, deadwood volume, occurrence of threatened species, information on high nature value areas, and heritage trees, among others.

Weaknesses and gaps of all standards

The national FSC standards in some of the countries assessed do not fully reflect the vision of the CNF guidelines in promoting natural forest dynamics. Many FSC standards, including those in Slovakia and Sweden, lack specific guidance on promoting light interventions or developing management approaches that actively promote natural dynamics. In the case of France, the national standard is only partially aligned with CNF guidelines as it focuses on protecting, rather than actively promoting natural processes. This more conservation-oriented approach does not fully reflect the CNF guideline's emphasis on embracing and directing natural dynamics through light but regular interventions.

PEFC standards generally exhibit lower alignment with the CNF guidelines on promoting natural forest dynamics. For instance, Romanian standard does not require or refer to harvesting on the basis of naturalness or level of damage beyond the total volume harvested, and therefore allows harvesting methods and scales that may be inconsistent with the CNF guidelines. The French standard, on the other hand, focuses on enhancing biodiversity in a general context, with no reference to emphasising or promoting natural dynamics or similar terms. More broadly, a common weakness across the majority of PEFC standards is their focus on maintaining existing diversity rather than actively promoting increased forest complexity and natural dynamics. This approach, particularly seen in countries like Slovakia and Sweden, falls short of the proactive stance advocated by the CNF guidelines. Furthermore, all national standards demonstrate a lack of specific measures and indicators for monitoring the implementation of natural dynamics-focused management. This absence of concrete benchmarks, most evident in standards from Germany and Italy, challenges the ability to assess progress and ensure that management practices are effectively promoting natural forest dynamics.

3.1.3. Promoting natural tree regeneration

Description of the CNF tool

Promoting natural tree regeneration is the first tool in the toolbox of the **CNF guidelines**, emphasising its role in promoting genetic diversity and enhancing forest resilience. This approach prioritises the natural regeneration of forests, harnessing ecological processes to create robust and diverse ecosystems. The guidelines advocate for natural regeneration as the primary method, recognising its ability to maintain local genetic adaptations and support a

wide range of forest-dependent species. However, they also acknowledge that in some circumstances, such as following severe forest disturbance or in response to the effects of climate change, artificial regeneration may be necessary. In such cases, the Guidelines emphasise the importance of using local, native species wherever possible. They also provide nuanced recommendations for the cautious introduction of climate-adapted species, balancing the need for future resilience with the preservation of existing ecological relationships ([55]).

The Guidelines also reinforce the importance of minimising soil disturbance during regeneration processes, recognising the vital role of soil ecosystems in forest health. By promoting a mix of species and age classes through natural regeneration, the Guidelines aim to create structurally complex forests that are more resilient to environmental stressors and provide diverse habitats ([56]).

Table 8: Specific examples from the national standards on *promoting natural tree regeneration*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Promoting natural tree regeneration: Natural regeneration should be the prevailing approach to regenerating forests. Artificial regeneration may be implemented when necessary due to: - Reduced natural genetic diversity; - Unsuccessful natural regeneration; - Need for assisted migration to facilitate climate-adapted regeneration; and - Restoring a suitable habitat for a species.	The **German FSC standard** demonstrates strong alignment with CNF guidelines, stating that natural regeneration has priority (using site-appropriate species). This approach **prioritises natural processes** while ensuring ecological suitability and fully embraces the CNF tool of promoting natural tree regeneration. Furthermore, the German FSC standard **specifies the conditions** upon which **artificial regeneration may be carried out**.	**10.2:** The Organization* shall use species for regeneration that are ecologically well adapted to the site and to the management objectives*. The Organization shall use native species* and local genotypes* for regeneration, unless there is clear and convincing justification for using others. **10.2.1**: Forest renewal is oriented towards the natural forest association*. Only site-appropriate* species are used. **10.2.2:** Natural regeneration has priority insofar as it coincides with 10.2.1. **10.2.5:** Artificial regeneration is carried out under the following conditions when necessary: a) forest transformation; b) advance cultures and underwood crops; c) afforestation and reforestation incorporating natural succession*; d) species enrichment; and e) in the event of a failure of natural regeneration, provided browsing is not the cause of this failure (e.g., due to grass and weed growth) ([57]).

([55]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

([56]) Ibid.

([57]) FSC (2018). *Deutscher FSC-Standard 3-0.* Accessed here.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Artificial regeneration should be based on reproductive materials obtained from natural stands or native trees of local provenance deployed in seed orchards mimicking natural pollination and reproduction. Selection should aim for vigorous and genetically diverse seed crops adapted to the site. Closer-to-nature measures provide different possibilities to minimise the risk associated with climate change. However, the use of non-native species adapted to future climatic conditions may be considered in very specific cases, for example, as pioneer or nurse trees that protect the regeneration of native species. In this context, important adaptability criteria include resistance to drought and heat, and compatibility with the existing ecological system, notably the mycorrhizae, as well as pest resilience and disease resilience. Extensive manipulation of soils (scarification) and hydrology (ditching and the construction of access roads) should be avoided or minimised to exceptional and well-justified cases under due consideration of its biodiversity impacts.	The **Polish FSC standard** establishes natural regeneration as a priority and provides specific provisions for different forest ecosystems through detailed requirements for wet, bog, and riverine forest types.	**6.3:** Ecological functions and values shall be maintained intact, enhanced, or restored, including: a) Forest regeneration and succession; b) Genetic, species, and ecosystem diversity; and c) Natural cycles that affect the productivity of the forest ecosystem ([58]). **6.3.1:** While establishing new stands, spontaneous natural regeneration of trees and shrubs shall be prioritized in accordance with aims of silviculture. New natural regeneration of desired species shall be initialized and protected ([59]).
	The **Slovenian FSC standard** aligns with this CNF tool by requiring that species selected for **regeneration be ecologically well-adapted and or native/local**, unless the use of non-native species is justified. This approach promotes ecological suitability and local adaptation in regeneration processes, although it could be strengthened with more specific criteria and considerations for the use of non-native species.	**10.2.1:** Species chosen for regeneration are ecologically well adapted to the site, are native species and are of local provenance, unless clear and convincing justification is provided for using non-local genotypes or non-native species ([60]). **10.1.2:** Regeneration activities are implemented in a manner that: 1) For harvest of existing plantations, regenerate to the vegetation cover that existed prior to the harvest or to more natural conditions using ecologically well-adapted species; 2) For harvest of natural forests, regenerate to pre-harvest or to more natural conditions; or 3) For harvest of degraded natural forests, regenerate to more natural conditions ([61]).
	The **French PEFC standard** provides a contrasting example by stating that natural tree regeneration does not have priority over artificial tree regeneration. This approach **differs significantly from the CNF guidelines**, which indicate a preference for natural regeneration processes in forest management where possible and advisable.	**2.4:** Ensure the regular renewal of their forest, by means of natural regeneration and/or planting programmes and/or artificial sowing in order to ensure the quantity and quality of forest resources ([62]).

([58]) FSC (2013). *FSC National Standard of Forest Management in Poland*. Accessed here.

([59]) Ibid.

([60]) FSC (2023). *The FSC Interim Forest Stewardship Standard for Slovenia*. Accessed here.

([61]) Ibid.

([62]) PEFC (2016). *Sustainable Forest Management Rules – Requirements for Metropolitan France*. Accessed here.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
The preparation of seeding sites should be limited to the planting hole. The spacing of planting should help to increase species diversity by the self-sowing of valuable, auxiliary tree and shrub species as well as herbaceous vegetation.	Ekoskog explicitly recommends natural regeneration after harvesting.	**Criterion 3.1**: "After felling, reforestation takes place through natural regeneration. Replanting may only be used if tree species that are natural to the site are not present near the area to be regenerated."

Key findings

- Natural regeneration is addressed in both FSC and PEFC standards across most of the countries assessed, but often without clear prioritisation over artificial methods.
- The national standards exhibit a general lack of specific benchmarks or thresholds for natural regeneration.
- Climate change adaptation through species selection is inconsistently addressed across the national standards.
- The use of native species is generally encouraged, but criteria for non-native species vary widely.
- Ekoskog promotes natural tree regeneration as the primary method for reforestation after felling, allowing exceptions only where suitable natural tree species are absent in the immediate area. It does not mandate specific proportions of natural regeneration, areas of planting, or the types and numbers of species used for planting. The standard prohibits ditching and maintenance of existing ditches, except where necessary to prevent damage to neighbouring properties, roads, or infrastructure. Non-native tree species are strictly forbidden, and forestry is excluded in biotopes of high natural value or areas with threatened species, prioritising ecological integrity and conservation.

The comparative assessment reveals a notable gap between the CNF guidelines' emphasis on natural tree regeneration and the requirements set forth in most of the assessed national PEFC standards, as well as the national FSC standards. While natural regeneration is mentioned in nearly all standards examined, there is a considerable absence of concrete measures to prioritise and implement this approach effectively as per the Guidelines. For example, Germany stands out as the most aligned with the CNF guidelines, with both its national FSC and PEFC standards providing detailed requirements for natural tree regeneration and clear conditions that permit the use of artificial methods. In contrast, countries like Sweden and Italy demonstrate more limited alignment in this regard, with standards focusing more on the productive aspects of tree regeneration in economic terms, lacking specific guidelines for natural regenerative processes. The national PEFC standard for Italy, for example, ties forest growth operations to the productivity of the forest, while the national PEFC standard for Sweden strongly links tree regeneration to the economic viability of timber production.

Table 9: Assessment of national standards' contribution to *promoting natural tree regeneration*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	Yes	Partial	N/A	Partial	Partial	No	Partial	Partial
PEFC	Yes	Partial	No	Partial	Partial	No	Partial	Partial
Ekoskog	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A

Most countries assessed, including France, Poland, Romania, Slovakia, and Slovenia, demonstrate partial support of natural tree regeneration. Their standards recognise the value of natural regeneration but often lack detailed criteria, quantitative targets, or explicit prioritisation over artificial methods, a prevailing trend among the CNF objectives and intervention tools assessed so far. This gap between acknowledging the principle and providing operational guidance is a common theme across many national standards, reflecting a significant area for improvement to align with CNF guidelines.

Strengths and suitability of all standards

The national FSC standards generally demonstrate partial alignment with the CNF guidelines on natural tree regeneration. One key strength found across several national FSC standards is the explicit preference for natural regeneration, notably in Germany, Poland, and Slovenia. Moreover, these standards often require the use of native or well-adapted species and consider site-specific conditions in regeneration planning, aligning with the approach that is presented in the CNF guidelines. For instance, the Polish FSC standard outlines specific treatments for different regeneration treatments for different forest types (such as wet, bog, and riverine forest types (Indicator 6.3.2)). Additionally, some FSC standards, such as those in both France and Poland, include provisions for enhancing biodiversity through regenerative practices. For example, the French FSC standard explicitly states a preference for natural regeneration in semi-natural forests (indicator 6.6.1) and prescribes that natural regeneration or post-harvest planting be carried out to protect the environmental values of the forest (10.1.1). Similarly, the national Polish standard priorities the maintenance, enhancement, or restoration of ecological functions and values of the forest, which includes tree regeneration, diversity, and natural cycles.

The national PEFC standards assessed also show some strengths and suitability for a closer-to-nature approach to promoting natural regeneration. The German PEFC standard in particular stands out for its strong emphasis on natural regeneration and detailed guidance on implementation. In addition, the German and Slovenian PEFC standards explicitly recognise natural regeneration as a preferred method, emphasising the importance of maintaining forest health and vitality through regenerative practices.

Ekoskog has a specific criterion for forest regeneration, which supports practices prioritising natural processes and ecological integrity. The standard requires natural regeneration to be the primary method after felling and details measures that limit as much as possible negative impacts on the forest's ecological integrity. Ekoskog provides more concrete guidance than PEFC and FSC on the concrete measures to be implemented. The standard also includes requirements for minimising soil preparation.

Weaknesses and gaps of all standards

A notable weakness across most of the FSC national standards assessed is the lack of guidance on the conditions and approaches for artificial regeneration when natural regeneration is unsuccessful or unsuitable. This is evident in Poland, Romania, Slovenia and even in Sweden, where artificial regeneration is considered a norm. Furthermore, the absence of quantitative targets for determining whether and to what extent natural regeneration is achieved, particularly absent in French and Romanian standards, makes it difficult to effectively measure and ensure that the tools presented in the CNF guidelines are supported. Most standards also provide inadequate guidance on how to deal with the myriad of factors or conditions that can prevent natural regeneration or make it the suboptimal course of action, such as pressure from ungulates or competing vegetation.

Another common gap identified is the limited incorporation of climate change adaptation strategies into considerations of species selection, with only Germany addressing this comprehensively. Moreover, the Guidelines' outlined approach on the use of non-native species is inconsistently realised across the national standards assessed, often lacking the careful consideration and specific conditions contained in the Guidelines. For instance, the Slovakian and Slovenian standards require that a justification is provided where non-native species are used but do not provide any specific use cases or parameters for this justification. In addition, some FSC national standards lack detailed guidelines on soil manipulation and site preparation (Romania, Slovakia, Slovenia)

The national PEFC standards also show some gaps in alignment with CNF guidelines on natural regeneration. A major weakness identified by the analysis is the absence of a clear prioritisation of natural regeneration over artificial methods in most national standards. No PEFC national standard provided sufficient detail on the implementation of natural regeneration processes, focusing more on the production aspects of forest management in economic terms. As a result, this production-oriented approach often overshadows the biodiversity considerations that are emphasised by the CNF guidelines. In France, Italy and Sweden, for instance, forest growth operations are strongly tied to maintaining forests' production capacity. Another common weakness is the limited guidance on climate change adaptation in regeneration practices, with only Germany's PEFC standard addressing this issue directly. Many PEFC standards assessed, particularly in French, Romanian and Slovenian cases, also lack specific criteria for soil protection and site preparation in regeneration processes which, are important aspects of the approach presented in the CNF guidelines. Like the FSC standards assessed, the lack of quantitative targets or benchmarks for natural regeneration is a consistent gap identified in all the PEFC national standards as well, making it difficult to assess and ensure compliance with CNF principles.

Finally, the Ekoskog standard lacks guidance on the conditions and approaches for artificial regeneration when natural regeneration is unsuccessful or inappropriate. The standard also fails to address climate change adaptation when considering species selection.

3.1.4. Ensuring respectful harvest interventions

Description of the CNF tool

Next, **ensuring respectful harvest interventions** is the second intervention tool in the CNF guidelines' toolbox, with the aim to preserve the multiple functions of forests while promoting biodiversity. Central to this tool as presented in the Guidelines is the use of harvesting methods

that mimic natural disturbance patterns, moving away from large-scale clear-cutting in favour of approaches that are more precise and selective. Moreover, this tool stipulates that harvesting operations should not be conducted during ecologically sensitive period, nor in primary or old-growth forests. Concretely, the Guidelines recommend forestry techniques such as single-tree selection, group selection, or small gap cuts that are limited to areas between 0.2 and 0.5 hectares, methods which intend to maintain the forest's internal microclimate and safeguard its ecological integrity ([63]).

Table 10: Specific examples from the national standards on *ensuring respectful harvest interventions*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Ensuring respectful harvest conditions: Harvesting operations take into account the need to preserve all the functions of the forest. They should facilitate the rebuilding of the corresponding site-specific: (i) tree numbers; (ii) canopy; or (iii) share of canopy. Harvesting is done using single-tree selection (thinning), group selection, or gap cuts (max. 0.2-0.5 ha)) mimicking natural disturbance patterns. Small clear-cuts are only used in exceptional circumstances (e.g. to temporarily mimic natural disturbances). During harvest, buffer zones along streams are set to reduce the impacts of harvesting on	The **German FSC standard** demonstrates partial alignment with CNF guidelines by requiring forest exploitation based on single to group-wise harvesting of stems. However, it falls short of full compliance by **allowing clear-felling** up to 1 ha in certain circumstances, which exceeds the CNF recommendation for small-scale interventions.	**10.1.1:** Forest exploitation is based on the single to groupwise* harvesting of stems; the Organization refrains from the implementation of schematic regeneration approaches*. The following exceptions, the CB will be informed about, are possible: Up to 1 ha: - The conversion of unstable*, unnatural stands. - Natural regeneration in forest development types* dominated by oak or pine. The stocking density of the main stand does not fall below 0.3 in the process. - Where in the case of very small private forest ownership (maximum 5 ha) timber quantities that can only be achieved through clear-felling are required for extraordinary reasons given that the management structure permits no other exploitation approaches. Neighbouring clear-fell areas are also incorporated in the calculation of these are forest areas in the sense of the applicable state forest law. - Species conservation and biotope tending measures based on a reasoned nature conservation concept. - Creation and tending of recreation facilities and functions ([64]).

([63]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

([64]) FSC (2018). *Deutscher FSC-Standard 3-0.* Accessed here.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
watercourses in the forest. Habitat trees are maintained to ensure structural complexity. Harvesting does not take place during ecologically sensitive periods such as nesting or breeding periods to minimise disturbance to birds in line with Article 5 of the EU Birds Directive. Harvesting is not planned or conducted in primary and old-growth forests. The Commission guidelines for defining, mapping, monitoring and strictly protecting EU primary and old-growth forests are applied.	The **Slovenian FSC standard** exemplifies strong alignment with CNF principles by requiring a comprehensive assessment of multiple stand indicators to determine appropriate harvest levels. This approach demonstrates a **more holistic consideration of forest ecosystem dynamics** in harvest planning.	**5.2.1:** Timber harvesting levels are based on an analysis of current Best Available Information. The acceptable harvesting levels are ensured through the assessment of stand indicators by forest-type silviculture classes. The following are checked: tree composition, stand structure, tree damage, rejuvenation, ratio of development phases, stand design, rate of nursing, wood stock, increment, utilization of productive capacity of forest sites and quality of forest trees ([65]). **5.2.2:** Based on the timber harvesting level analysis, a maximum allowable annual cut for timber is determined that does not exceed the harvest level that can be permanently sustained including by ensuring that harvest rates do not exceed growth ([66]). **5.2.3:** Actual annual harvest levels for timber are recorded. The Organization may cut more than one year's volume within one year, provided that all other requirements of this standard are met and that the harvest over ten years (the validity of the Forest Management Plan) does not exceed the allowable cut determined in 5.2.2 for the same ten-year period ([67]).
	The **French PEFC standard** diverges considerably from the CNF guidelines by **prioritising the maintenance of production capacity over biodiversity enhancement**. This approach contrasts with the CNF emphasis on balancing production with robust ecosystem protection, illustrating a fundamental misalignment with the CNF guidelines' core principles.	**2.6:** Ensure that the quantity and quality of forest resources is maintained in the medium and long term by using techniques that minimise direct and indirect damage to forestry, pedological, biological or hydrological resources (excluding damage caused by game). N.B.: refer to item 4.7 for game damage. **-** Conduct regeneration, maintenance and harvesting operations in a manner that does not reduce the forest's production capacity ([68]).

([65]) FSC (2023). *The FSC Interim Forest Stewardship Standard for Slovenia*. Accessed here.

([66]) Ibid.

([67]) Ibid.

([68]) PEFC (2016). *Sustainable Forest Management Rules – Requirements for Metropolitan France*. Accessed here.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
	Ekoskog excludes areas of high natural value from forestry. Timber removal and felling are regulated, with harvesting limited to individual trunks or small groups, and a maximum patch size of 0.2 hectares, except for the restoration of young plantation forests.	**4.1. "**Saleable timber is only harvested as individual stems or small groups of trees. The area of gaps in the canopy cover due to felling shall be limited wherever possible and must not exceed 0.2 hectare. Larger gaps may however be acceptable when restoring young plantations." **Criterion 5.1**: "Areas with high conservation values and/or which, following assessment of the structure of the area, its species content, history and physical environment, are known or may be expected to contain threatened species (categories VU, EN and CR in the Red List) are left to develop freely or are managed in such a way that their conservation values are preserved or improved."

Key findings

- FSC national standards unevenly support this CNF tool among the countries assessed, with partial alignment in some countries (e.g., Germany, France, Sweden) and limited to no alignment in others.
- The national standards assessed for both certification schemes lack consistent, explicit requirements for mimicking natural disturbance patterns through selective harvesting methods.
- The protection of watercourses is addressed in most FSC national standards (e.g., Germany, Poland, Sweden, and Slovenia).
- The retention of habitat trees is only included in FSC national standards for a few countries (e.g., Germany and Sweden).
- PEFC national standards across all countries assessed generally lack specific criteria for harvesting methods aligned with CNF principles, often allowing clearcutting without clear restrictions.
- Few FSC national standards (i.e., France and Sweden) explicitly restrict harvesting during ecologically sensitive periods, such as breeding seasons.
- The protection of primary and old-growth forests is inconsistently addressed by both FSC and PEFC schemes, with several national standards lacking specific provisions.
- According to Ekoskog requirements, areas of high natural value must be left for free development or managed to preserve their ecological integrity. Timber removal and felling are regulated, with harvesting limited to individual trunks or small groups, and a maximum patch size of 0.2 hectares, except for restoring young plantation forests. Clear-cutting of young forests is prohibited, except when necessary for accessibility. Additionally, at least 20 habitat trees per hectare must be preserved, ensuring biodiversity and ecosystem stability.

The comparative assessment reveals a generally mixed picture of alignment with the CNF guidelines in terms of ensuring respectful harvest conditions across the 8 countries assessed. FSC standards are generally more supportive of this CNF tool, with 4 out of 7 of the national standards assessed (Germany, France, Sweden, and Slovenia) demonstrating partial or more full support of the tool. Even among these national standards, however, there remain considerable gaps in fully implementing the aims of the CNF guidelines. For instance, while

Germany's FSC standards promotes single to group-wise harvesting, it does not have a clear focus on mimicking natural disturbance patterns. Moreover, Ekoskog and Slovenia's FSC standards stand out in fully supporting this CNF tool, incorporating detail criteria for assessing stand indicators to determine appropriate harvest levels.

Table 11: Assessment of national standards' contribution to *ensuring respectful harvest interventions*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	Partial	Partial	N/A	No	No	Partial	No	Yes
PEFC	Partial	No	Partial	No	Partial	No	No	Partial
Ekoskog	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A

The PEFC standards demonstrate a similar picture in terms of alignment, with 4 out of 8 of the national standards assessed showing poor alignment. The PEFC standard achieved partial support of this CNF tool in Germany, Italy, Romania and Slovenia. Moreover, based on the results of the compliance assessment, the PEFC standards generally lack specific criteria for harvesting methods and often focus more on maintaining the productive capacity of the forest in economic terms rather than on enhancing biodiversity as emphasised in the CNF guidelines. This is exemplified by the French PEFC standard, which has a clear and strong focus on maintaining productive capacity.

Strengths and suitability of all standards

The FSC standards assessed demonstrate some strengths in addressing sustainable harvest levels and promoting some form of selective harvesting. Many FSC standards (Germany, Poland, Sweden, and Slovenia) include requirements to protect watercourses, although specific buffer zone widths are often not required. Furthermore, the retention of habitat trees is a common feature, as mentioned in Germany's and Sweden's standards, providing a basis for maintaining biodiversity structures. Some standards, such as Sweden's, exempt certain habitats, including 'virgin-type forests' (which is equivalent to certain types of old-growth forests) from harvesting and management activities other than those that promote natural biodiversity, partly in line with CNF recommendations for the protection of old-growth forests.

Overall, the national PEFC standards assessed show similar limited alignment with the CNF guidelines in terms of ensuring respectful harvesting. Despite some major gaps when compared to CNF guidelines, there are some positive elements present across national standards that indicate support for this CNF tool. The German and Slovenian PEFC standards, for example, require the consideration of multiple forest functions and protective functions of forests. Moreover, the Italian PEFC standard requires sustainable harvesting rates and includes provisions for hydro-geological restrictions. Almost all national standards mandate some level of watercourse protection measures during harvesting operations. Similarly, in Slovenia the PEFC standard requires forest management plans promote both wood and non-wood forest products and services. Notably, it explicitly requires that extraction of non-wood products does not exceed the forests' capacity.

Ekoskog's criterion 4 on harvesting demonstrates strength in ensuring sustainable timber extraction practices. The criterion requires the removal of individual trees to prevent important gaps in the canopy cover and requires that felling residues are to be left in place. In addition, forestry activities must be structured around ecologically sensitive periods in order to minimise

disturbance. Heritage trees must be maintained at a minimum threshold of 20 trees per hectare, while clear cutting is prohibited.

Weaknesses and gaps of all standards

Despite demonstrating some alignment, the national FSC standards assessed exhibit considerable gaps in fully supporting this tool of the Guidelines. Many national standards lack explicit requirements for mimicking natural disturbance patterns through selective harvesting methods. While some national standards do in fact address buffer zones along watercourses, specific width requirements for such buffer zones are frequently absent. Furthermore, measurable quantitative targets for habitat tree retention are inconsistent or missing entirely in several standards. Few of the national FSC standards assessed explicitly restrict harvesting during ecologically sensitive periods, such as breeding seasons. Critically, the protection of primary and old-growth forests is not consistently addressed across national standards, with several countries (e.g., Germany, France, Poland, and Romania) lacking specific safeguards in this regard.

The national PEFC standards assessed also demonstrate substantial gaps in supporting this CNF tool. In at least half the countries assessed, the PEFC national standards lacked specific criteria for harvest methods aligned with the CNF guidelines by, for example, allowing clear-cutting without clearly stipulated restrictions (e.g. Slovakia, Sweden, Romania and Poland). Another common gap is the lack of specific provisions for identifying and maintaining habitat trees (Poland, France, Slovenia and, to a lesser extent, Slovakia). In addition, provisions to limit harvesting during ecologically sensitive periods can only be identified within German and Romanian standards. Like the FSC standards assessed, the protection of primary and old-growth forests is rarely mentioned in the PEFC standards (particularly in Slovenia, Poland, Italy, France). In general, the approach of many PEFC standards (e.g. France, Sweden, and Italy), is more focused on maintaining production capacity than on strengthening biodiversity and ecosystem functions, as is widely emphasised in the CNF guidelines.

Finally, Ekoskog appears to apply the most stringent standard in terms of harvesting conditions. However, the standard makes no mention of primary and old-growth forests and refers only to high nature value areas.

3.1.5. Minimising other management interventions

Description of the CNF tool

The third intervention tool of the CNF guidelines' toolbox is on **minimising other management interventions** beyond natural forest beyond natural forest dynamics in order to promote ecological resilience and biodiversity. This approach recognises that although forests are complex ecosystems capable of self-regulation, some management intervention may be necessary in certain circumstances. However, the Guidelines stress that such interventions should be carefully considered and limited in scope and frequency. Fertilisation and liming, for example, are practices that should be strictly controlled. This CNF tool recommends that they should only be used in exceptional circumstances and with rigorous scientific justification. Similarly, the use of biological pesticides is restricted to exceptional circumstances, requiring

a thorough assessment before it is applied. This cautious approach extends to other forms of intervention as well ([69]).

Table 12: Specific examples from the national standards on *minimising other management interventions*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Minimising other management interventions: Fertilisation and liming of the forest are strictly limited and well justified when practised. Biological pesticides are used only in exceptional conditions after rigorous assessment to treat outbreaks of pests or pathogens.	The **German FSC** standard exemplifies strong alignment with the CNF guidelines, requiring that organisations refrain from the use of fertilisation for the purpose of increasing yields and allowing pesticide use **only in exceptional, officially prescribed circumstances**.	**10.6.1:** The Organization* refrains from fertilisation for the purpose of increasing yields. Means of verification: documents (soil assessment, liming and application concept, documentation of the implementation) ([70]).
	The **Romanian PEFC** standard includes specific indicators for the **area of forest fertilised** and the **volume of fertiliser used**, providing concrete metrics for assessing compliance with minimising other management interventions.	**2.3:** Biological and chemical pest control: Actions to prevent and combat forest-damaging phenomena that can not be prevented or controlled only by cultural means are included in an integrated system of forest protection measures ([71]). **2.3.d:** Evolution of fertilizer treatment, applied in the certification area; Area treated in the last year; volume of fertilisers used in the last year; changes over the last 5 years average ([72]).

([69]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

([70]) FSC (2018). *Deutscher FSC-Standard 3-0.* Accessed here.

([71]) PEFC (2017). *Criteria and Indicators for assessing sustainable forest management in Romania.* Accessed here.

([72]) Ibid.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
	The **Slovenian PEFC** standard aligns closely with the CNF tool by prohibiting the use of pesticides and chemicals except when approved by public forestry services for controlling harmful insects or ensuring game protection, demonstrating a **highly restrictive approach to chemical interventions.**	**2.3: Use of chemicals in forest** - Integrated forest protection shall be implemented. The use of pesticides and other chemical substances in the forest shall be prohibited, unless by virtue of a decision by the public forestry services aimed and controlling the gradation of harmful insects and for ensuring protection against game wildlife. The use of chemical substances must be targeted and limited to the minimum, taking into account the alternative silviculture and other biological measures. If fertilizers are used, this must be supervised and the fertilization executed in an ecologically acceptable manner ([73]). Prohibited pesticides are: i) the World Health Organisation Type 1A and 1B pesticides and other very poisonous pesticides, ii) chlorinated hydrocarbons pesticides whose derivatives remain biologically active and are accumulated in the food chain, and iii) any pesticides banned by international agreements. Producer's instructions are observed for the use of pesticides. Proper equipment and recognized training must be completed if pesticides are used. **2.3.b:** Quantity of used chemical substances in the forest ([74]).
	The **Swedish PEFC** standard presents a challenge to CNF alignment by stating that 'fertilisation may also be an appropriate measure to maintain productive capacity of land'.	**3.6.2:** In connection to extraction of forest fuel, the land owner shall obtain information, for example via research findings or the Forest Agency, on the need and benefits of ash restoration to the site or other part of the forest holding. The need and benefits may refer to the land's productive capacity or to water quality. If needed, and where practical and economic prerequisites for ash restoration prevail, ash shall be restored to suitable land within the forest holding. Fertilization may also be an appropriate measure to maintain productive capacity of the land ([75]).
	Ekoskog strictly prohibits the use of pesticides and fertilisers. Forestry interventions that could damage threatened or sensitive species are to be avoided as well.	**3.4: "**Chemical or biological pesticides are not used." **3.5.** "Forest land is not fertilised with commercial fertiliser, slurry, manure or other natural or synthetic fertilisers." **9.1. "**Forestry operations that may harm or eliminate the known presence of threatened or sensitive species are avoided, or are adapted and limited to avoid damage."

([73]) PEFC (2021). *Criteria and Indicators for Sustainable Forest Management at the Regional Level.* Accessed here.

([74]) Ibid.

([75]) PEFC (2022). *PEFC Sweden Forest Standard.* Accessed here.

Key findings

- FSC national standards in several countries (Germany, Poland, Romania, Slovenia, Slovakia) strongly align with CNF guidelines on limiting fertiliser use to exceptional circumstances and requiring scientific justification.
- PEFC national standards generally show less stringent restrictions on fertiliser use compared to FSC, with fewer countries (Poland, Slovenia, and Romania) closely aligning with the CNF tool.
- Both FSC and PEFC national standards across most countries assessed lack specific guidelines on liming practices as outlined in the CNF guidelines.
- FSC standards in multiple countries (e.g., Germany, Poland, Slovenia) emphasise integrated pest management and strict limitations on pesticide use.
- PEFC standards in several countries (France, Italy, Sweden) lack specificity in restricting pesticide use to exceptional circumstances as per the CNF guidelines.
- Documentation and monitoring requirements for interventions are common across most national standards for both FSC and PEFC.
- Ekoskog prohibits the use of chemical and biological pesticides. The standard states that no fertiliser may be used on forest land that the construction of forest roads and off-road driving must be safeguarded.
- Ekoskog further mentions that activities that may damage or destroy known occurrences of threatened or sensitive species should not be carried out.

The comparative assessment of FSC and PEFC national standards reflects a mix of approaches to minimising other management interventions, with FSC standards generally demonstrating stronger support of this CNF tool. The majority of FSC standards assessed indicate strong support, while PEFC standards show more mixed results, with only 3 out of 8 countries supporting the CNF tool. The FSC standards of Germany, Poland, Romania, Slovenia and Slovakia, as well as Ekoskog stand out for their strict restrictions on the use of fertilisers and pesticides, often requiring scientific justification and documentation. More concretely, Germany's FSC standard requires the avoidance of fertiliser to increase yields and allows the use of pesticides only in exceptional, officially prescribed circumstances. Similarly, the Slovenian FSC standard specifies that fertiliser use should be limited to nurseries and point applications in artificial reforestation.

Table 13: Assessment of national standards' contribution to *minimising other management interventions*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	Yes	Partial	N/A	Yes	Yes	No	Yes	Yes
PEFC	Partial	No	No	Yes	Yes	No	Partial	Yes
Ekoskog	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A

In the case of PEFC, while some of the national standards assessed, such as Poland, Slovenia and Romania, exhibit strong support of the CNF guidelines in this respect, a number of other standards, such as France, Italy and Sweden, lack the specificity and strict limitations that the Guidelines require. The Slovenian PEFC standard, for example, prohibits the use of chemicals except in specific circumstances approved by the forest services. In contrast, the Swedish PEFC standard is less restrictive on the use of fertilisers in its forests, stating that 'fertilisation may also be an appropriate measure to maintain the productive capacity of the land' (criterion 3.6.2).

Strengths and suitability of all standards

The FSC national standards for most countries assessed demonstrate strong support of the CNF tool. One key strength identified is the strict limitation of fertiliser use, with many of the FSC national standards assessed restricting fertiliser use to exceptional circumstances or specific applications such as nurseries, as evidenced by the cases of Germany, Poland, Slovakia and Slovenia. Another key strength observed in most national standards (Germany, France, Poland, Slovakia and Slovenia) is the emphasis on integrated pest management and the requirement for rigorous justification of pesticide use. For example, the German FSC standard allows pesticide use only in exceptional, officially prescribed circumstances. Furthermore, most FSC standards also include detailed documentation and monitoring requirements for all interventions to better ensure transparency and accountability. In addition, German and Romanian national standards explicitly set out criteria to ensure that any intervention provides ecological benefits at least equivalent to natural silvicultural processes.

Although generally less aligned with CNF guidelines than the national FSC standards assessed, the PEFC standards in several of the countries assessed demonstrate some strengths in support of this tool. A few national standards, particularly in the case of Slovenia and Romania, have established strong restrictions on the use of chemicals and fertilisers. In addition, a common strength of many of the national PEFC standards assessed is the requirement for ecological justification and expert advice before implementing interventions. This is exemplified by the German PEFC standard, which requires liming for soil protection only to be carried out based on the results of soil or forest nutrition expertise or when sound site surveys have been conducted and documented (criteria 2.3). Finally, many of the PEFC national standards emphasise forest health monitoring and the implementation of protective measures.

Ekoskog prohibits the use of fertilisers and pesticides, strongly aligning with the CNF guidelines. Furthermore, Ekoskog dedicates two criteria for minimising the impact of forest roads and off-road driving in particular, and specifies that any damage affecting land hydrology must be repaired. Diriving in areas designated for conservation is also prohibited.

Weaknesses and gaps of all standards

Despite an overall high level of alignment, the FSC standards in the countries assessed show some consistent gaps in fully embracing the CNF tool's approach to minimising other management interventions. One notable gap observed is the lack of explicit restrictions on liming practices in most of the national standards assessed. In addition, some of the national standards assessed, such as those in France and Sweden, allow more flexibility in pesticide use that goes beyond the CNF guidelines' recommendation of 'certain exceptional conditions that would need rigorous assessment before use' ([76]).

The PEFC standards generally show more apparent gaps in aligning with this CNF tool. One major weakness identified is the less stringent restrictions on the use of fertilisers and pesticides in many of the national standards assessed, as is particularly evident in the case of France, Italy and Sweden. Many of the national PEFC standards assessed also lack clear criteria for the ecological justification of management interventions (e.g., Italy and Sweden), potentially allowing more frequent or less environmentally sound management practices. Furthermore, like the FSC standards, PEFC standards in most of the countries assessed pay limited attention to liming practices as outlined in the CNF guidelines, representing a consistent gap in addressing all aspects of forest interventions.

([76]) Ibid. p.24

In contrast, Ekoskog does not provide any guidance on liming practices.

3.1.6. Preserving and restoring soil and water ecosystems

Description of the CNF tool

Preserving and restoring soil and water ecosystems represents the fourth of eight intervention tools in the CNF guidelines' toolbox, which outlines an approach to forest management that recognises the intricate relationship between forest health and the integrity of its underlying soil and water systems. Under the Guidelines, this tool emphasises the need to not only maintain but strengthen the natural functions of forest soils. Specifically, the CNF guidelines stress the importance of minimising soil disturbance through the careful planning and implementation of forestry operations, including but not limited to avoiding or severely limiting activities such as ploughing, tillage, and terracing, which can disrupt the structure of the soil ([77]).

At the same time, this CNF tool also reinforces the critical role of water in forest ecosystems, outlining the protection of natural water courses, wetlands, and riparian zones, as well as recommending the maintenance of buffer zones along water bodies and adapting management practices to preserve water quality and natural hydrological cycles. In addition, the CNF guidelines address the use of machinery in forest operations, recommending light or low-bearing equipment to reduce soil compaction and erosion risks ([78]).

([77]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

([78]) Ibid.

Table 14: Specific examples from the national standards on *preserving and restoring soil and water ecosystems*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Preserving and restoring soil and water ecosystem forests: Forest management should minimise the negative impacts on the forest soil. Ploughing and tillage operations, as well drainage or terracing should be avoided. The construction of access roads and skid trails should be done with minimum impact on the soil and water regime. Light or low-bearing machines must be preferred. Heavy machinery should only be used on surfaces that can bear them (e.g. roads). Natural landforms, geomorphic processes and aquatic ecosystems such as wetlands, rivers and lakes are protected. Riparian forests are preserved and are not subject to 'clean-ups' i.e. clear-cutting.	The **German FSC** standard offers a good example by setting a quantitative target to drive on no more than **10% of the managed forest land** as extraction tracks, providing a clear measure to limit soil compaction and protect forest ecosystems.	**10.10:** The Organization* shall manage infrastructural development, transport activities and silviculture* so that water resources and soils are protected, and disturbance of and damage to rare* and threatened species*, habitats*, ecosystems* and landscape values* are prevented, mitigated and/or repaired ([79]). **10.10.1:** The Organization* adapts the infrastructure* to the needs of long-term* forest management in the sense of 10.0 and arranges this infrastructure* in a manner appropriate to the terrain and taking into consideration the local conditions and ecological values so that as little forest soil* is impacted upon as possible ([80]). **10.10.6:** The Organization* strives to drive on no more than 10% of the managed forest land* as extraction tracks ([81]).
	The **French FSC** standard falls short of CNF guidelines by only regulating and attempting to **minimise impacts of practices such as clear-cutting near water banks**, rather than excluding certain areas from this practice altogether.	**6.7.2:** A minimum 10-meter-wide buffer zone is maintained along the banks of natural water bodies and watercourses. No clear-cutting* is performed there ([82]).
	The **Italian PEFC** standard provides a positive example by **requiring a hydro-geological restriction map**, which can help identify and protect sensitive soil and water ecosystems. However, it lacks specific guidance on avoiding ploughing, tillage, or drainage operations.	**Criterion 5:** Maintenance or appropriate enhancement of protective functions in forest management (notably soil and water). **5.1.a:** Presence of hydro-geological.-restriction map or another representation of the protective function of the wooded areas. **5.1.b:** Amount of forest area managed for protective purposes and its variation over time ([83]).

([79]) FSC (2018). *Deutscher FSC-Standard 3-0.* Accessed here.

([80]) Ibid.

([81]) Ibid.

([82]) FSC (2016). *The FSC National Forest Stewardship Standard for Metropolitan France.* Accessed here.

([83]) PEFC (2015). *Annex 2: ITA 1001-1 CRITERIA AND INDICATORS FOR SUSTAINABLE FOREST MANAGEMENT CERTIFICATION ON A INDIVIDUAL AND GROUP SCALE.* Accessed here.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
	The **Slovenian PEFC** standard exemplifies good practice by requiring forests with **protective functions** to be mapped in management plans, with management targeted to maintain and enhance these functions, especially for soil erosion, floods, and landslides.	**5.1:** Management and enhancement of soil protection function of forest, - Forests having protective function must be mapped in forest management plans. Forest management must be targeted to maintain and enhance protective function, notably in terms of soil erosion and different effects of water, such as floods and landslides. Support ecosystem services must be promoted and maintained ([84]). **5.1.b:** Area and share of forests primarily managed to maintain and enhance soil protection function, including changes in the share ([85]).
	Ekoskog includes strict criteria for the protection of soils and water. The standard explicitly protects wetlands and supports the restoration of previously drained peatlands.	**3.3. "**Soil preparation is only carried out in exceptional cases". **8.1.** "Protection zones around lakes, watercourses and wetlands shall be delimited according to site conditions and reported in the forest plan" **10.1.** "Forest roads are only constructed if a costing exercise shows that the route is profitable for forestry on the properties concerned." **11.1**. "Off-road driving is restricted as far as possible to periods when the ground is frozen or when the bearing capacity is otherwise good" **12.1. "**On nutrient-rich peatland in southern Sweden, existing ditches are filled or blocked. The forest is managed with the goal of restoring it to a natural state for the rewetted soil, in line with the principles and requirements of this standard"

([84]) PEFC (2021). *Criteria and Indicators for Sustainable Forest Management at the Regional Level.* Accessed here.

([85]) Ibid.

Key findings

- Both the FSC and PEFC national standards assessed generally recognise the importance of soil and water conservation but differ in the specificity and scope of their requirements.
- The FSC standards assessed vary widely in their approach, with only few providing specific guidance in the form of quantitative targets or thresholds, as in the case of Germany (no more than 13.5% of managed forest land is used as extraction tracks, indicator 10.10.7), France (mandatory 10-metre buffer zones along watercourses, indicator 6.7.2), and Romania (mandatory 5-metre buffer zones on both sides, indicator 6.7.1, Annex K).
- PEFC standards often focus on broader principles of soil and water conservation (e.g. Slovenia), requiring comprehensive mapping of forests with protective functions.
- Both certification schemes near uniformly fail to address specific CNF recommendations to avoid ploughing, tillage or terracing, except for PEFC Germany, which mentions the avoidance of complete ploughing, while the PEFC standards for Slovakia and Poland address this element indirectly.
- The use of light or low-bearing machinery is rarely explicitly addressed in either FSC or PEFC standards in any of the countries assessed. While the PEFC standard for Slovakia requires 'environmentally friendly technologies appropriate to given production conditions', and the PEFC standard for Poland includes provisions for minimising soil compaction, most standards lack specific guidance on machinery type and weight limits.
- Protection of watercourses and riparian zones is generally addressed in both FSC and PEFC standards, although the extent and specificity of protection measures vary (e.g. the French PEFC standard prohibits the use of fertilisers near watercourses).
- There is a notable lack of guidance in both certification schemes on the preservation of natural landforms and geomorphic processes.
- Ekoskog outlines general principles for protecting soils and water ecosystems. The preparation of soil is only allowed under exceptional circumstances (criterion 3). The standard applies restrictions related to driving practices to minimise impact on soil (criteria 10 and 11). The use of pesticides and fertilisers is prohibited to prevent the contamination of soil and water, while soil preparation is limited and should only occur in exceptional cases to avoid soil disturbance.
- Ekoskog includes specific provisions for the restoration of previously drained peatlands, mandating that on nutrient-rich peatlands in southern Sweden, existing ditches are filled or plugged, with forest management aimed at creating natural forest conditions for the rewetted soil. Other drained peatlands are managed to maintain the groundwater level as high as possible without harming existing forests.

The comparative assessment of FSC and PEFC standards in the eight EU Member States reveals a mixed picture, indicating that while national standards under both FSC and PEFC certification schemes largely recognise the importance of preserving and restoring soil and water ecosystems in forests, their alignment with other concrete aspects of the CNF tool, such as the avoidance of heavy machinery or measures on ploughing and tillage, is often lacking. Overall, Ekoskog and the PEFC standards assessed were found to be consistent in supporting this aspect of the CNF guidelines, either fully or partially, while the support for the FSC standards was more varied among the national standards assessed, with the PEFC national standards either partially (6 out of 8) or fully (2 out of 8) supporting the CNF tool. Three national FSC standards showed partial support, and one showed full support, while three countries indicated no support. Both the FSC and PEFC national standards generally recognise the importance of soil and water conservation, but often lack the specific, protective measures

outlined in the CNF guidelines, whereas Ekoskog includes specific provisions in this regard. The German FSC standard is an example of this, setting quantitative targets for limiting extraction tracks to 10% of managed forest land. Even so, this use of quantitative thresholds is not consistent across countries or schemes.

Table 15: Assessment of national standards' contribution to *preserving and restoring soil and water ecosystems*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	Yes	No	N/A	No	Partial	Partial	No	Partial
PEFC	Yes	Partial	Partial	Partial	Partial	Partial	Partial	Yes
Ekoskog	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A

While certain aspects of soil and water protection are generally recognised and consistently addressed by both FSC and PEFC standards, particularly in relation to the protection of watercourses and riparian zones, other key elements of this CNF tool are consistently underrepresented in most of the national standards examined. This includes the absence of an explicit preference or recommendation for the use of light or low-bearing machinery, or the avoidance of specific soil-disturbing practices such as ploughing and tillage, except for the German PEFC standard, where complete ploughing must be avoided in order to protect the soil (criteria 5.4).

Strengths and suitability of all standards

Certain FSC national standards demonstrate an adequate approach to soil and water protection, including detailed operational guidance aligned with various aspects of the CNF tool presented in the Guidelines. In particular, the national standards of Germany, France, Romania, and Sweden include quantitative thresholds aimed at minimising the impacts of forestry operations. For instance, the German FSC standard limits extraction tracks to 10% of the managed forest area and specific technical measures for soil protection during transport activities (indicator 10.10.6), while the Romanian FSC standard establishes water protection through multiple interrelated indicators (indicators 6.7.1-9, Annex K), including strict limitations on the use of chemicals near water bodies (10 metres from water courses). In addition, the French standard protects water resources during infrastructure development, with specific requirements for road construction and maintenance, as well as a 10m buffer-zone along watercourses (indicator 6.7.2). Similarly, the Swedish standard requires that buffer-zones be maintained or restored to protect water environments (indicators 6.7.1-3).

The assessed PEFC standards consistently recognise and include measures to protect soil and water in forest management. For example, the Slovenian PEFC standard requires that special attention is given to forests with water protection functions to avoid harmful impacts on water resources (criteria 5.2), and that the construction of forest roads minimises erosion risks on non-protected soils (criteria 3.4). In addition, in Italy, the standard provides explicit guidance on minimising the impact of access roads on soil and water regimes (indicator 3.5.b), while also prohibiting soil cultivation throughout the forest, therefore indirectly addressing the avoidance of ploughing and tillage operations (indicator 5.2.b). The Swedish PEFC standard also includes a wide range of measures to protect soil and water in forestry operations. For example, the standard includes requirements to prevent soil compaction and soil conservation measures (criteria 3.2.1), requirements for methods to prevent damage to soil and water quality (criteria 5.7), and requirements to maintain edge and buffer zones (criteria 5.8).

Ekoskog, contrary to PEFC and FSC is the only standard including specific provisions (with the specific criterion 12) for the restoration of previously drained peatlands, which are key for the preservation of water ecosystems. In addition, ditching on peatlands is prohibited. The standard also includes concrete measures for the protection of soil and water ecosystems, especially regarding the criterion 3 for forest regeneration: soil preparation is to be limited and the use of pesticides and fertilisers is prohibited. Finally, the standard applies restrictions related to driving practices to minimise impacts to the soil (criteria 9 and 10).

Weaknesses and gaps of FSC and PEFC standards

Although the FSC standards in the countries assessed often show a considerable level of operational detail, there are consistent gaps that largely prevent the full support of this CNF tool according to the Guidelines. The main gap identified is the lack of explicit guidance on avoiding practices such as ploughing, tillage and terracing. This omission is common to all of the FSC national standards and indicates a departure from the CNF guidelines' emphasis on minimising soil disturbance. Another common weakness is the inconsistent treatment of the use of machinery. The FSC standards also lack specific requirements for the use of light or low-bearing machinery to minimise soil disturbance, another key recommendation of this CNF tool. While the FSC standards assessed generally protect riparian zones, they often fall short of the recommendations of the CNF guidelines by not explicitly prohibiting clear-cutting in these areas, even if it is often an indirect result of the relevant criteria and indicators. In addition, several FSC standards, particularly those for Poland, Romania, Slovakia and Slovenia have, either no or limited criteria for road construction to prevent damage to the water and soil, which are also important factors under the Guidelines.

In comparison, the PEFC standards in the countries assessed generally provide less specific operational guidance than the FSC standards, often relying on broader principles of soil and water conservation. Like the trend observed in the FSC standards assessed, a common weakness in several of the PEFC standards is the lack of explicit guidance on the use of light or low-bearing machinery to minimise impacts to the soil, although this is indirectly addressed by the PEFC standard for Sweden through criteria 3.2.1, which aims to minimise soil compaction. Again, as with FSC, the PEFC standards assessed do not explicitly prohibit or outline limitations surrounding practices such as ploughing, tillage or terracing in forest areas, except for Germany, which is a significant deviation from the approach recommended in the guidelines. In addition, the treatment of riparian forests and restrictions on activities in these areas are often less comprehensive than recommended in the CNF guidelines, with many standards lacking specific protection against practices such as clear-cutting in these sensitive areas.

3.1.7. Optimising deadwood retention

Description of the CNF tool

Representing the fifth of eight intervention tools in the CNF guidelines, **optimising deadwood retention** plays a key role in maintaining and regenerating forest ecosystems. Deadwood serves multiple important roles in the forest, including that of a natural habitat, nutrient pool, water storage, as well as a precursor of soil organic matter for thousands of species. The CNF guidelines emphasise the importance of maintaining sufficient deadwood in forests at all stages of decomposition, including standing dead and dying trees with cavities for nesting and

roosting. This approach is cognizant of the fact that certain species of fungi, lichen, moss, and insects are entirely dependent on the presence of deadwood ([86]).

The Guidelines themselves recommend that decisions on actual volumes, density, and locations of deadwood should be based on a myriad of factors, including fire management, safety considerations, pest outbreak control, as well as the specific characteristics of the forest stand. Critically, the Guidelines stress that the complete removal deadwood should be considered only as a last resort, as such actions can disrupt the natural processes of the forest, hindering regeneration, and reducing the heterogeneity of the landscape ([87]).

Table 16: Specific examples from the national standards on *optimising deadwood retention*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Optimising deadwood retention: Leaving enough deadwood in the forest in all stages of decomposition (including standing dead and dying trees with actual or potential cavities for nesting and roosting). Actual volumes, density and locations should be decided with consideration given to fire management, safety aspects (recreation), and the control of pest outbreaks guided by biological knowledge, management objectives, and the situation in a particular stand (forest type, basal area of living trees, stand age, natural disturbances and species composition).	The **Polish FSC** standard exemplifies strong alignment with CNF guidelines by calling for **scientific evidence-based decision-making** in deadwood management. This approach reflects the CNF guidelines' emphasis on adaptive management and consideration of various factors in deadwood retention decisions.	**6.3.8:** FMU shall leave dead and decaying wood, diverse in their size, species and forms. The amount of the dead wood is based on scientific evidence, shall refer to local conditions and dominant function of the forest, as well as shall be spatially differentiated ([88]). **6.3.9:** Forest Manager shall refer to the external monitoring results and treat the amount of deadwood provided by National Forest Inventory for particular FMU as reference, until consistent methodology of dead wood measurement and investigation will be developed for monitoring purposes ([89]).
	The **Slovakian PEFC** standard exhibits good examples of a **quantifiable targets**, setting minimum requirements for the amount of deadwood to be left after harvest for biodiversity development (min. 10 m³/ha) and providing guidance on the size that allows important species to survive (diameter over 30 cm, length over 2 m).	**8.4.5.2:** Parts of dead wood in various stages of decomposition and biomass after tending and harvesting operations shall be purposefully left for the development of biodiversity (at least 10 m³/ha) ([90]). **8.4.5.3:** Quantitative (diameter over 30 cm, length over 2 m) and qualitative properties of left dead wood with different stages of decomposition allow the survival of relevant species of organisms bound to dead wood - xylophagous species e.g. beetles ([91]).

([86]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

([87]) Ibid.

([88]) FSC (2013). *FSC National Standard of Forest Management in Poland*. Accessed here.

([89]) Ibid.

([90]) PEFC (2022). *Sustainable Forest Management – Requirements.* Accessed here.

([91]) Ibid.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Removing all deadwood should a last solution and well justified.	The **Italian PEFC** standard shows a **very low level of consideration** for optimising deadwood, namely by only making vague references to deadwood as 'leaving dead trees or parts of them on the ground'.	**4.6a:** Leaving monumental trees, if present. Leaving some of the rare species trees, if present. Leaving dead trees or parts of them on the ground ([92]).
	Ekoskog shows strong considerations for optimising deadwood retention, with clear quantitative thresholds.	**6.1. "**Existing dead wood and dead wood created by natural disturbances, such as windthrow or insect infestation, is left in place unless forestry legislation requires otherwise." **6.2.** At least 20% of natural stand volume and 20 m³ of standing dead wood per hectare should be maintained to restore natural tree composition and structure. The forest plan outlines implementation, with a long-term goal of increasing dead wood to natural forest levels.

Key findings

- FSC standards generally include requirements for deadwood provision, albeit through a diversity of approaches (Germany: 10 biotope trees per hectare; Romania: 1-3 trees per hectare, with higher retention requirements in ecologically sensitive areas; Poland: to be based on 'scientific evidence and local conditions'; Sweden: detailed retention guidelines; and France: mandatory retention requirements for both standing and ground deadwood) to less specific provisions (Slovakia and Slovenia: limited guidance).
- PEFC standards show clear quantitative targets in few countries (Slovenia: 3% dead woody mass requirement; and Slovakia: minimum 10 m³/ha with specific size requirements – diameter over 30cm, length over 2m) to vague or missing provisions in others (Germany, France, and Italy).
- The concept of retaining deadwood at different stages of decomposition is treated inconsistently by both FSC and PEFC schemes, being addressed in some standards (FSC Germany: mandates full decomposition cycles; FSC Sweden: retention requirements for fresh and year-old deadwood; PEFC Slovakia: explicit requirements for different stages of decomposition), and largely missing in the other standards assessed.
- The national standards assessed in both schemes largely do not clearly convey that deadwood removal should be a last resort.
- Ekoskog mandates a minimum of 20% of stand volume and 20 cubic metres of standing and lying deadwood per hectare after conversion to organic forestry, providing clear quantitative guidance. However, the standard lacks detailed conditions for removal. Information on the volume of deadwood (average per hectare) must be part of the forest management plan.

([92]) PEFC (2015). *Annex 2: ITA 1001-1 CRITERIA AND INDICATORS FOR SUSTAINABLE FOREST MANAGEMENT CERTIFICATION ON A INDIVIDUAL AND GROUP SCALE.* Accessed here.

The comparative assessment on optimising deadwood retention in the FSC and PEFC national standards shows mixed results, with a minority of standards (2 out of 7 for FSC and 3 out of 8 for PEFC) sufficiently supporting this CNF tool according to the Guidelines, indicating significant room for improvement for both certification schemes. Nevertheless, aspects of the national standards of both schemes contain good practices to be discussed further.

Accordingly, the Polish FSC standard stands out as one such positive example, in large part by calling for decisions on deadwood management to be based on scientific evidence and local conditions (indicator 6.3.8), as well as for solutions to be tailored to the needs and characteristics of each forest (indicator 6.3.8-9). Furthermore, the Swedish standards for both FSC and PEFC also emerge as strong examples, providing detailed requirements for the retention of deadwood during different management activities, with FSC specifically requiring the retention of high stumps, lying coarse woody debris and trees dead for more than one year (indicator 6.6.11), while also exempting areas with abundant old and large trees and high frequency of coarse woody debris from management except for biodiversity purposes (indicator 6.4.11). Additionally, the PEFC standard includes several requirements for the retention of deadwood (criterion 5.5.2) as well as the protection of all older deadwood during management activities (criterion 5.5.1).

Table 17: Assessment of national standards' contribution to *optimising deadwood retention*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	Partial	Partial	N/A	Yes	Partial	Yes	No	No
PEFC	No	No	No	Partial	Partial	Yes	Yes	Yes
Ekoskog	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A

However, these good practices and principles were not consistently found in all the national standards assessed. Across the PEFC and FSC schemes, national standards lacked specific quantitative targets or clear management guidelines for optimising deadwood retention, such as the case of the FSC standards for Slovakia and Slovenia as well as the PEFC standards for Germany, France, and Italy. Moreover, all standards, including Ekoskog, do not provide guidance on how to assess when deadwood removal may be justified.

Strengths and suitability of all standards

FSC standards generally show a strong recognition of the importance of deadwood for biodiversity and ecosystem functioning. This is evident in the national standard for Germany, which requires an operational biotope wood and deadwood strategy integrated into the forest management plan, including specific targets like maintaining an average of ten biotope trees per hectare (indicator 6.6.5) and formal recording systems for monitoring and validation (indicators 6.6.6 and 10.0.2). In addition, the French FSC standard explicitly prohibits harvesting of dead or decomposing trees except in justified cases (indicator 10.11.2) and requires maintaining 'all dead trees standing or on the ground' as part of habitat tree requirements (indicator 6.6.3). Furthermore, the national FSC standards for Poland and Sweden emphasise the need for evidence-based decision-making and monitoring in deadwood management, which is well aligned with the adaptive management approach of the CNF guidelines. For example, the Polish standard calls for decisions on deadwood management to be based on scientific evidence and local conditions so that solutions can be tailored to the specific needs and characteristics of each forest (indicators 6.3.8-10). On the

other hand, the Swedish national standard shows a strong alignment with the CNF tool, in particular by including several requirements for the retention of deadwood during management activities, and in particular by exempting uneven-aged and stratified forests with an abundance of old and large trees and a high frequency of coarse woody debris in different stages of decomposition from management activities, except for management activities that maintain or promote biodiversity (indicator 6.4.11).

In contrast, a few of the national PEFC standards assessed provide examples of quantitative targets for deadwood retention, as in the case of Slovenia and, to a lesser extent, Sweden and Slovakia. For example, the Slovenian PEFC standard includes a national requirement to leave 3% of the dead wood mass in the forest (criterion 3.1), while also requiring district foresters to promote the ecological functions of the forest (criterion 4.7). The national standard for Slovakia provides another measurable example of how deadwood retention can be approached, in particular by setting a quantifiable minimum requirement for the amount of deadwood to be left after harvesting at a minimum of 10 m^3/ha in order to promote the development of biodiversity, with specific size requirements (diameter over 30cm, length over 2m) to support species survival.

The Ekoskog standard clearly identifies deadwood retention as key to supporting biodiversity. Under criterion 6, Ekoskog requires a minimum threshold of 20 m^3/ha of standing and lying deadwood per hectare (to be increased overtime to approach levels found in natural forests), which is higher than thresholds identified in the PEFC standard in Slovakia, for example.

Weaknesses and gaps of all standards

A significant weakness of many of the FSC national standards assessed is the lack of specific, quantifiable targets for deadwood volume or diversity. While the importance of deadwood is generally recognised, the lack of clear targets makes it difficult to assess compliance and ensure adequate deadwood retention. For example, the Romanian FSC standard makes reference to the need for ‘sufficient’ deadwood (indicator 10.11.3) but does not provide indicators that define such sufficiency. Similarly, the national standard for France recognises the importance of deadwood for biodiversity and ecosystem functioning, but does not establish thresholds for deadwood retention, such as minimum volumes. In addition, many FSC standards provide limited guidance on how to balance deadwood retention with other management objectives, such as fire prevention and pest control, which is another focus of the CNF tool.

While some of the national PEFC standards assessed provide clear quantifiable targets, such as Slovenia and Slovakia, these examples are largely the exception rather than the rule, as many PEFC standards, such as those of Germany and France, lack these more measurable, quantitative thresholds, as well as sufficiently detailed guidance on the structure of deadwood (e.g., standing, fallen), while the Italian national standard provides limited details on deadwood at all.

Critically, both FSC and PEFC standards generally fail to address the CNF guidelines' recommendation to consider and justify deadwood removal as a last resort, which may in turn lead to unnecessary removal of ecologically valuable deadwood in certified forests.

Finally, Ekoskog lacks detailed conditions for deadwood removal, only mentioning accessibility for forestry measures.

3.1.8. Setting areas aside

Description of the CNF tool

The practice of **setting areas aside** represents the sixth intervention tool in the CNF guidelines' toolbox, aimed at enhancing biodiversity conservation and ecological resilience in forest ecosystems. The operationalisation of this tool involves the voluntary designation of forest areas to be left unmanaged or minimally managed to allow natural processes to prevail. The Guidelines emphasise the importance of strategically selecting these areas to maximise their ecological value. Ideally, set-aside areas should be large enough – typically more than 2-10 hectares – to support a diverse range of species, particularly those dependent on undisturbed forest habitats ([93]).

These areas play an important role in preserving key habitats, facilitating biodiversity networks and corridors, and protecting threatened species. Furthermore, the Guidelines stress the importance of connectivity between set-aside areas and advocate for a landscape-scale approach that takes into account the wider ecological context. Accordingly, when selecting areas for set-aside, forest managers are encouraged to prioritise sites of high conservation value, such as those containing old trees, representative samples of different forest development stages, or unique associated habitats such as wetlands and grasslands. The Guidelines also highlight the importance of avoiding fragmentation and discourage the use of, for example, fences that could impede wildlife movement. By implementing this approach, forests can better mimic natural ecosystem dynamics, supporting a wider range of biodiversity and strengthening the overall resilience of the forest ([94]).

Table 18: Specific examples from the national standards on *setting areas aside*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Setting areas aside: Some areas of different sizes should be set aside as a measure to support closer-to-nature forest management. The selection and establishment of set-aside areas should aim to: - preserve tree-related microhabitats and	The **Swedish FSC standard** demonstrates alignment with CNF guidelines by requiring that **5% of the forest area be set aside** for biodiversity or traditional land use practices, including buffer zones, wetlands, and uneven-aged forests. Another 5% is managed with long-term protection and enhancement of conservation values as the primary objective, promoting diverse habitat types and succession stages.	**6.5.1**: A selection of the productive forest land area is set aside and exempt from measures other than management to maintain and promote natural biodiversity or biodiversity conditioned by traditional land use practices. The selection of areas: a) covers a minimum of 5 % of the productive forest land area, b) is based on forest conservation values, landscape representativeness and biodiversity ([95]).

([93]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

([94]) Ibid.

([95]) FSC (2019). *The FSC National Forest Stewardship Standard of Sweden.* Accessed here.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
veteran trees to contribute to multi-taxon species richness in forest ecosystems; - allow parts of trees to go through their full life cycle and preserve forest biota in forest landscapes that are representative of the different development stages of a forest to strengthen naturalness; - help protect threatened species (e.g. on the IUCN Red List and on national lists of threatened species); - facilitate biodiversity networks and corridors across scales in coordination with adjacent forest	The **Slovenian PEFC standard** provides an innovative approach through its **EcoCell system,** where private owners can dedicate areas of their forests to be set aside and left to natural processes, receiving financial compensation. This aligns well with the CNF guidelines' recommendation for voluntary set-asides and provides economic incentives for conservation.	**4.2:** Ecologically significant biotopes and habitats and specific areas of their conservation, - When planning and managing forests, the ecologically significant, typical, rare and sensitive forest biotopes, habitat types and species must be preserved, especially within the scope of the network of special areas of conservation. Wherever possible, practical measures shall be taken to maintain or improve biological diversity. Indicators – 4.2.b – Forest area under special management regime and the area of other forest land for preserving biotic and landscape diversity and special nature elements, 4.2.c – Area and share of forests in special areas of conservation, 4.2.d – Area and changes in forest area with exceptionally stressed function of natural heritage protection, 4.2.e – Area and changes in forest area with exceptionally stressed biotope function, 4.2.f – Scope of budgetary funds allocated to measures for ensuring a favourable condition of ecologically important habitat types and species ([96]).

([96]) PEFC (2021). *Criteria and Indicators for Sustainable Forest Management at the Regional Level.* Accessed here.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
owners/managers (in this context, it is particularly important to outline the need to avoid fencing around forest areas, except in particular cases); - promote integrative tools to preserve the richness of rare and threatened species to support species diversity and representativeness within conservation hotspots; - ensure the diversity of associated habitats and species linked to the forest (e.g. water ecosystems such as ponds, riparian forests, peat bogs, rocky areas and grassland); - maintain or improve trees that stand out (remarkable or heritage trees) because of their beauty, size or age, and also maintain or improve landscape elements (viewpoints, remains, etc.) to conserve natural heritage.	The **French FSC standard** provides a good example of alignment with the CNF tool in terms of measurable thresholds by setting a specific threshold for set-aside. The standard requires that **10% of the area per management unit be set aside** for conservation purposes, providing forest managers with a clear, quantifiable target that supports biodiversity conservation objectives.	**6.5.1:** A conservation area network* covering a minimum of 10% of the area of either the Management Unit or the entire group of Management Units is established. This network includes: 1. Retention system of unmanaged and ageing areas, 2. Areas of High Conservation Value* from categories 1, 3 and 4 (Principle 9), 3. Semi-natural forest* areas greater than 1 ha, 4. Other elements of habitats and protection areas* defined and mapped in 6.4, 6.6 and 6.7 (key habitats, riparian* forest, buffer zones, forest associated habitats, etc.), as well as diversified forest edges (vertical structure and composition), the areas of which must be estimated and verifiable in the field ([97]). **6.4.2:** The potential impact of management activities and appropriate* protection measures are de-fined, justified and implemented for the key species and habitats* actually present within the Manage-ment Unit. These measures may include the following: 1. integral conservation areas, 2. zones and/or periods of temporary exclusion of certain activities, 3. areas providing habitat connectivity, and/or 4. extensive silvicultural* methods and other management measures to ensure the sur-vival and sustainability of the species and habitats identified.

([97]) FSC (2016). *The FSC National Forest Stewardship Standard for Metropolitan France.* Accessed here.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
	Ekoskog provides good alignment with CNF guidelines, with a threshold of 10% of the productive forest to be left aside. The areas left aside must be selected according to their high conservation value.	**5.1:** Areas with high conservation value or those expected to contain threatened species (VU, EN, CR on the Red List) should be left undisturbed or managed to enhance conservation. This includes key biotopes identified by the Swedish Forest Agency. Forestry activities may only occur if they support conservation, with exceptions documented in the forest plan. **5.2:** At least 10% of productive forest land must be set aside for natural development to promote biodiversity, selected based on conservation and landscape ecology principles. Government-subsidised protected areas cannot be counted. These areas serve as reference points for forest management. **5.3**: Forestry is prohibited in forests above the sub-alpine boundary.

Key findings

- Several FSC national standards include specific area requirements for set-asides, with some examples of quantified targets, such as France's requirement of 10% for conservation areas and 3% for unmanaged/ageing areas (with 1% strictly unmanaged), and Germany's requirement to set aside 10% of forest land for natural forest development.
- The national PEFC standards assessed show considerable variation in their approach to set-aside, ranging from relatively detailed frameworks in Sweden (minimum 5% of productive forest) and Slovenia (EcoCell system) to limited or no explicit requirements in countries such as France, Italy and Germany.
- Where set-aside concepts are addressed, there is often insufficient detail on the need for connectivity between set-aside areas as outlined in the CNF guidelines, with the exception of two national standards: FSC France (indicator 6.4.2) and PEFC Sweden (criterion 5.1.3).
- All national standards in both schemes lack guidance on facilitating biodiversity networks and corridors at different scales in coordination with adjacent forests, and specific selection criteria for tree-related microhabitats within such areas.
- Ekoskog requires at least 10% of productive forest land to be set aside for free development, prioritising areas with high natural value or the presence or potential presence of threatened species. Management in these areas is permitted only if it aligns with the biotope's natural values. The standard does not address connectivity between set-aside areas but requires the exclusion of 'mountain forests' from forestry activities, while heritage trees must be preserved (20 cubic meters per hectare).

The results of the comparative assessment indicate that while most of the FSC (5 out of 7) and PEFC (5 out of 8) standards assessed include at least some elements of set-asides, this is typically incomplete and missing key elements sought by the Guidelines, such as the need for connectivity between set-aside areas and the facilitation of biodiversity networks and corridors at different scales in coordination with adjacent forests. First, Ekoskog and the national FSC standards generally provide more explicit measurable requirements for set-aside areas (called Representative Sample Areas or RFAs) by establishing minimum area thresholds, as in the

case of Germany, France, Poland, Romania, Sweden and Slovenia. For example, France requires conservation area networks covering a minimum of 10% of the management unit (indicator 6.5.1) and unmanaged/ageing areas comprising at least 3% of the total area, while Poland sets a specific minimum requirement of 10% of the management unit for conservation zones and protected areas (indicator 6.2.10). However, unlike Ekoskog, the national FSC standards lack detailed more guidance on other elements required by the CNF guidelines, such as detailed criteria for the selection and protection of tree-related microhabitats and veteran trees.

Table 19: Assessment of national standards' contribution to *setting areas aside*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	No	Partial	N/A	Partial	Partial	Partial	No	Partial
PEFC	No	No	No	Partial	Partial	Yes	Partial	Yes
Ekoskog	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A

By comparison, the PEFC standards demonstrate more variation, ranging from no mention of set-aside areas in several countries to more detailed approaches in others, such as Sweden, Poland and Slovenia. For example, the EcoCell system of the Slovenian PEFC standard (criteria 4.2), which provides a framework for the declaration and compensation of set-aside areas, stands out as a positive example of how to support the implementation of the CNF tool. Overall, both the PEFC and FSC certification schemes typically fall short of providing the level of detail and specific objectives for set-aside areas as outlined in the CNF guidelines, particularly with regards to facilitating biodiversity networks and corridors at different scales, and the selection and protection of tree-related microhabitats and veteran trees.

Strengths and suitability of all standards

The FSC national standards assessed show largely partial alignment with the CNF tool on set-asides. One strength identified is the inclusion of specific quantitative requirements in 6 of the 7 FSC national standards assessed. For example, as noted above, the approach taken by France requires that at least 10% of the management unit be part of conservation area networks and 3% for unmanaged/aging areas, complemented by multiple conservation measures through indicator 6.4.2, including integral conservation areas and habitat connectivity areas, and indicator 6.5.2, which considers ecosystem representativeness at the eco-regional level when selecting unmanaged and aging areas. This example provides a clear, quantifiable target for forest managers to act upon. Similarly, the Slovenian FSC standard mandates that RSAs combined with other conservation areas must comprise at least 10% of the Management Unit, with requirements for restoration to more natural conditions when needed (indicators 6.5.3-5). In addition, the FSC standards for Poland (indicator 6.2.10) and Sweden (indicator 6.5.4) pay particular attention to the protection of rare and threatened species, with specific requirements that in the case of Sweden, large forest owners have a specific action plan for threatened species in set-aside areas. Also, through its system of establishing RSAs, the national standard for Romania defines selection criteria for set-asides that are focused on primary forests and habitats of high natural value, with specific provisions for bog woodlands, dwarf pine scrubs and marginal habitats (indicator 6.5.1).

Next, some of the PEFC standards assessed show notable strengths in terms of outlining the CNF guidelines' approach on set-aside areas. For example, the Swedish PEFC standard has detailed requirements for set-asides, including a minimum of 5% of productive forest be set-aside, along with provisions for habitat connectivity and requirements for the forest owner to

strive towards connectivity of habitats worthy of protection (criterion 5.1.3). The benefits of the EcoCell system of the Slovenian standard have also been noted, demonstrating strong alignment through its innovative EcoCell system, which provides a framework for declaring and compensating set-aside areas with adjusted management practices, particularly within designated conservation areas including Natura 2000 sites (criterion 4.2). Furthermore, the PEFC standard for Poland, and to a similar extent, for Slovakia and Slovenia addresses the protection of rare, sensitive or representative ecosystems by requiring their protection as part of the framework for 'ecologically important forest areas (including areas set aside for nature conservation' (criterion 4.4.2), aligning with the objectives of the CNF.

Ekoskog is well aligned with the CNF intervention tool of setting areas aside, with a minimum threshold of 10% of productive forest to be set aside, in addition to areas protected under other regulations or receiving state compensation. Ekoskog's criterion 5 includes specific provisions for areas of high natural value or where threatened species are likely to occur: these areas should be left to natural development or managed to preserve or enhance their ecological value. In contrast to PEFC and FSC, the Ekoskog standard excludes forests above the mountain boundary from forestry activities. In addition, Ekoskog's criterion 7 on the preservation of habitat trees (20 cubic meters per hectare to be conserved) strengthens the ecological value of the forest area.

Weaknesses and gaps of all standards

The main weakness of the national FSC standards is the often-incomplete coverage of the various factors and conditions of the CNF guidelines that the standard considers in relation to the required set-aside. For example, while the German FSC standard sets quantitative targets for the creation of set-aside areas, it lacks explicit provisions for the preservation of tree-related microhabitats and veteran trees to support multi-taxon species richness as per the Guidelines. Even in countries where set-asides are addressed, such as Sweden, there is insufficient detail on key elements outlined in the CNF guidelines, such as connectivity between areas. In addition, as already noted prior, the national standards in both schemes lack guidance on facilitating biodiversity networks and corridors across scales in coordination with adjacent forest owners or managers – all key elements of set-asides as outlined in the CNF guidelines.

A key weakness of the assessed PEFC standards is the complete absence of set-aside requirements in several cases, namely Germany, France, and Italy. Furthermore, except for the national standard for Sweden, quantitative thresholds to determine the minimum size of set-aside areas are rarely used, even in cases where set-asides are required. Otherwise, the weaknesses common to the PEFC national PEFC standards assessed are similar to those of FSC as well, i.e. the lack of guidance on multiple factors and conditions that are specific to the set-aside concerned, such as the facilitation of biodiversity networks and corridors at different scales, and the selection and protection of tree-related micro-habitats and veteran trees, the protection of threatened species, and the maintenance of landscape elements in set-aside areas.

Despite setting a high quantitative target for set-asides, Ekoskog neglects ecological connectivity aspects in relation to set-asides.

3.1.9. Taking a scale-specific approach

Taking a scale-specific approach: Individual trees and groups of trees

The CNF Guidelines recommend the widespread adoption of a scale-specific approach to forest management, including at the level of individual trees and groups of trees. This approach recognises the role that even individual trees and groups of trees can play in fostering biodiversity, enhancing forest resilience and supporting a wide range of ecological functions. More specifically, this tool within the Guidelines encourages a shift away from purely economic considerations when evaluating individual trees, towards a multi-criteria assessment that integrates climatic, environmental, social and economic factors. In practice, this approach can improve the ability of forests to withstand and recover from environmental stresses and the accelerating impacts of climate change ([98]).

Table 20: Specific examples from the national standards on *taking a scale-specific approach at the level of individual trees or groups of trees*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
(i) Level of individual trees or groups of trees		
Taking a scale-specific approach: (i) The level of individual trees and groups of trees: During forestry management operations, each tree or group of trees should therefore be evaluated in terms of its usefulness. Criteria for harvesting should consider the trees' role in the ecosystem and should balance climate, environmental, social and	The **Romanian FSC standard** exemplifies strong alignment with the CNF guidelines, **requiring environmental impact assessments at all three scales** (individual, stand, landscape). This approach operationalises the evaluation of individual trees' ecological roles, closely mirroring the CNF guidelines' emphasis on individual tree-level management.	**6.2.1:** An environmental impact assessment* identifies potential present and future impacts of management activities on environmental values*, from the stand level to the landscape level. 1. If national legislation requires an environmental impact assessment, this will be carried out according to the legal provisions. 2. At the time of tree marking for harvesting, where the legislation does not require an environmental impact assessment, the Organization evaluates the impact of its activities on the identified environmental values, according to the requirements of this standard ([99]).

([98]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

([99]) FSC (2019). *The FSC National Forest Stewardship Standard of Romania.* Accessed here.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
economic criteria in line with the overall objectives of: (i) restoring and conserving biodiversity; and (ii) promoting resilience against climate change.	The **Swedish PEFC standard** demonstrates partial alignment with the CNF guidelines by requiring the **preservation of specific 'conservation trees'** (trees of special conservation value that are different from the stand to be harvested) on a per-hectare basis.	**5.3.1:** At thinning and regeneration felling, all conservation trees shall be retained to live, die, decompose, and decay. If the total number of conservation trees at regeneration felling amounts to less than 10 per hectare, these shall be complemented with potential conservation trees so that 10 trees per hectare are always retained. In stands where it is difficult to distinguish conservation trees, e.g. in older forest of lower site classes, consideration may be adapted according to the following: For forest owners with forest land site indexed T18/G18 or lower, all deciduous conservation trees are retained, and at least 10 coniferous conservation trees per hectare, as an average in the area concerned.
	The **French PEFC standard** falls short of the aims of the CNF guidelines by **only considering tree-level approaches for areas with steep slopes (at least 30%).** This limited scope does not capture the multi-criteria approach as envisaged by the CNF tool.	**2.5:** In areas with steep slopes (incline of 30% or over), opt for irregular treatments or management by individual tree or medium-sized forest unit ([100]).
	Ekoskog includes requirements for the protection of individual trees.	**7.1.** There should be at least 20 large, old trees with high conservation values per hectare to be left for free development. Trees located in set aside areas do not count towards the threshold.

Key findings

- The FSC demonstrate highly limited compliance with a scale-specific approach to forest management at the level of individual trees or groups of trees, with the exception of the Romanian standard, which explicitly requires that individual tree marking to be consistent with environmental impact assessments, and to a lesser extent, the Swedish standard, which shows some specific measures at the level of individual trees or groups of trees.
- The national PEFC standards assessed show similarly limited alignment with the requirement for tree-specific approaches to forest management, with the exceptions of Sweden and Slovakia, namely for their inclusion of 'habitat tree' indicators.
- Both FSC and PEFC standards in most countries assessed fail to incorporate the CNF guideline's emphasis on expert marking of single trees for felling (e.g. Germany, France, Italy, Poland, and Slovenia).
- Neither the PEFC or FSC certification schemes consistently address the evaluation of trees based on their role in promoting resilience against climate change, as emphasised in the CNF guidelines.
- Ekoskog includes a minimum threshold for the conservation of habitat trees (minimum of 20/ha). Information on the stand's habitat trees must be included in the forest's 20-year management plan.

([100]) PEFC (2016). *Sustainable Forest Management Rules – Requirements for Metropolitan France*. Accessed here.

The result of the comparative analysis reveals significant gaps between the CNF guidelines and the current practices outlined in the FSC and PEFC standards in the countries assessed. While the Romanian FSC standard fully supports the approach outlined in this CNF tool by requiring environmental impact assessments at all scales, including that of individual trees, and the Swedish FSC standard shows partial alignment through its tree retention and conservation requirements, as well as the German FSC standard which demonstrates limited alignment by establishing clear parameters for single to groupwise harvesting approaches, these cases of alignment are the exception rather than the rule. On the other hand, the national PEFC standards assessed showed a similarly low level of alignment with the CNF guidelines in this respect, except for Sweden and Slovakia, both of which set concrete requirements for the preservation of specific 'conservation trees' and 'habitat trees' respectively.

Table 21: Assessment of national standards' contribution *to taking a scale-specific approach – individual trees and groups of trees*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	No	No	N/A	No	Yes	Partial	No	No
PEFC	No	No	No	No	No	Partial	Partial	No
Ekoskog	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A

Strengths and suitability of all standards

The FSC standards demonstrate strengths in addressing tree management at the individual or group level, albeit only to a limited extent across countries. The Romanian standard's requirement for environmental impact assessments at the individual tree level is closely aligned with the CNF guidelines and provides a detailed framework for assessing the ecological role of each tree through an environmental impact assessment at the individual tree level (indicator 6.1.1), with individual tree marking to be consistent with this assessment. In addition, the Swedish FSC standard, while less ambitious, requires the retention of trees with high biodiversity value and sets quantitative targets for the retention of trees during harvesting. For example, for commercial thinning, the Swedish standard requires that an average of at least five existing deciduous trees per hectare are given favourable conditions (indicators 6.6.4-8), while for regeneration felling there are specific requirements to leave at least 10 trees per hectare on the felled area and to leave trees with high biodiversity value (indicators 6.6.1-3).

While the alignment of the national PEFC standards assessed with this CNF tool was limited, a few notable strengths were identified, mainly in the Swedish and Slovakian standards. For example, the Swedish standard provides for the protection of 'conservation trees' during thinning and regeneration felling (criteria 5.3.1), demonstrating some consideration for trees at the individual level. In addition, the Slovakian PEFC standard includes specific requirements for the protection of 'habitat trees', which should be at least 5 suitable individuals of the mother stand per 1 ha of stand area. It is important to note, however, that these positive examples are limited in the sense that they do not address the multi-criteria approach to assessing individual trees or stands as recommended by the Guidelines.

The Ekoskog standard aligns with the CNF guidelines with respect to forest management at the individual tree level. The standard protects habitat trees, with a minimum threshold of 20 trees/ha, recognising their individual ecological value. Under the standard, criterion 4 on forest harvesting requires that trees in the stand reach a maturity of at least 20 cm in diameter at breast height, 'focusing on favouring high-quality target trees by removing inferior competitors', which allows the assessment of individual trees.

Weaknesses and gaps of all standards

Both FSC and PEFC standards generally show limited alignment with the CNF Guidelines with respect to forest management at the level of individual trees or groups of trees. With a limited number of exceptions, such as the FSC national standards for Romania and, to a lesser extent, Sweden and Germany, as well as the PEFC standards for Sweden and Slovakia, most of the national standards assessed across both schemes do not include provisions for forest management at the individual tree or stand level, and where they do, they typically do not fully address the multi-criteria approach presented by the CNF guidelines.

While the Ekoskog standard largely addresses individual tree management in accordance with the CNF guidelines, information on individual tree management is not required in the unit's management plan.

Taking a scale-specific approach: Stand level

The CNF guidelines also recommend that forest management adopt a scale-specific approach at the level of the forest stand, which they define as a spatially explicit part of the forest with selected commonalities that is a fundamental unit for ecological and economic forest management planning. By considering factors such as species composition, stand structure, vertical complexity, soil fertility, tree age and dominant tree species, the CNF guidelines aim to increase variability within stands, resulting in increased biodiversity and ecosystem resilience ([101]).

Table 22: Specific examples from the national standards on *taking a scale-specific approach at the level of the stand*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
(ii) Level of the stand		

([101]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Taking a scale-specific approach: (ii) The level of the stand: Individual forest stands are identified and closer-to-nature objectives are determined at the level of these stands. The objectives may include species composition, stand structure, vertical complexity, soil fertility, tree age or dominant tree species.	The **German FSC standard** exemplifies strong alignment with CNF guidelines, requiring the **adoption of silvicultural strategies for tending and use that consider the tree species composition, dynamics, and structure of the natural forest association**. This approach aims to maintain and develop site-appropriate, semi-natural forest stands, directly supporting the CNF tool of increasing structural complexity at the stand level.	**10:** Silvicultural* strategies for tending and use shall be adapted to the tree species composition, dynamics and structure of the natural forest association*. Their objective shall be to maintain and to develop site appropriate*, semi-natural forest stands*. The conservation imperative becomes especially important upon achievement of this target ([102]). **10.0.2:** For all forest development types* greater than 5 % of the forest land* the following details are recorded: - the natural forest associations* of the respective sites - future tree species composition - dynamics (duration of the regeneration and exploitation periods) - structure (horizontal and vertical) - proportion of biotope trees* and dead trees* - target standing volume - handling of sites affected by calamities - silvicultural tending and exploitation strategy ([103]).
	The **Slovenian PEFC standard** actively promotes the **stimulation of diverse horizontal and vertical stand structures and species mixtures through forest management plans**. This direct focus on structural diversity aligns closely with the CNF guidelines' emphasis on increasing within-stand variability to enhance biodiversity and ecosystem resilience.	**4.8:** Tree diversity of stands – Forest management must promote tree structure suitable for the site as well as species diversity and mixed stands. Where applicable, the diversity of horizontal and vertical structures, such as uneven-aged structure and mixed stands, shall be stimulated by means of forest managing plans. Traditional management systems which have created special ecosystems (such as coppicing) shall be promoted at suitable sites, if applicable ([104]).

([102]) FSC (2018). *Deutscher FSC-Standard 3-0.* Accessed here.

([103]) Ibid.

([104]) PEFC (2021). *Criteria and Indicators for Sustainable Forest Management at the Regional Level.* Accessed here.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
	Ekoskog requires stand level planning that considers the promotion of a diverse horizontal and vertical structure.	**2.1**: Forest management is based on a forest plan with a division of the holding into biotopes based on natural conditions. The plan should include: - Stand volume details by tree species and development objectives. - Dead wood volume per hectare. - Target diameters for harvesting timber by species. - High conservation value areas and potential habitats for threatened species. - Presence of threatened/sensitive species and other significant natural or cultural values. - Conservation set-aside trees with identification details.

Key findings

- PEFC standards often include detailed requirements for stand level planning and management objectives.
- FSC standards present a mixed picture, with strong support for the CNF tool in Germany and Romania, partial alignment in France, Sweden, Slovakia, and Slovenia, and poor alignment in Poland.
- Neither FSC nor PEFC standards consistently address all stand level factors identified in the CNF guidelines.
- Ekoskog requires stand-level planning via a 20-year plan accompanied by management objectives and a description of key ecological parameters.

The comparative assessment of FSC and PEFC standards in the selected EU Member States shows an uneven but often strong support for this CNF tool for a scale-specific approach at the stand level. PEFC standards generally show a high level of support, with five out of eight countries (France, Italy, Sweden, Slovakia and Slovenia) fully aligned with the tool, followed by two standards (Germany and Romania) being aligned in the case of FSC. Correspondingly, PEFC standards are rather consistent in incorporating stand-level planning and management objectives into their frameworks, with the exceptions of Poland.

Table 23: Assessment of national standards' contribution to *taking a scale-specific approach – stand level*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	Yes	Partial	N/A	No	Yes	Partial	Partial	Partial
PEFC	Partial	Yes	Yes	No	Partial	Yes	Yes	Yes
Ekoskog	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A

However, the level of detail and specific factors considered at the stand level vary considerably between countries and schemes. For example, the German FSC standard closely follows the CNF guidelines by requiring silvicultural strategies that take into account tree species composition, dynamics and structure of natural forest associations at the stand level (10.0.1-

2). The national PEFC standard for France demonstrates another effective approach by requiring detailed planning that considers environmental values and silvicultural activities at the stand level (5.2.1). In addition, the Swedish PEFC standard goes further by requiring comprehensive stand level information, including area, age, forest management objective and tree species distribution for forest holdings of 20 ha or more (criterion 3.1.1).

Strengths and suitability of all standards

The FSC standards assessed demonstrate particular strength in the way certain countries incorporate Environmental Impact Assessments (EIAs) at the stand level. A prominent example is offered by the national standard for Romania, which requires an EIA that identifies the potential current and future impacts of management activities on environmental values from the stand level to the landscape level, in line with the recommendation of the CNF tool to consider multiple factors at the stand level in forest management and planning. Several national FSC standards also include detailed silviculture strategies at the stand level, namely Germany (indicators 10.0.1-2), France (indicator 5.2.1), Slovakia (indicator 10.5.1) and Slovenia (indicator 10.5.1). Specifically, the German standard requires detailed silvicultural strategies aimed at maintaining and developing site-appropriate forest standards that take into account the species composition, dynamics and structure of natural forest associations (indicator 10.0.1), while the French standard requires detailed silvicultural planning that takes into account stand-level characteristics in particular (indicator 5.2.1).

The PEFC standards assessed generally excel in requiring detailed forest management plans that integrate stand level objectives, although the degree of specificity varies between the national standards assessed. The Swedish PEFC standard is a good example, requiring forest management plans for holdings of 20 ha or more, with detailed stand level information and assigned forest management objectives (criterion 3.1.1). In addition, the PEFC standard for Slovakia requires that harvesting activities are in line with ‘the condition and needs of the stand’ (indicator 8.3.1.3) and demonstrates clear stand-level strategies by setting the objective of ‘maintaining or improving the condition of forest stands in relation to their stability, biodiversity, vitality and ecological value by implementing appropriate measures with the maximum possible use of natural processes’ (indicator 8.2.1). Furthermore, the Slovenian PEFC standard, for example, actively promotes diverse horizontal and vertical stand structures and species mixes through its forest management plans. This approach in turn supports the CNF tool's objective of increasing variability within stands and enhancing overall forest diversity.

Ekoskog requires stand-level planning via a 20-year plan, accompanied by management objectives and a description of key ecological parameters. The standard promotes principles that support a diverse forest composition (native species, maintenance of heritage trees, protection of vulnerable species) and tree age diversity (including the protection of heritage trees, deadwood maintenance, and respectful harvest), and that support the preservation of soil fertility and wetlands.

Weaknesses and gaps of all standards

The absence of a consistent set of clear ecological objectives at the stand level emerges as a weakness in many of the FSC national standards’ approaches forest management planning. The Polish FSC standard, for example, focuses primarily on descriptive parameters rather than setting ecological objectives, such as increasing vertical complexity and soil fertility objectives at the stand scale. Similarly, the Swedish FSC standard lacks specific requirements for stand-level objectives in its plan requirements, while the Slovenian FSC standard lacks specific guidance for setting stand-level objectives for factors such as species composition, structure, and complexity at the stand level in particular.

While the national PEFC standards generally include provisions for stand level planning, they vary in the extent to which they address the key elements outlined in the CNF guidelines. The Polish PEFC standard had a number of gaps, with no explicit requirements to identify individual forest standards or to set biodiversity objectives at stand level. Gaps in alignment with the CNF guidelines were less acute in the case of standards showing partial compliance, such as Germany and Romania. For example, while the German PEFC standard requires a forest management plan that considers, among other factors, 'stand descriptions', it does not explicitly address more specific factors such as stand structure, vertical complexity and soil fertility. To a similar extent, Romania's PEFC standard does not explicitly require the setting of specific closer-to-nature objectives at the stand level, such as increasing structural complexity and vertical diversity, and instead biodiversity objectives are primarily addressed through broader forest management planning.

Ekoskog does not specify in detail which ecological parameters must be part of the forest management plan. The standard largely does not address the vertical structure of the forest.

Taking a scale-specific approach: Landscape level

As the last of the three scale-specific approaches, the CNF guidelines also emphasise the importance of taking a landscape-level approach to forest management planning and practice. This CNF tool recognises that forests are not isolated entities, but rather integral components of broader ecosystems. In turn, the CNF guidelines advocate for the creation of a diverse mosaic of forest structures across landscapes, encompassing variations in species composition, age distribution and habitat types, with the aim of enhancing overall ecosystem resilience and biodiversity by maintaining or restoring a network of habitats and ecological corridors ([105]).

Table 24: Specific examples from the national standards on *taking a scale-specific approach at the level of the landscape*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
(iii) Level of the landscape		
Taking a scale-specific approach: (iii) The level of the landscape: Forest management planning, taking into account the closer-to-nature principles, is done at the landscape level.	The **Swedish FSC standard** exemplifies strong alignment with CNF guidelines, requiring management to 'maintain and/or restore a varying mosaic of species, sizes, ages, spatial scales and regeneration cycles appropriate for the landscape values in that region, and for enhancing environmental and economic resilience'. This thorough approach ensures that forest management considers the broader landscape context.	**6.8:** The Organization shall manage the landscape in the Management Unit to maintain and/or restore a varying mosaic of species, sizes, ages, spatial scales and regeneration cycles appropriate for the landscape values in that region, and for enhancing environmental and economic resilience ([106]). **6.8.1:** Large forest owners: A landscape ecology perspective is applied in planning, taking into account the spatial distribution of the landholding ([107]).

([105]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

([106]) FSC (2020). *The FSC National Forest Stewardship Standard of Sweden.* Accessed here.

([107]) Ibid.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
	The **Slovakian FSC standard** aligns well with CNF principles by requiring 'environmental impact assessments to identify potential impacts of management activities on environmental values, from the stand level to the landscape level'. This approach ensures that forest management decisions consider their wider ecological context and potential long-term impacts.	**6.2.1:** An environmental impact assessment identifies potential present and future impacts of management activities on environmental values, from the stand level to the landscape level ([108]). **6.3:** The Organization* shall identify and implement effective actions to prevent negative impacts of management activities on the environmental values*, and to mitigate and repair those that occur, proportionate to the scale*, intensity* and risk* of these impacts ([109]).
	Ekoskog explicitly refers to the application of a landscape ecology perspective in the management of the forest.	**2.3. "**A landscape ecology perspective is applied and landscape ecology considerations shall be stated in the forest plan."

Key findings

- Overall, both the FSC and PEFC national standards show considerable support for a landscape-level approach to forest management, with 5 out of 7 FSC national standards and 5 out of 8 PEFC national standards aligned with this CNF tool.
- These aligned FSC (5 of 7) and PEFC (5 of 8) national standards incorporate landscape-level considerations through a wide variety of mechanisms, such as environmental impact assessments (FSC Romania, indicators 6.1.1, 6.2.1), regional certification structures and forest reports (PEFC Germany, indicators 7.1.1-2), and landscape-level analyses of conservation values and habitats (FSC Sweden, indicators 6.1.1-2), among others.
- Both the FSC and PEFC standards in Sweden and Slovakia show a strong focus on landscape-level management, requiring planning in a landscape-ecological context.
- Where there are gaps in landscape-level requirements, these tend to be partial rather than complete omissions, with standards often addressing at least some landscape elements but not fully including all landscape-level CNF elements as per the Guidelines.
- Ekoskog recommends applying a landscape ecology perspective to the management of the forest stand, and landscape ecology considerations must be specified in the forest management plan.

Analysis of the FSC, PEFC and Ekoskog standards reveals a broadly supportive picture with the CNF guidelines' emphasis on landscape-level approaches to forest management, with few exceptions. While there is a discernible trend towards incorporating landscape-level considerations, the depth and specificity of these requirements varies between countries and between certification schemes. Sweden and Slovakia emerge as good examples, with both their FSC and PEFC standards strongly aligning with landscape-level management principles. For example, the Swedish PEFC standard requires all forest management planning to be carried out in a landscape ecological context (criteria 1.13), taking into account natural runoff

([108]) FSC (2023). *The FSC Interim Forest Stewardship Standard for Slovakia.* Accessed here.

([109]) Ibid.

areas and ecosystem restoration needs. Similarly, the Slovakian FSC standard requires environmental impact assessments from the stand to the landscape level (indicator 6.2.1).

Table 25: Assessment of national standards' contribution to *taking a scale-specific approach – landscape level*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	Partial	Yes	N/A	No	Yes	Yes	Yes	Yes
PEFC	Partial	Yes	Yes	Partial	No	Yes	Yes	Yes
Ekoskog	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A

However, this level of alignment is not universal across all the standards assessed. In some countries there are gaps in both the FSC and PEFC national standards assessed, mainly in the depth with which landscape level planning is addressed.

Strengths and suitability of all standards

The FSC standards generally demonstrate strong alignment with the landscape-level approach presented in the CNF guidelines. One prominent feature identified from the standards is the requirement for environmental impact assessments that explicitly consider landscape-level impacts, as demonstrated by the Romanian and Slovakian standards in particular. The FSC standards, by and large, also place a strong emphasis on maintaining or restoring a diverse mosaic of species, sizes and ages that are particularly appropriate to the landscape as a result of their international benchmark on which the national standards are based, as in the case of Germany, France, Sweden, Slovakia and Slovenia. More concretely, the Swedish FSC standard offers a strong example through its requirement for detailed Ecological Landscape Plans (indicators 6.8.1-2), identification and analysis of conservation values and habitats in the landscape (6.1.1-2), while also mandating wind-resistant tree selection based on biodiversity significance at both stand and landscape levels. In addition, the Slovakian FSC standard further includes specific management guidelines for Intact Forest Landscapes and large landscape-level ecosystems (Annex H of the national standard).

On the other hand, most of the national PEFC standards assessed also demonstrate relatively consistent alignment with the landscape-oriented approach of the CNF guidelines, albeit through a variety of different measures and means. The Swedish PEFC standard is a prime example, explicitly requiring all forest management planning to be conducted within a landscape ecological context (Annex 1 of the national standard). This approach takes into account natural run-off areas and emphasises ecosystem restoration, which is closely with the vision of holistic landscape management in the CNF guidelines. The Slovenian PEFC standard offers an interesting example by including quantitative indicators for different landscape types (indicator 4.9b), while the Slovakian PEFC standard requires procedures to ensure biodiversity conservation at multiple levels, including the landscape level, during the forest monitoring plan development process (8.4.1.9).

Finally, Ekoskog clearly requires the application of landscape ecology in the forest management plans. The principles **also** requires that all forestry measures must consider the landscape perspective. The selection of set aside areas must be based on forest landscape ecology principles.

Weaknesses and gaps of all standards

Despite their generally strong alignment with the CNF tool, there are relatively few instances where the FSC national standards assessed fall short of fully embracing the landscape-scale management approach as outlined in the CNF guidelines. Namely, the Polish FSC standard lacks provisions for landscape-level planning, focusing on stand and forest management unit (FMU)-level approaches without specifically considering the landscape-level context.

Among the PEFC standards assessed, the identified weaknesses mainly relate to the lack of explicitness of landscape-level requirements. This gap is largely limited to the Romanian national PEFC standard and to a lesser extent to the German and Polish standards. For example, the Romanian national standard does not explicitly state that forest management planning should be carried out at the landscape level. Furthermore, although the Polish PEFC standard requires that forest management planning takes into account biodiversity at genetic, species, ecosystem and landscape levels (4.4.1), it does not appear to integrate landscape-level management planning more horizontally.

Ekoskog does not explicitly specify landscape level requirements in forest management plans.

3.1.10. Managing ungulate species at natural carrying capacity

Description of the CNF tool

The final tool outlined in the CNF guidelines is the **management of ungulate species at natural carrying capacity**, which recognises the significant impact that grazing pressure can have on forest regeneration processes, both natural and artificial. The Guidelines advocate a balanced approach that combines protective measures with population management strategies. It also recommends the use of adapted, site-specific barriers, such as stem fencing or temporary small-scale fencing, carefully designed to protect regeneration without disrupting the connectivity of forest habitats. At the same time, the CNF guidelines emphasise the importance of regulating ungulate populations, taking into account factors such as the current status of the ungulate population, the condition of the habitats and the extent of damage to the forest ([110]).

By considering these factors together, this approach aims to achieve a delicate balance between the presence of ungulates and forest regeneration. The Guidelines also emphasise the need for cooperation between different stakeholders, including regulatory authorities, forest owners and hunters, to effectively implement ungulate management strategies. In doing so, this CNF tool aims to foster forest ecosystems that are resilient, diverse and capable of sustaining both healthy ungulate populations and thriving forest regeneration ([111]).

([110]) EC (2023). *Guidelines on closer-to-nature forest management.* Accessed here.

([111]) Ibid.

Table 26: Specific examples from the national standards on *managing ungulate species at natural carrying capacity*

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
Managing ungulate species at natural carrying capacity: Protect forest regeneration by creating adapted and site-specific barriers or protective measures such as stem fencing or temporary and small-scale plot fencing in a way that does not disturb the connectivity of forest habitats. Regulate ungulate populations according to the state of the ungulate population, the state of biotopes and the extent of the damage to the forest. A balanced hunting policy, in combination with protective silvicultural measures, will allow young trees to develop, and at the same time make it possible to maintain healthy populations of ungulate species.	The **German PEFC** standard is strongly aligned with this CNF tool. It achieves this by **requiring adapted game populations as a prerequisite for natural forest management** in the interest of biodiversity. Game populations are considered to be adapted if the regeneration of the principal tree species is possible without protective measures, the regeneration of the secondary tree species can be ensured with reasonable effort if necessary, and no further peeling damage occurs to the principal tree species over a significant area.	**4.11:** Adapted game populations are a basic prerequisite for near-natural forest management in the interests of biodiversity. The forest owner as owner of his own hunting estate or as a member of a hunting co-operative works within the scope of their personal and legal possibilities to work towards adapted game populations ([112]). a) Game populations are considered to be adapted if the regeneration of the main tree species is possible without protective measures, the regeneration of secondary tree species where appropriate regeneration of secondary tree species can be secured with reasonable effort and fresh peeling damage to the main tree species does not occur on a large scale.
	The **Slovenian FSC** standard demonstrates effective integration of ungulate management by specifying that the **management of ungulates shall be included in the forest management plans of each forest management unit**, which is in line with the CNF guidelines emphasis on incorporating ungulate management into broader forest management strategies.	**6.4.2:** Management activities are designed or modified to avoid negative impacts to rare and threatened species and their habitats ([113]). **6.4.3:** The rare and threatened species and their habitats are protected, including through the provision of conservation zones, protection areas, connectivity, and other direct means for their survival and viability, such as species' recovery programs ([114]). **6.4.4:** A system is in place to prevent hunting, fishing, trapping and collection of rare or threatened species ([115]).

([112]) PEFC (2020). *PEFC-STANDARDS FUR NACHHALTIGE WALDBEWIRTSCHAFTUNG*. Accessed here.

([113]) FSC (2023). *The FSC Interim Forest Stewardship Standard for Slovenia*. Accessed here.

([114]) Ibid.

([115]) Ibid.

CNF guidelines	Specific examples from national standards	Criteria or indicators from the corresponding national standard
	The **Swedish PEFC** standard partially supports this CNF tool by requiring forest owners to aim for **a balanced ungulate population while minimising damage** to the forest according to quality assurance methods.	**3.11:** Forest owners shall aim for adaptation of the size of game populations so that the long-term objectives regarding forest management and nature conservation may be obtained. A close cooperation between the forestry sector and hunters is a prerequisite for obtaining the objective of vital game populations which is on balance with the fodder supply ([116]). **3.11.1:** Forest owners shall work for a balance between the size of ungulate populations and the fodder supply in order to keep damage levels down ([117]). **3.11.2:** To judge whether the size of ungulate populations is well-balanced, objective and quality assured methods shall be used as a basis. The size of ungulate populations may be considered well-balanced and on balance with fodder supply when: • rowan, aspen, sallow, and oak have the possibility to grow into trees in those parts of the country where they naturally occur o it is possible to regenerate the forest land with suitable tree species; • at least 7 out of 10 regenerated stems of pine are undamaged at 5 m height; and the number of undamaged main stems of pine at 5 m dominant height is between 1200 and 1600 stems per hectare, depending on site class ([118]).
	The **Romanian FSC standard** illustrates a limitation in addressing ungulate management by focusing primarily on threatened and endangered species in general, **rather than on ungulate populations** specifically.	**6.4.2:** Employees are trained on identification of rare and threatened species and their habitat present in the management unit ([119]). **6.4.3:** Potential impacts of management activities on rare and threatened species* and their conservation* status and habitats* are identified according to the procedure mentioned at 6.2.1. and management activities are modified to avoid negative impacts ([120]). **6.4.4:** The rare and threatened species* and their habitats* are protected, including through the provision of conservation zones*, protection areas*, connectivity*, and other direct means for their survival and viability, such as species' recovery programs ([121]).

([116]) PEFC (2022). *PEFC Sweden Forest Standard.* Accessed here.

([117]) Ibid.

([118]) Ibid.

([119]) FSC (2019). *The FSC National Forest Stewardship Standard of Romania.* Accessed here.

([120]) Ibid.

([121]) Ibid.

Key findings

- Both FSC and PEFC standards across most countries lack explicit requirements for or references to site-specific protective barriers or fencing to manage ungulate impacts while maintaining habitat connectivity, with the exception of Germany (PEFC).
- The FSC national standards assessed generally show limited provisions for managing ungulate species at natural carrying capacity.
- The PEFC national standards assessed demonstrate relatively more attention to ungulate management (i.e. Germany, Slovakia, Sweden, and Slovenia).
- Several national standards focus on the monitoring and damage assessment of ungulates (notably FSC and PEFC Germany, PEFC Sweden).
- While hunting is mentioned as a management tool in several standards, it is often without specific guidelines for maintaining natural carrying capacity (e.g., PEFC France, PEFC Italy, FSC Poland, FSC Slovakia, PEFC Slovenia).
- The Ekoskog standard does contain provisions applicable to the management of ungulate species.

Across all the national standards examined, the comparative assessment reveals a marked gap in supporting this tool as presented by the CNF guidelines for the management of ungulate species at natural carrying capacity. While some countries under the FSC and PEFC schemes show elements of alignment with the Guidelines, namely Germany, Slovenia, Sweden, and to a lesser extent Slovakia, there remains a widespread absence of approaches that include any details on the need for or reference to site-specific barriers (e.g. fencing) and measures for determining appropriate ungulate population levels aligned with natural carrying capacity. As mentioned above, the national PEFC standard for Germany stands out as a positive example, primarily because it requires adapted wildlife populations, considers hunting leases as an ungulate management tool, and refers to protective barriers and fencing, in particular by obliging forest owners to regularly inspect fenced areas and inform the forest owner of any need for repair.

Table 27: Assessment of national standards' contribution to *managing ungulate species at natural carrying capacity*

VFCS	DE	FR	IT	PL	RO	SE	SK	SI
FSC	Partial	No	N/A	No	No	Partial	No	Partial
PEFC	Yes	No	No	No	No	Partial	Partial	Partial
Ekoskog	N/A	N/A	N/A	N/A	N/A	No	N/A	N/A

In a similar vein, the Swedish PEFC standard includes detailed criteria (3.11) that explicitly aim to balance the size of ungulate populations by including a number of quantifiable measures to assess the damage caused by ungulate populations. Nevertheless, these examples are the exception rather than the rule, as most countries, including France, Italy, Poland, and Romania largely lack specific provisions for ungulate management in both their FSC and PEFC national standards.

Strengths and suitability of all standards

The national FSC standards assessed show varying strengths in addressing the management of ungulates at natural carrying capacity. A positive example includes the German FSC

standard, which shows partial alignment by including clear requirements through indicator 6.6.1 for adapting game levels to enable natural regeneration without assistance, by mandating regular monitoring of browsing and bark damage, and by requiring hunting plans based on documented damage assessment results. Similarly, the Slovenian FSC standard shows partial compliance by incorporating ungulate management in its forest management plans and implementing effective measures to control hunting activities (indicator 6.6.4). Furthermore, the Swedish FSC standard also shows partial alignment through provisions for retaining game-favoured trees and the establishment of monitoring protocols (indicator 6.6.9). In general, however, one element of the CNF guidelines is broadly absent from the national FSC standards assessed: requirements or references to the need for site-specific barriers or fencing.

There are a select number of strong examples from the PEFC standards assessed in terms of how the management of ungulates is approached. The German PEFC standard is the prime example, demonstrating good practice in this respect by explicitly requiring adapted game populations, including considerations for hunting leases aimed at preventing game damage, and obliging forest owners to regularly inspect fenced areas and inform the forest owner of any need for repair. Between all countries and both FSC and PEFC schemes, the aspect of the CNF guidelines regarding the need for site-specific barriers and fenced areas was only mentioned by the German PEFC standard. Furthermore, three other national PEFC standards, namely those for Sweden, Slovenia and Poland, require monitoring of the impact of game on forest regeneration and biodiversity, demonstrating a recognition of the importance of ungulate management in maintaining forest health. In concrete terms, the Swedish PEFC standard prescribes several quantitative indicators for assessing the extent to extent to which ungulate populations are well-balanced as per criteria 3.11., as shown in greater detail in Table 26. Moreover, in the case of Slovenia, their standard requires the regular monitoring of the impact of game on forest regeneration, growth and biodiversity, and that these results are taken into account when planning further game management measures as per criteria 4.10 (Table 26). Finally, the national standard for Poland refers to the need to control the impact of game populations on forest regeneration, for example through indicator 4.4.12: ‘measures shall be taken to limit excessive pressure of game animal populations endangering forest regeneration and growth as well as on biodiversity.’

Weaknesses and gaps of all standards

The main weakness of the FSC standards assessed is the general lack of specific provisions on both the need to create site-specific barriers or protective measures, and to a lesser extent, the inconsistent inclusion of measures on the need to determine appropriate ungulate population levels aligned with the natural carrying of the forest. For example, none of the national FSC standards examined address the creation of protective barriers or fencing, while four national standards contain indicators that prescribe or make reference to the need to manage ungulate populations based on forest damage and ecosystem capacity, as in the case of Germany (indicator 6.6.1), France (indicator 6.6.4), Romania (indicator 6.6.3), and Slovenia (indicator 6.6.4), to varying extents. Overall, this CNF tool remains one of the least evenly supported by both the FSC and PEFC national standards assessed.

The national PEFC standards assessed largely share the two main weaknesses identified in the FSC standards assessed, in particular the lack of guidance on protective fencing or other site-specific barriers to protect regeneration from ungulate damage, with the notable exception of the national standard for Germany as described above. In addition, the concept of managing ungulates to the 'natural carrying capacity' of the forest was typically not clearly defined or operationalised in the national standards assessed.

There is a gap in the Ekoskog standard when it comes to the management of ungulates, as no guidance is provided.

4. Suitability of the forest certification schemes assessed for a Closer-to-Nature approach

The comparative assessment of FSC and PEFC national standards in eight EU Member States reveals largely **partial to inconsistent implementation** of the key objectives and intervention tools of the CNF guidelines that were highlighted for this report (Table 28), while the assessment of the Ekoskog standard reveals a mostly consistent implementation of the key objectives and intervention tools, with room for improvement in certain areas, such as managing ungulate species and including benchmarks for promoting natural forest dynamics. While certain elements of the Guidelines are well-reflected in some of the national standards assessed, there is evidently **significant variation** both across VFCS and between Member States. On the one hand, this **challenges the ability to consistently apply** CNF practices across the EU. However, in certain cases, namely the national standards of **Slovenia, Romania, Germany,** and to a lesser extent, **Slovakia,** there appear to be more frequent good examples of VFCS standards which, although falling short in certain respects, represent actionable forest standards that are **more in line with the CNF approach** to forest management as presented in the Guidelines.

Taken together, the findings presented in Chapter 3 demonstrate the **potential of the current VFCS** to **support the implementation** of CNF, while also recognising that there are clear areas where further improvements would be needed to sufficiently promote the implementation of CNF management practices through these VFCS for use in the EU.

Table 28: Overview results of FSC and PEFC comparative assessments

CNF objectives and intervention tools	VFCS	DE	FR	IT	PL	RO	SE	SK	SI
Increasing structural complexity	FSC	Y	P	N/A	Y	Y	P	P	Y
	PEFC	P	N	Y	Y	Y	N	P	Y
Promoting natural forest dynamics	FSC	Y	P	N/A	Y	Y	P	N	P
	PEFC	P	N	P	Y	N	P	P	P
Promoting natural tree regeneration	FSC	Y	P	N/A	P	P	N	P	P
	PEFC	Y	P	N	P	P	N	P	P
Ensuring respectful harvest interventions	FSC	P	P	N/A	N	N	P	N	Y
	PEFC	P	N	P	N	P	N	N	P
Minimising other management interventions	FSC	Y	P	N/A	Y	Y	N	Y	Y
	PEFC	P	N	N	Y	Y	N	P	Y
	FSC	Y	N	N/A	N	P	P	N	P

CNF objectives and intervention tools	VFCS	DE	FR	IT	PL	RO	SE	SK	SI
Preserving and restoring soil and water ecosystems	PEFC	Y	P	P	P	P	P	P	Y
Optimising deadwood retention	FSC	P	P	N/A	Y	P	Y	N	N
	PEFC	N	N	N	P	P	Y	Y	Y
Setting areas aside	FSC	N	P	N/A	P	P	P	N	P
	PEFC	N	N	N	P	P	Y	P	Y
Scale-specific approach: individual trees and groups of trees	FSC	N	N	N/A	N	Y	P	N	N
	PEFC	N	N	N	N	N	P	P	N
Scale-specific approach: stand level	FSC	Y	P	N/A	N	Y	P	P	P
	PEFC	P	Y	Y	N	P	Y	Y	Y
Scale-specific approach: landscape level	FSC	P	Y	N/A	N	Y	Y	Y	Y
	PEFC	P	Y	Y	P	N	Y	Y	Y
Managing ungulate species at natural carrying capacity	FSC	P	N	N/A	N	N	P	N	P
	PEFC	Y	N	N	N	N	P	P	P

The following sections focus on a number of overarching trends that emerge from the main findings of Chapter 3 and contribute to this central message of the comparative assessments, highlighting the different ways in which the VFCS assessed represent an inconsistent application of CNF practices, as well as what are some of the implications of advancing CNF management practices using these existing schemes in their current form.

Varying Degrees of Alignment Across CNF Objectives and Tools

In view of the main findings of the comparative assessment, the national FSC and PEFC standards and Ekoskog show significant variation in their alignment with the different CNF objectives and tools that were assessed, with certain elements indicating stronger consistency across schemes while others reveal more persistent gaps.

The assessment of *increasing structural complexity* (section 3.1.1) illustrates this trend, with Ekoskog and FSC and PEFC standards in countries such as Germany, Poland, Romania, and Slovenia demonstrating strong alignment with the CNF guidelines. These standards, for example, promote **diverse forest structures and species composition,** an important condition for **enhancing biodiversity and ecosystem resilience** – key goals of the closer-to-nature forestry approach. Yet, the comparative assessment of another CNF tool, *promoting natural tree regeneration* (3.1.3), finds that there is a notable lack of **specific benchmarks or thresholds** observed in most national standards that could be used to assess whether fulfilment of the CNF tool is being achieved, and thus contributing towards its generally poorer assessment against the Guidelines.

This discrepancy between the fulfilment of the objectives and tools of the Guidelines is further evidenced by the assessment on *optimising deadwood retention* (3.1.7), which for example, refers to the importance of deadwood, but do not consistently impose specific quantitative targets for determining how much should be retained. The Ekoskog standard sets clear quantitative requirements with deadwood proportion representing at least 20% of stand volume and reaching a volume of 20m^3 per hectare. The PEFC standards show considerable variation in respect to deadwood retention, with some countries, such as Slovenia, setting clear requirements (e.g., leaving 3% of dead woody mass in the forest), while others provide more limited details. Moreover, this pattern of inconsistent alignment with the Guidelines can be observed across other CNF objectives and tools as well, such as *setting areas aside* (3.1.8) and *managing ungulate species at natural carrying capacity* (3.1.10).

Accordingly, this inconsistency in how the assessed VFCS approach deadwood management, set asides, among several other CNF objectives and tools assessed, is further evidence that as of present, certain elements of the Guidelines have been more effectively mainstreamed into national VFCS than others.

Inconsistency Between and Within Certification Schemes

The next overarching trend identified is that the extent of alignment with the CNF guidelines varies not only between the FSC and PEFC schemes, but also between the different national standards within each scheme. This inconsistency suggests that country-specific contextual factors play an important role in shaping the national certification standard, even though its criteria and indicators are in both cases anchored in the international benchmarks for FSC and PEFC. However, it is not possible to determine whether this trend is applicable to the Ekoskog standard, as it only applies to Sweden (with recent plans to include Finland and Estonia in the scheme) with a single set of criteria.

To elaborate further, in the comparative assessment of *promoting natural forest dynamics* (3.1.2), the FSC standards for Germany, Poland, and Romania show strong alignment, whereas the standard for Slovakia, for example, lacks explicit references to this particular CNF objective. Similarly, the PEFC standards in Italy, Poland and Slovenia demonstrate moderate alignment in this regard, while those in France and Romania have more apparent gaps, suggesting that while the international benchmarks for both schemes may provide the foundation for which the national standards are based, the process by which the national standards are developed plays a highly influential role in shaping the extent to which each standard does or does not sufficiently support the objectives and tools of the Guidelines. Furthermore, there are several key factors that can account for this variation in national standards within the same certification scheme. One is that national forest legislation, although not explicitly examined in this assessment, inevitably influences the form that standards take at the national level. This is because, regardless of the international benchmark on which they are based, national standards must operate within the existing legal and regulatory framework of their respective countries, which may either enable or constrain certain forestry practices. This could result in national standards choosing not to prohibit certain forest management practices that are already prohibited by national legislation, such as conducting forest management operations in old-growth forests.

This pattern of inconsistency is further evidenced by the comparative assessment on *taking a scale-specific approach* (3.1.9). In this case, both FSC and PEFC standards exhibit different degrees of alignment at different scales (individual tree, stand, and landscape level) and between different countries. For example, the Romanian FSC standard fully supports a scale-specific approach by requiring environmental impact assessments at all scales, from individual

trees to the level of the landscape. In contrast, most other national standards lack specific guidance on forest management at the level of individual trees or groups of trees. As they are currently presented, the inconsistencies of these standards result in different levels of precision in forest management across the EU.

Lack of Quantitative Targets and Specific Benchmarks

Another widespread and important weakness identified from the comparative assessment of both the FSC and PEFC standards is the repeated absence of clear, measurable targets or quantitative benchmarks in relation to the different CNF objectives and tools. This gap can therefore hamper the ability to determine whether and when different CNF practices are being effectively implemented on the ground.

Expanding on this trend further, the assessment on *increasing structural complexity* (3.1.1) highlights that in the case of both VFCS, national standards among most of the selected Member States lack specific, measurable targets or quantitative benchmarks for assessing progress towards achieving structural complexity in the forest concerned. For example, while the Italian PEFC standard sets a target of having more than 50% of the total forest area covered by ecologically adapted forest types and the Ekoskog standard prevents the planting of non-native species, most other standards lack comparably concrete targets. In addition, the assessment on *promoting natural tree regeneration* (3.1.3) reveals a similar pattern. As the majority of countries assessed demonstrate a lack of specific benchmarks or thresholds for determining the extent of natural regeneration, without clear targets, it is difficult to determine whether natural regeneration is being prioritised over artificial methods, and what the deciding factors are in each case.

In light of these findings, the lack of quantitative targets and specific benchmarks for these distinct aspects of forest management limits the ability of these VFCS to deliver measurable and verifiable improvements in forest ecosystem health and resilience to the exacerbating impacts of climate change. In addition, such gaps may challenge the ability to assess the effectiveness of VFCS as credible driver of CNF-aligned practices.

Gap Between Recognition and Operationalisation

The next overarching trend to emerge from the comparative assessment is that while many of the national standards recognise the underlying principles of the various aspects of the CNF guidelines in broad terms, they often fall short of providing detailed, operational guidance on how to implement them in practice. This gap, in turn, presents an important barrier to the practical application of CNF practices in certified forests across the EU, representing another area where these VFCS may currently be limited in advancing CNF.

Exploring this trend further, the assessment on *promoting natural forest dynamics* (3.1.2) demonstrates that while many of the standards assessed recognise the importance of natural processes – an aspect of forest management that is stressed by the Guidelines – they often lack specific and actionable guidance on, for example, promoting the use of light interventions or developing management approaches. For instance, the Ekoskog standard promotes the application of a landscape scale perspective but does not explicitly specify landscape level requirements in forest management plans. Examples such as these are demonstrative of the broader trend: that a lack of operational guidance could result in forest managers or practitioners struggling to translate the broad principles into specific, on-the-ground practices, leading to inconsistent or sub-optimal biodiversity outcomes.

Drawing from the assessment on *ensuring respectful harvest interventions* (3.1.4) can shed further light on this trend. The results of the comparative assessment found that while many standards appear to recognise the need for and refer to sustainable harvesting, they often lack explicit requirements for mimicking natural disturbance patterns through selective harvesting methods. For example, the German FSC standard promotes single to group-wise harvesting, yet it does not provide clear guidance on how to implement these practices in a manner that closely mimics natural disturbance regimes. However, Ekoskog limits timber removal to individual trunks or small groups, with a maximum patch size of 0.2 hectares, but there are no guidelines on how to mimic natural disturbance regimes.

Similarly, the comparative assessment on *setting areas aside* (3.1.8) indicated that while many national standards recognise the importance of conservation areas in general terms, there is often insufficient detail on ensuring that key elements of the CNF tool are fulfilled, such as to ensure connectivity between set-aside areas as set out in the Guidelines.

As these findings suggest, the gap between recognition and operationalisation in various aspects of forest management may limit the ability of these VFCS to effectively translate CNF principles into practice. Without clear, practical guidance, forest managers and practitioners may struggle to effectively implement CNF practices effectively in a way that maximises the biodiversity potential of the forest.

Stronger Focus on Conservation Than Active Enhancement

Another widespread trend that emerges from the main findings is that both the FSC and PEFC standards assessed often emphasise the maintenance of existing biodiversity or forest structures rather than actively enhancing or increasing complexity as advocated by the CNF guidelines. In contrast, the Ekoskog standard explicitly requires that forest management should increase the ecological value of the forest, and that measures should be taken to restore the complexity of the ecosystem. The more conservative approach of FSC and PEFC potentially limits the ability of these VFCS to drive significant improvements in biodiversity and ecosystem resilience in the forests concerned.

In the comparative assessment on *increasing structural complexity* (3.1.1), some of the national standards across schemes in Member States such as France, Sweden, and Slovakia, focus more on maintaining existing biodiversity rather than actively increasing structural complexity. This approach, while likely to result in the effective preservation of the *existing* environmental values of the forest, may miss opportunities to actively improve the health and resilience of forest ecosystems beyond their current state. On the other hand, the Ekoskog standard promotes the enhancement of the ecological value of the forest: measures must be taken to restore forest conditions if they deviate too greatly from their natural state, the ecological value of set-aside areas must be improved, and previously drained peatlands in the forest stand must be restored.

Furthermore, a similar pattern can be observed from the comparative assessment on *promoting natural forest dynamics* (3.1.2), where many of the standards focus on maintaining existing diversity rather than actively promoting increased forest complexity and natural dynamics. To use the Swedish FSC standard as an example, it requires the preservation of certain habitat types but does not provide more explicit guidance on enhancing natural dynamics in the forest areas concerned. In turn, this may lead to more static forest management practices that do not fully leverage the potential of natural processes that otherwise could be used to strengthen biodiversity outcomes.

Economic Considerations often prioritised

The final overarching trend identified from the comparative assessments, except for Ekoskog, is that, in several cases, and more often in the national PEFC standards assessed, **considerations of economic viability and timber production take precedence** over some CNF principles. This prioritisation of economic factors potentially limits the ecological benefits of certified forest management and may hinder the full implementation of CNF in the EU.

Looking into this trend further, in the assessment on *ensuring respectful harvest interventions* (3.1.4), some PEFC standards focus more on **maintaining the productive capacity of the forest in economic terms**, rather than on enhancing the biodiversity outcomes of the forest as emphasised in the Guidelines. For example, the French PEFC standard has a focus on maintaining productive capacity, stating that regeneration, maintenance, and harvesting operations should not reduce the productive capacity of the forest. While the economic viability of forest operations is indeed an important consideration, this stated emphasis in the national standard may lead to forest management decisions that prioritise **short-term timber yield over long-term ecosystem health and resilience**. Ekoskog, in contrast, imposes strict harvest and regeneration conditions that aim at conserving the long-term ecosystem health and resilience of the forest.

In addition, the assessment on *promoting natural tree regeneration* (3.1.3) shows a continuation of this trend, with some PEFC standards linking forest growth operations to the productivity of the forest, rather than focusing on the maintenance and promotion of natural processes. For example, the Swedish PEFC standard focuses its requirements for tree regeneration on the economic viability of timber production. Also, in areas where the standards show a stronger alignment with the objectives and tools of the CNF, e.g. on *increasing structural complexity* (3.1.1), some of the assessed standards make the implementation of diversity enhancing measures **contingent on economic feasibility**. This is highlighted by Polish PEFC standard, which explicitly mentions the objective of structural diversity in forest management but frames the implementation of diversity-enhancing measures as dependent on economic feasibility. This caveat could limit the application and effectiveness of measures to enhance important CNF objectives, such as increasing structural complexity, especially in situations where short-term economic considerations may conflict and be weighed against longer-term ecological benefits.

4.1. Strengths and suitability of standards assessed with the Closer-to-Nature guidelines

The results of the comparative assessments presented in Chapter 3 indicate that the FSC, PEFC and Ekoskog certification standards have several key strengths in aligning with and operationalising the objectives and intervention tools of the CNF guidelines. These strengths, in turn, provide a solid basis for the implementation of CNF practices in certified forests in the EU. The following sections highlight the four main areas in which these standards show particular promise and shed light on how the Guidelines can be translated into workable standards for use in the EU.

Strong support for increasing structural complexity

First, many of the FSC, PEFC and Ekoskog national standards assessed provide good examples of the CNF objective on *increasing structural complexity*. This strength is evidenced by the widespread recognition and promotion of diverse forest structures and species composition across multiple national standards.

The German FSC standard, for instance, requires the maintenance of ‘a varying mosaic of species, sizes, ages and spatial scales’, which closely reflects the CNF guidelines' emphasis on creating more diverse and mixed forests. Similarly, the Polish FSC standard prioritises diversity in plantation composition, including factors such as size, spatial distribution, and age classes, while the Romanian FSC standard contributes to structural complexity at the landscape level through the inclusion of High Conservation Value areas.

On the other hand, the national PEFC standards also show good practice in this respect, as the Italian PEFC standard set a concrete target of more than 50% of the total forest area being covered by ecologically adapted forest types. In addition, we also saw that the Romanian PEFC standard includes clear indicators for the degree of naturalness, while the Polish PEFC standard explicitly mentions the objective of structural diversity in forest management, including uneven-aged and mixed stands. Moreover, the results also showed how the Slovenian PEFC standard actively promotes diverse horizontal and vertical stand structures and species mixes through its forest management plans as part of the comparative assessment on taking a scale-specific approach to forest management.

Finally, Ekoskog requires that measures be taken to approach the state of nature in terms of the complexity of the ecosystem, such as the structure, variation, processes and biological diversity of the forest. The standard requires that if conditions in the forest differ significantly from natural conditions, restorative measures must be implemented to restore the complexity of the ecosystem.

Taken together, certification schemes strongly emphasise natural regeneration and species diversity as key components of structural complexity, with good examples provided by a number of national standards. This widespread recognition of the importance of structural complexity is a good example of how certain elements of the Guidelines can be implemented on the ground in the form of concrete standards.

Detailed approach to preserving soil and water ecosystems

In addition to the solid foundation that both VFCS provide for the CNF objective of increasing structural complexity, the FSC, PEFC and Ekoskog standards assessed also generally demonstrate a thorough approach to *soil and water protection*, and provide a number of strong, detailed examples of how to align with the CNF guidelines' emphasis on preserving what are essential elements of thriving, biodiverse ecosystems.

Certain national FSC standards focus on minimising the impacts of forest management by prescribing specific measures. This often includes requirements to protect water bodies and maintain riparian buffer zones, which is in line with the core objective of the CNF tool to better preserve aquatic ecosystems. Furthermore, certain FSC standards require measures to prevent soil erosion and compaction, particularly during harvesting and road construction. For example, the German FSC standard is a notable case for setting quantitative targets to limit soil disturbance, resulting in clear, measurable benchmarks for forest managers to follow.

Specifically, the standard sets a target that no more than 10% of the managed forest area should be used as logging roads.

However, the PEFC standards in particular show strength in this aspect of the Guidelines, particularly in how they often integrate soil and water protection into broader forest management planning. For example, a common feature of the assessed national PEFC standards, as exemplified by Slovenia and Germany, is the requirement to identify and specifically manage forests with protective functions, including those related to soil and water conservation.

Ekoskog shows strength in relation to the protection of soil and water ecosystems. The standard requires the minimisation of impacts of forest management on soil and water ecosystems. The standard specifically prohibits soil preparation, and the use of fertilisers and chemical or biological pesticides. In addition, Ekoskog is the only standard that includes criteria specifically focused on the protection of watercourses and wetlands, with the delimitation of protection zones around them. The standard explicitly states that the forest should be managed with the goal of restoring ditched wetlands to their natural state.

Recognition of landscape-level management

Moving on to the next area of good practice, a number of national standards in the FSC, PEFC and Ekoskog schemes also show a focus on *landscape-level forest management*, supporting one of the three scale-specific approaches outlined in the Guidelines.

This is particularly evident in the standards for France, Sweden, Slovakia and Slovenia for FSC, PEFC and Ekoskog. The Swedish PEFC standard, for example, requires all forest management planning to be carried out in a landscape ecological context, considering natural flow areas and ecosystem restoration needs. On the other hand, the national FSC standards for Sweden and Slovenia place a strong emphasis on maintaining or restoring a diverse mosaic of species, sizes and ages appropriate to the landscape. The Ekoskog standard specifically requires that forest management activities must be carried out in consideration of the landscape perspective. Landscape ecological considerations must also be included in forest management plans.

Another important and unique finding is that several national standards, particularly in the case of FSC, explicitly require environmental impact assessment at the landscape level. For example, the Romanian FSC standard require environmental assessments from the stand to the landscape level, helping to ensure that forest management decisions consider their wider ecological context and potential long-term impacts, as emphasised in the CNF guidelines.

Because of this widespread recognition of the importance of landscape-level forest management across multiple national standards and certification schemes, these results point to another area where there is a strong foundation for implementing the objectives and tools of the Guidelines.

Promoting natural forest dynamics

Complementing the landscape level approach, many FSC and PEFC standards are well aligned with the CNF objective of *promoting natural forest dynamics* in some respects. The FSC standards are notable in this area, with the national standards for Germany, Poland, and Romania demonstrating alignment with the CNF tool on *promoting natural forest dynamics*.

While there is room for improvement in a number of the national standards assessed, the general recognition of the importance of natural forest dynamics in many FSC and PEFC standards is another concrete example and good basis for how these VFCS can be further developed and used to more widely implement CNF management practices on the ground.

4.2. Gaps and weaknesses of the standards assessed with the Closer-to-Nature guidelines

Despite these strengths, the results of the comparative assessment have also revealed several areas where the FSC and PEFC standards, and the Ekoskog standard to some extent, fall short of fully aligning with the CNF guidelines.

Limited provisions for optimising deadwood retention

A gap observed in both FSC and PEFC standards is the often limited provisions for or references to *optimising deadwood retention*, a gap that is particularly evident in several national standards of both certification schemes. On the one hand, many FSC standards, including those of Germany, France, Slovakia and Slovenia, recognise the importance of deadwood, but lack specific quantitative targets for retention volumes. In contrast, there is more variation in the extent to which national PEFC standards have requirements for deadwood retention, ranging from detailed guidelines in some national standards (e.g. Slovenia) to vague or missing provisions in others. Ekoskog on the other hand, offers clear quantitative requirements on the retention of deadwood.

Ultimately, however, the lack of specific, quantitative targets for deadwood retention and the inconsistent treatment of this important aspect of forest management for achieving strong biodiversity outcomes represents a key gap in terms of these standards' ability to fully implement the CNF guidelines.

Infrequent provisions for setting areas aside

In addition to the limitations of the standards in terms of deadwood retention, many of the FSC and PEFC national standards assessed provide incomplete guidance for forest *set-aside*s relative to the CNF guidelines. This weakness is illustrated by the fact that several national standards in both schemes do not require connectivity between set-aside areas, nor do they provide guidance on facilitating biodiversity networks and corridors at different scales in coordination with adjacent forests, nor specific selection criteria for tree-related microhabitats within such areas. The Ekoskog standard also falls short of addressing the connectivity of set-aside areas.

Accordingly, the incomplete guidance on set-asides in many of the national standards of both FSC and PEFC schemes is one of the clearest gaps identified by the comparative assessment of the Guidelines. Addressing this gap could, in turn, greatly enhance the contribution of these certification schemes to a more CNF-oriented approach to forest management. Ekoskog, on the other hand, specifically requires that the management of set-aside areas must improve or preserve their conservation values.

Limited guidance on managing ungulate species

While the standards fall short in addressing set-asides, they also exhibit rather limited alignment with the CNF guidelines in terms of *managing ungulate species at natural carrying capacity*.

This gap is evidenced by a consistent lack of specific provisions for the management of ungulate species in most of the national standards assessed in among the certification schemes concerned. The FSC national standards assessed generally lack specific provisions for the management of ungulates at natural carrying capacity. While certain PEFC national standards in particular (e.g. Germany, Slovakia, Sweden and Slovenia) contain more references and detailed guidance on the management of ungulates, others lack specific guidance, in line with many of the key weaknesses of the standards identified in the assessment in general. Ekoskog does not include any reference to the management of ungulate species.

Furthermore, a more specific weakness revealed by the comparative assessment of this CNF tool is that FSC, PEFC and Ekoskog standards in the countries assessed, with the exception of PEFC Germany, do not explicitly address the use of protective barriers or fences to manage the impact of ungulates on forest regeneration, as recommended by the CNF guidelines. In addition, while hunting is mentioned as a management tool in some standards, it is often without clear guidance on how to maintain natural carrying capacity in accordance with the Guidelines. For example, the PEFC standards for France, Italy, and Slovenia, as well as the FSC standards for Poland and Slovakia refer to hunting, but do not provide specific guidance on its use as a tool for managing ungulate populations. The Ekoskog standard does not refer to hunting at all.

Insufficient guidance on respectful harvest interventions

Finally, the results of the comparative assessment showed that both FSC and PEFC standards often fail to provide sufficient guidance on *ensuring respectful harvesting interventions*, contrary to Ekoskog that provides strong requirements on this aspect.

Further investigation reveals that one of the factors contributing to this weakness is the lack of specific criteria for harvesting methods in many of the national standards, as shown by the comparative assessment of the PEFC national standards, which generally lack specific criteria for harvesting methods and instead often allow clear-cutting without clearly stipulated restrictions.

Even among the FSC standards assessed, which are generally better aligned, there remain significant gaps in alignment with the Guidelines. While some national standards, such as Germany's, promote single to group-wise harvesting, they often lack, for example, a clear focus on mimicking natural disturbance patterns. In addition, only a few FSC national standards (e.g. France and Sweden) explicitly restrict harvesting during ecologically sensitive periods, such as breeding seasons, as advocated by the Guidelines. As a result, this gap could potentially lead to significant disturbance of wildlife during critical periods and, in turn, challenging biodiversity outcomes.

4.3. Prospects and challenges for Closer-to-Nature Forest management

4.3.1. Outcomes in relation to Closer-to-Nature Forest management

Closer-to-Nature Forest management approaches can deliver significant environmental benefits, including enhanced biodiversity, improved ecosystem resilience, and stronger climate change mitigation. These ecological outcomes are intrinsically linked to the economic dimensions of forest management as well. For instance, CNF practices can reduce certain costs traditionally associated with forest management through less intensive interventions, instead having greater reliance on natural processes, while potentially increasing the resilience of forests to disturbances that may carry immediate economic consequences. While some short-term economic trade-offs may result from the transition to CNF management approaches, these practices can instead support long-term economic sustainability and stability through diversified income streams, reduced vulnerability to market fluctuations and external shocks, and the maintenance of multiple ecosystem services.

Economic impacts

In recent years, more studies have been focusing on the evaluation of the impacts of forest certification, particularly on economic aspects. Corticeiro et al. (2023) analysed the literature on forest certification ("forest certification" was either in the title, abstract, or keywords) and found 2565 publications, including 594 with European authors. ([122]) Researchers found that from the selected terms, *economy*, related family words, and *market* were the words that were found in a higher percentage of publications from Europe (86% and 62% respectively).

Forest certification is seen as an opportunity to increase a company's competitive advantage in the local and international market. ([123]) Certification schemes offer a valuable communication tool to improve a company's corporate image, recognition and reliability. A survey among Slovak forest owners and wood companies has found that for more than half of respondents, improved market access was the main motivation, slightly before environmentally responsible image and credibility creation. Numerous companies operating along the supply chain of wood-based products are guided by the need to respond to the consumers' demand for certified products. The intention to get a premium was considered as less critical, although the lack of premiums was highlighted as a main factor limiting the development of market in certified forest products. ([124])

Some studies have found that companies in the forest-based industry benefited more from an increase in sale than economic returns in terms of premium price for products. ([125]) A similar observation was made in a study comparing the extent of forest certification in EU Member

([122]) https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4816911

([123]) https://pubs.cif-ifc.org/doi/abs/10.5558/tfc2011-070

([124]) https://www.researchgate.net/publication/277641394_Survey_of_attitudes_towards_forest_and_chain_of_custody_certification_in_the_Slovak_Republic

([125]) https://open.fsc.org/entities/publication/2be898b9-4342-48b5-9718-99620666d6d7

States to forest outputs and related secondary activities (Corticeiro et al., 2023). ([126]) The study revealed an increase in revenues proportional to the percentage of certified forest within each EU country, with revenues plateauing after at least 70% of the forests having received In the forest-based industry, literature has shown that price premiums obtained via the adoption of forest certification are not the main motivation for both forest-based industry and large forest companies. Instead, the non-market benefits associated with forest certification are put forward.

Environmental impacts

Understanding the impacts of certification schemes on facilitating biodiversity-friendly practices as well as on environmental outcomes relevant to climate mitigation is essential. However, the evidence regarding the impact of forest certification schemes on environmental impact evaluation methods is limited. ([127]) ([128]) The lack of evidence on impacts relates to the complexity of the task: a systematic collection of data concerning impacts of forestry on biodiversity is lacking, and the diversity of forests and their geographic location creates different impacts no matter the forest management practices, which causes comparability issues. ([129]) The various studies that do exist on evaluating environmental impacts of forest certification are often limited by design and a methodology that may not be sufficiently rigorous to prove causation (ibid). In general, there is little information on how forests are managed in Europe, even more so for privately owned forests, beyond information about the conservation state of forests. ([130])

Nevertheless, despite data limitations, numerous studies have employed mixed methods to determine the impacts of such certification schemes, such as before-and-after comparisons, matched pair analysis (quasi-experimental design), synthetic control methods, and field-based ecological surveys. Remote sensing and GIS-based methods are providing more effective monitoring data for landscape-level analysis – however, certification effects may take years to become visible and assess, making short-term analysis challenging.

A recent global systematic review of impacts of forest certification between 1993 and 2021 showed an overall positive impact on biodiversity, carbon stock and emission reductions, forest structure and conservation areas in 53% of the studies reviewed for Europe (Wolff and Schweinle, 2022). In 2018, the Wageningen University led a qualitative Literature Review of Scientific Research on the Environmental Impacts of FSC and PEFC certifications and produced similar results. Di Girolami & Arts (2022) found an overall positive impact of forest certification (FSC and PEFC), compared to non-certified forests, in the 31 studies they reviewed. ([131])

An empirical WWF study in Estonia showed an increased number of biotope trees, deadwood and habitats for endangered species in forests certified by FSC. Di Girolami and Arts (2022), found in their qualitative literature review overall strong positive impacts associated to FSC and PEFC in preserving animal species, included ones listed as endangered or vulnerable by

([126]) https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4816911

([127]) https://www.ingentaconnect.com/content/oekom/gaia/2013/00000022/00000001/art00008

([128]) https://gupea.ub.gu.se/handle/2077/44417

([129]) https://www.wur.nl/en/show/Environmental-impacts-of-forest-certifications.htm

([130]) https://iris.unito.it/bitstream/2318/1866375/1/EFI_fstp_12_2022.pdf

([131]) https://www.wur.nl/en/show/Environmental-impacts-of-forest-certifications.htm

IUCN. ([132]) However, researchers note the importance of context, considering that positive results were achieved only when certified forests were surrounded by un-fragmented habitats, the intensity of logging low, and hunting strictly controlled.

In Portugal, it was found that cork oak woodland regeneration was more abundant in forest certified conservation zones. ([133]) Di Girolami et al.' studies review found that, overall, FSC certification was very important in temperate forests in Portugal to enhance landscapes important to biodiversity. ([134])

In the boreal biome, impacts of certification are more mixed, with issues associated with set aside areas. These areas were assessed as functionally well connected only for species with small habitat requirements, if pertinent at all. ([135]) Researchers note that a number of studies call for a strengthening of FSC indicators related to biodiversity conservation.

A recent study conducted a prospective exercise by estimating the potential outcomes associated with widespread (global) adoption of closer to nature forestry - see Rosa et al., 2023. ([136]) The aim was to determine if CNF could counteract global species loss arising from increased demand for forest biomass in climate mitigation scenarios until 2100. Researchers found that even if the EU could cover part its wood demand with internal CNF, that would not compensate for the negative impacts associated with imports of biomass under high climate mitigation scenarios with greater demand for lignocellulosic crops and energy wood. They add that banning clear-cut and reducing the impact of logging in regions outside of the EU with increased production within the EU would however reduce extinction risks and provide recommendations for how risks could be addressed through complementary measures.

4.3.2. Barriers to implementation and adoption

Based on a review involving 42 in-depth interviews with national experts and forest practitioners, Konczal et al. (2023) find that "personal motivations and knowledge of forest managers and their long-term economic thinking related to the resilience of the forest in the face of climate change" are the main factors facilitating the adoption of CNF. ([137]) From Konczal et al.'s (2023) study, the main barriers perceived across investigated countries ([138]) were current wood-market demands and a lack of public financial incentives:

> *"The majority of foresters responded that they felt under pressure to adapt forest management to developments of the wood market, with problematic consequences for forest biodiversity […] including homogenous demand for a certain wood assortment, be it in the form of timber or biomass. This translates into an incentive to practice uniform forest management, thus counteracting many principles related to stand or*

([132]) Ibid.

([133])https://www.researchgate.net/publication/266083388_Effects_of_forest_certification_on_the_ecological_condition_of_Mediterranean_streams

([134]) https://www.wur.nl/en/show/Environmental-impacts-of-forest-certifications.htm

([135]) https://www.wur.nl/en/show/Environmental-impacts-of-forest-certifications.htm

([136]) https://pubs.acs.org/doi/full/10.1021/acs.est.2c07867

([137]) https://www.sciencedirect.com/science/article/pii/S0301479722021922

([138]) Countries included as case studies within the study include: Austria, Belgium, Denmark, France, Germany, Poland, Spain, Switzerland and Sweden.

landscape diversity that are seen as crucial aspects for integrating conservation and forest use." ([139])

If forestry objectives tend to broaden to include nature conservation and recreation objectives, foresters listed economic objectives as the main objective in their district/country, which increases the pressure on foresters to satisfy market demands counteracting CNF principles. ([140]) The lack of national laws supporting or incentivising the adoption of CNF was also pointed as a factor hindering their adoption.

Researchers underline the importance of social factors as both enabler and hindering factor for the adoption of nature conservation measures into forest management practices with public pressure being a crucial factor influencing the uptake of CNF in Europe:

"When described as a facilitating factor, social pressure was related to the increasing environmental awareness in society and the expectations this raises towards foresters to implement (more) nature conservation measures. When described as an inhibiting factor, interviewees referred mostly to situations in which society does not support forest management in general and was perceived to expect strictly protected areas instead" ([141])

Beyond social macroeconomic factors hindering the adoption of CTN practices, Larsen J.B. et al. (2022) went through CNF principles to examine practical and economic barriers for adoption. ([142]) They point out that CNF require increased knowledge and flexibility from foresters in various respects. For example, the promotion of native tree species that may become maladapted in the face of climate change would require foresters to mobilise solid knowledge to select other rare native species that are more adapted. However, the growing impacts of climate change may motivate the transition towards mixed stands management, more resilient to disturbance, despite the complexity involved.

Larsen et al. (2022) underline the lack of supporting tools assisting foresters for maintaining landscape heterogeneity and managing forests at small spatial scale. ([143]) They also point out that "*the highly fragmented forest landscapes and frequently small-sized forest properties found in many parts of Europe pose serious challenges to landscape-level planning and management approaches*". ([144])

Implementing CNF may also increase operation and monitoring costs, induce increased planning, require highly trained workers and specialised low-impact machinery (including for the implementation partial harvesting and the promotion of structural heterogeneity, the preservation of forest structure during harvest, the promotion of genetic diversity or for avoiding other intensive management operations). Besides additional forest management costs, Moore

([139]) Ibid.

([140]) Ibid.

([141]) Ibid.

([142]) https://efi.int/publications-bank/closer-nature-forest-management

([143]) Ibid.

([144]) Ibid.

et al. (2012) underline the audit, time and preparation costs associated with compliance with the standards required for certification ([145]).

On the side of the forest-based industry, there are some administrative costs associated with certification. Galati et al., 2017 underline the fact that employees need to be trained to manage internal processes and procedures or use external consultants, which represents an increase in operating costs ([146]).

5. Performance grades used in voluntary certification schemes

Voluntary certification schemes in various sectors have successfully implemented **performance grades** to differentiate products based on quality or compliance with certain standards. Such graded approaches provide consumers with more detailed information than binary certification systems, potentially driving market preferences and incentivising producers to exceed minimum requirements. This chapter analyses established grading systems including the **EU Energy Label**, **Nutri-Score**, **UK Food Hygiene Rating Scheme**, and **USDA Beef Quality Grades**, as each scheme offers valuable insights into the development, implementation, and effectiveness of graded certification. Building on these examples, the chapter explores how similar approaches might be adapted for forest management certification aligned with CNF principles. Various **potential criteria and indicators for evaluating CNF practices are considered**, drawing from scientific literature and existing policy frameworks. In addition, different scoring methodologies are examined, including single indicator-based systems measuring forest management intensity or naturalness, and multiple indicator-based systems combining various quantified indicators. The analysis also considers both the practical implementation challenges and the potential benefits of introducing a graded approach to CNF certification in the EU.

5.1. Analysis of non-forestry certification schemes with performance grades

5.1.1. EU Energy Label

In 1994, Directive 92/75/EEC introduced an energy consumption labelling scheme for household appliances. Since then, the EU Energy Label has been expanded to provide information on the energy consumption of various products, such as fridges, washing machines and televisions. It helps consumers compare the energy efficiency of household goods at the point of purchase. The EU Energy Label allows them to choose the most energy-efficient appliances, which can help households decrease energy consumption and save money. This also contributes to reducing greenhouse gas emissions in the EU. Products covered by the EU Energy Label include:

- Fridges and freezers
- Dishwashers

([145]) https://academic.oup.com/jof/article/110/2/79/4599492

([146]) https://www.sciencedirect.com/science/article/abs/pii/S1389934116304336

- Washing machines and washer-dryers
- Electronic displays (televisions and monitors)
- Light sources

The EU Energy Label is a comparative scale from A (most efficient) to G (least efficient) that indicates the energy efficiency of household appliances. The Label includes information on the product's energy efficiency class and energy consumption (see right). It also shows additional information on non-energy parameters, such as water demand, noise emissions, and repairability, among others.

Besides providing information to consumers, the EU Energy Label serves to drive innovation among producers. It encourages manufacturers to develop and sell appliances that use more energy efficient technologies. Producers are interested in seeing their products appear in the highest-rated energy efficiency class(es) when compared to competitors. Accordingly, manufacturers of less energy efficient appliances are stimulated to enhance their products to improve their energy labels.

Over time, manufacturers have improved the energy efficiency of their appliances, causing fewer products to be placed in the bottom classes. This has gradually overpopulated the top categories, leading to the addition of the new classes A+, then A++ and A+++. Crucially, the least energy efficient appliances on the current market are more efficient than when the EU Energy Label was introduced.

To simplify labelling, the old labels have been replaced with a new classification system. The new EU Energy Label removed the categories A+, A++ and A+++ and reintroduced the A to G scale. In 2021, the EU started ‘rescaling’ products, readjusting their energy labels to the new labelling scheme. This reform aimed at improving the clarity of the labelling system and helping consumers differentiate between energy efficiency classes.

How the energy efficiency categories are assessed

In general, the process of calculating an energy efficiency graded label is dependent on the product, country of origin, and the specific standards in place. The calculation of energy efficiency involves laboratory testing, where products are tested in standardised conditions in a lab to measure energy consumption. Such tests are conducted under standardised conditions to ensure consistency across products. Data that is collected during the testing phase are utilised to calculate the energy consumption of product over a specific period, usually expressed in kilowatt-hours. For example, washing machines are tested with a standardised load (usually a mixed or cotton load) and at specific temperatures. The energy consumption per cycle is then measured and the energy consumption of a washing machine is normalised per kilo of laundry.

Energy consumption data is then used to calculate an Energy Efficiency Index (EEI), which is a ratio comparing the energy consumption of a specific product to a baseline or reference consumption for a specific product category. Baselines are derived from the performance of a typical product with average characteristics. The baseline consumption is defined by EU regulations and represents the energy use of an average product of a certain size or capacity. For example, the EEI for washing machines is calculated based on annual energy consumption, which is a typical estimate of household standard of 220 washing cycles per year. The reference value for annual consumption is based on typical energy use for similar washing machines. The EU often revises the energy efficiency ratings thresholds and testing standards to reflect technological advancements and changes to the quality of products based on market competition, in order to ensure the label provides up-to-date and accurate

information. Once figures are established for the product's energy consumption and the reference value, the Energy Efficiency Index is then calculated as the actual energy consumption of a product divided by the reference energy consumption times 100.

The EEI is then converted into a ratings scale, ranging from A (most efficient) to G (least efficient) based on the following EEI values:

- A: <41
- B between 41 and 50
- C: between 51 and 63
- D between 64 and 79
- E between 80 and 99
- F between 100 and 125
- G: > 125

Effectiveness of the label

In 2019, the special Eurobarometer 492 showed that 93% of consumers recognised the EU Energy Label while an additional 79% replied that they consider it when purchasing household products and that it influences purchase choices when buying appliances. ([147]) Indeed, evidence from multiple studies suggests that the coloured alphabetical scale is well understood and the restored A–G scale of the readjusted label positively valued, ([148]) ([149]) ([150]) ([151]) and consumers understand alphabetical frameworks better than numerical ones. ([152]) Before the 2021 revision, many appliances were rated A+, A++, or A+++, leading to confusion about what was truly efficient, making it difficult for consumers to distinguish between products and potentially undermining the label's effectiveness. While the grading system is easy for consumers to comprehend, there is confusion among consumers with regard to the information on energy consumption and the technical data at the bottom of the label. Comprehension of the quantitative information is technically challenging due to the complexity of the unit of measurement, as consumers lack understanding of how the product's performance is evaluated and calculated (De Ayala & Del Mar Solà, 2022).

Several studies suggest a positive willingness to pay for highly energy-efficient appliances, although its scale varies from country to country and varying consumer profiles, the year the study takes place, and appliance types (De Ayala & Del Mar Solà, 2022; Schleich et al., 2021). Indeed, findings demonstrate that the energy label has increased the market share of certain types of appliances, such as cold appliances (refrigerators and fridge-freezer combinations) with the highest energy label between 15 and 38% (Schleich et al., 2021). Consumers tend to prefer appliances with higher energy efficiency ratings, particularly those in the A and B categories (De Ayala & Del Mar Solà, 2022). This preference is often driven by the long-term cost savings associated with lower energy consumption – indeed there are discussions as to whether monetary information on long-term savings should be included with the information provided in the label to further facilitate consumer purchases towards highly efficient products (ibid).

([147]) https://europa.eu/eurobarometer/surveys/detail/2238

([148]) https://addi.ehu.es/handle/10810/64324

([149]) https://www.mdpi.com/1996-1073/15/12/4272#B16-energies-15-04272

([150]) https://c2e2.unepccc.org/kms_object/energy-labelling-the-new-european-energy-label-assessing-consumer-comprehension-and-effectiveness-as-a-market-transformation-tool/

([151]) https://onlinelibrary.wiley.com/doi/abs/10.1002/bse.722

([152]) https://londoneconomics.co.uk/blog/publication/research-on-eu-product-labelling/

There is evidence that the energy efficiency label has increased the market share of energy-efficient appliances, and the label has contributed to the overall improvements of the energy efficiency performance of appliances. Energy labelling has moved consumer behaviour towards purchases of better performing products thus incentivising manufacturers to improve the energy performance of their products to achieve higher ratings: The European Commission estimates that the energy efficiency label, combined with the Ecodesign Directive, have led to 46Mte energy savings (Van Holsteijn, 2022). With the EU periodically updating the label criteria to push the market towards more efficient products, a dynamic of continuous improvement is facilitated. However, there are concerns that the label itself leads consumers to focus on energy-related information, and to disregard information on how to reduce their own energy consumption behaviour – therefore, energy efficiency graded labelling may facilitate products' performance, but the impacts on reducing energy consumption are more limited (Waechter et al., 2015).

5.1.2. EU Nutri-Score

The Nutri-Score is a front-of-pack label that provides information about the nutritional quality of food and beverages. It comprises a five-colour scale, ranking food products across different categories (see below). These range from category A (dark green), indicating the highest nutritional quality, to category E (dark orange), indicating the lowest nutritional quality. The Nutri-Score can help consumers choose food products of higher nutritional quality.

The Nutri-Score was developed in France, following a request from the French Ministry of Health. In 2017, after it was compared to other labelling systems proposed by industry and retailers, it was first implemented in France. Since then, several countries have recommended the use of the Nutri-Score, including Belgium, Germany, Luxembourg, Switzerland, the Netherlands and Spain.

The European Commission is currently evaluating the Nutri-Score as part of a broader initiative to harmonise front-of-pack labelling across the EU. The Commission has acknowledged the Nutri-Score as a potential candidate for a unified EU label, but unlike the energy efficiency label, it has not yet mandated its use across all Member States. In 2020, a Commission report on front-of-pack labelling accompanied the Farm to Fork Strategy. The aim is to improve consumer understanding of the nutritional value of foods, as well as to incentivise food choices towards healthier foods. A public consultation ran between 2021 and 2022 and the option to provide information on product's nutritional value through a graded indicator was considered the most likely to encourage changes in food purchasing – 83% among academics, 72% among consumer organisations, 69% among citizens, and 54% among NGOs. ([153]) A Commission proposal for a harmonised system for front-of-pack labelling was expected to be announced by the end of 2023, however, similar to other Farm to Fork Strategy initiatives, it has been removed from the Commission work programme for 2024, and is not on the tentative agenda for forthcoming Commission meetings, and therefore there is uncertainty as to whether this proposal will be tabled in the near future.

In the countries that utilise the Nutri-Score, it is currently not mandatory for it to be displayed as a front-of-pack label, and it remains up to food companies to decide whether they want to have it applied to their products. Unlike the energy efficiency label, which mandates labelling across product lines, food companies can choose to apply the Nutri-Score to certain products in their portfolio, opting to display it on products that are likely to receive a favourable score,

([153]) https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-mandatory-front-of-pack-nutrition-labelling

once a company adopts the Nutri-Score there is an expectation that it should be applied consistently across its entire range of products in order to avoid misleading consumers by showing scores on healthier products, while omitting scores on less healthy ones. The French government strongly encourages companies that adopt the Nutri-Score to apply across their product line consistently and there is ongoing monitoring to ensure that companies do not selectively apply the Nutri-Score only to their healthiest products. However, this monitoring is not strictly regulatory, and 'enforcement' is mainly through reputational risk, scrutiny from consumer protection agencies and NGOs, and government pressure to extend use across their product range.

How the Nutri-Score categories are assessed

The development of a nutrition scoring system was initiated by the British Food Standards Agency nutrient profiling system (the FSA-NPS), namely the FSAm-NPS. This system gives foods and beverages points for the nutritional content per 100 g or 100 mL, wherein scores are based on the nutritional content of sugars, energy, saturated fatty acids, sodium, proteins and dietary fibres, as well as fruits, vegetables, legumes and nuts.

The Nutri-Score is calculated using a points system that evaluates both favourable and unfavourable aspects of a food product, where total negative points are summed, and the total positive points are subtracted from this number. The calculation starts with negative elements of a food product. Points are awarded for the content of a food product based on energy content per 100 grams or 100 ml; sugar content per 100 grams or 100 ml; the amount of saturated fatty acids per 100 grams or 100 ml; and sodium content per 100 grams or 100 ml. The more unfavourable elements the food product contains, the more points are given higher energy content, more sugar, higher levels of saturated fatty acids, and higher sodium results in more points. Once the points of unfavourable nutrients have been calculated, positive points are then deducted based on the presence of fruits (% in the product), fibre content (per 100g or 100 ml); protein content (per 100g or 100 ml).

Point allocation is typically in the following ranges:

- Energy: from 0 to 10 (per 100g/100 ml)
- Sugars, saturated fatty acids, sodium: from 0 to 10 or more based on the respective content level
- Fruits, vegetables, legumes, and nuts: up to 5, depending on % in the product
- Fiber and protein: up to 5 points each in total deductions, depending on their content levels

The calculation allows for adjustments of certain product types, such as dairy products, with specific rules to ensure fair comparison across food categories. The final score is calculated as the total number of negative points with the total number of positive points subtracted from this number. Letter grades are then given according to the following score ranges:

- A: highest nutritional quality: -15 to -1
- B good nutritional quality: 0 to 2
- C: moderate nutritional quality: 3 to 10
- D: Poor nutritional quality: 11 to 18
- E: Lowest nutritional quality: 19 to 40

The Australian/New Zealand Health Star Rating is a similar food nutrition rating system to the Nutri-Score, but the grading system is based on a scale of stars from 0.5 to 5, with half star increments. A higher number of stars indicates a healthier food product based on its nutritional profile. Similar to the Nutri-Score, the algorithm bases are determined by assessing positive and negative nutritional aspects of a food product and the measurements are the same,

however the Health Star rating makes adjustments for food categories, using different baseline points and modifiers, to ensure fair competition for similar types of food whereas the Nutri-Score only does this for selected categories. The label, however, displays specific nutrient information such as energy, saturated fat, sugars, sodium, and fibre and protein. The Nutri-Score uses two main categories (general foods and beverages), whereas the Health Star Rating differentiates between various food categories, such as beverages, dairy, oils, and spread, with specific calculation criteria for each.

Effectiveness of the label

While the Nutri-Score is a relatively new type of informational intervention, recent studies comparing the effect of various labels on food purchases have concluded that the Nutri-Score is the most effective labelling scheme in the improvement of the nutritional quality of food choices by consumers (Crosetto et al., 2020; Egnell et al., 2020), and that summary labels such as the Nutri-Score are more effective than nutrient-specific ones (Ducrot et al., 2016). There is a high level of recognition of the scoring system, with estimates of label recognition of up to 73% amongst consumers (Skretkowicz & Perret, 2023a). A much lower proportion of consumers (26%) utilise the score to compare products and integrate the score onto their purchasing decisions, but almost half of consumers indicate that the score helps them evaluate the nutritional composition of a product (ibid).

The effectiveness of Nutri-Score has been demonstrated in terms of consumer ability to correctly classify food according to its nutritional quality, the nutritional quality of actual and intended food purchases, and portion size choices (Andreeva et al., 2021; Julia & Hercberg, 2018; Skretkowicz & Perret, 2023b). In addition, consumption of foods that have lower scores on the Nutri-Score scale are perceived by consumers to be associated with chronic disease risk (cancer, cardiovascular disease, metabolic syndrome, etc.) (ibid).

Effectiveness though is more substantive for foods in the top third of their category nutrition-wise, whereas there are little to no impacts for purchases with medium or low scores – these effects mean that overall, the Nutri-Score improves the nutritional content of the entirety of consumer purchases by a small amount (Dubois et al., 2021). In addition, there is a lack of evidence as to whether the score influences food manufacturers to improve the nutritional content of their products due to the voluntary nature of the label (Hau & Lange, 2023).

5.1.3. The UK Food Hygiene Rating Scheme

The Food Hygiene Rating Scheme provides citizens with information on the hygiene standards of food businesses in the United Kingdom (UK). The Scheme is organised by the British Food Standards Agency in partnership with local authorities in England, Wales and Northern Ireland. It rates various types of establishments where food is prepared, sold and/or consumed. These include restaurants, bars, cafes, takeaways, canteens, food vans, schools and others. Businesses receive these ratings based on their hygiene standards.

The ratings provide information on the hygiene standards observed during an inspection. The Food Hygiene Rating Scheme does not give information on the quality of the food, customer service or comfort. Businesses are rated every time they are inspected by a food safety officer. The frequency of these inspections depends on the potential risks to public health associated with the business. The type(s) of food that are handled, the number and type of customers and the hygiene standards observed during the last inspection, are considered in determining the frequency of inspections.

The Scheme features ratings from 5 to 0:

- 5: hygiene standards are very good
- 4: hygiene standards are good
- 3: hygiene standards are generally satisfactory
- 2: some improvement is necessary
- 1: major improvement is necessary
- 0: urgent action is required

The rating of the Food Hygiene Rating Scheme is displayed at the business premises, usually at the entrance door, a front window or another prominent place. In turn, this allows customers to make more informed decisions about the places where they would like to buy food. It also aims to encourage businesses to improve their food safety standards. The Scheme is mandatory, and enshrined in law in Wales and Northern Ireland, but displaying the rating sticker is voluntary in England.

How the Food Hygiene scores are assessed

The Hygiene score is calculated based on an inspection conducted by a food safety officer from a local authority, who follows guidelines set by the Food Standards Agency. During an inspection a food safety officer assesses three main areas. The first is hygienic food handling, which includes preparation, cooking, re-heating, cooling, and storage practices and whether the business is following safe food handling procedures. The second is cleanliness and the condition of the facility, which involves layout, ventilation and other aspects of a facility that could affect safety. The third is the management of food safety, which evaluates how well the business manages and records food safety, including how it identifies and controls risks and whether the business has a suitable food safety management system in place. Each of these three areas is scored separately during the inspection, according to the following scale:

- 0 = urgent improvement is necessary
- 1 = major improvement is necessary
- 2 = improvement is necessary
- 3 = Generally satisfactory
- 4 = Good
- 5 = Very Good

The scores from the three areas are combined to provide an overall rating, which is based on the lowest score received in any of the areas. The rating is then converted into a food hygiene rating as indicated in the above section. If a business receives a low score, they can request a re-inspection after making improvements.

Effectiveness of the label

The UK Food Agency in assessing the effectiveness of the Hygiene Rating system, found mixed results: awareness of the system varies considerably and this awareness impacts consumer choices. ([154]) For those who were aware of the scheme, they are more likely to be concerned with food safety and hygiene and the risks of becoming ill. This higher level of awareness led to these types of consumers to use the Rating Systems as part of their food choices. However, for those with low levels of awareness of the scheme, the Ratings System did not factor into their food choices. Consumers also perceived the trustworthiness of the label to be quite high, but that due to its voluntary nature in England, that only businesses already

([154]) https://www.food.gov.uk/research/research-projects/the-value-of-the-food-hygiene-rating-scheme-and-potential-changes-to-regulatory-approach-consumer-research?print=1

adhering to high standards for handling and preparing food would participate in the scheme. Thus, consumers had high levels of support for making the scheme mandatory.

The effectiveness of the scheme on improving the hygiene of food establishments is also highly dependent on local socio-economic situations: in areas with high levels of deprivation, more categories of premises received significantly lower hygiene scores. ([155]) However, evidence does suggest that the mandatory nature of the scheme in Scotland and Wales does improve the level of compliance with food hygiene law, and in lowering levels of foodborne illness ([156]) ([157]).

5.1.4. USDA Beef Quality Grades

In the United States, the USDA beef grades provide information on beef quality. The Beef Quality Grading was designed to facilitate beef marketing by creating uniform categories on beef quality. Under the grading scheme, beef quality refers to various traits related to the characteristics of the beef, including flavour, tenderness and juiciness. The Agricultural Marketing Service of the United States Department of Agriculture (USDA) is responsible for grading beef. This is a voluntary service of the USDA, but meat processors can request an inspection to receive a grading. There exist eight USDA Quality Grades for beef: Prime; Choice; Select; Standard; Commercial; Utility; Cutter; and Canner.

The eating quality of beef is generally the highest for 'Prime' and the lowest for 'Canner'. Prime beef is usually produced from young, well-fed cattle and has abundant marbling, making the meat very tender, juicy and flavourful. Choice beef also has a high quality, but a lower degree of marbling. Select beef tends to have a uniform quality and is generally leaner than prime and choice beef. It may, therefore, be less juicy or flavourful. Standard and Commercial tend to have less marbling and are less tender and are usually not labelled if their grades are sold at retail. Utility, Cutter and Canner are typically used in processed foods or canned products.

There are three main criteria for grading beef quality. These are the degree of marbling in the beef the maturity of the animal, and colour and texture. Marbling is the distribution and amount of intramuscular fat). Beef with high levels of marbling is more likely to be flavourful, juicy, and tender. For colour, evaluators assess the colour of lean meat and its texture, which should ideally be bright, cherry-red colour, and a consistent texture. External fat is also evaluated, which should be white or creamy rather than yellow or coarse. Texture is evaluated through various methods, including the amount of connective tissue present. The age of cattle strongly influences the tenderness of the meat that is produced. Meat becomes increasingly tough as the animal matures. Five maturity groupings have been created to account for the maturing process:

- A: 9 to 30 months
- B: 30 to 42 months
- C: 42 to 72 months
- D: 72 to 96 months
- E: more than 96 months

Marbling is assessed using a scale that quantifies the amount of intramuscular fat. This is done using a marbling score system, where grades correspond to specific levels of marbling. Beef

([155]) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10270956/

([156]) https://www.sciencedirect.com/science/article/pii/S0956713518304432#sec4

([157]) https://core.ac.uk/download/pdf/161104074.pdf

graders evaluate the marbling in the ribeye muscle at the cut surface after the carcass has been ribbed between the 12th and 13th ribs. A carcass is then allocated a marbling score ranging from abundant (highest) to practically devoid (lowest). In certain cuts, the size of ribeye muscle is measured in square inches as is fat thickness. Determining age is less precisely measured, however certain indicators such as bone ossification can provide such information.

Despite these quantified measurements, the evaluation process lends itself to subjectiveness. While there are specific marbling standards within the grading system, the assessment involves a visual inspection by a trained grader, and different graders may have differing perceptions of marbling density and distribution, or meat and fat colour and texture - even the determination of age can be quite subjective. However, new electronic instrument grade augmentation systems capture images on camera, which can then be analysed by a computer programme, and is now available to assess using a smartphone – allowing beef to be analysed remotely rather than on-site. ([158]) Such instruments have increased the consistency and efficiency in grading for the beef industry. ([159])

Effectiveness of the label

Despite the voluntary nature of the grade labels, a significant proportion of beef processed in the US is graded: according to the USDA Agricultural Market Service (2013), approximately 80% of all federally inspected beef slaughter and 94% of steer and heifer slaughter are quality graded. ([160]) Thus, beef grading does play a strong role in marketing and pricing strategies amongst producers. There is also evidence that consumers value quality grades when selecting steaks. ([161]) However, despite the popularity of the grading system, there are still high levels of confusion amongst consumers regarding the indicators of quality, particularly on the role of marbling. ([162]) ([163])There is also confusion regarding the rankings of 'select', 'choice', and 'prime'. ([164]) Therefore, while there is a high level of participation amongst beef producers and a high level of consumer recognition, the understanding of the meaning of the quality grades amongst consumers is lacking. Many consumers associate higher grades with higher prices, which influences their perceptions of quality, assuming that more expensive beef is of higher quality, but the specific reasons behind this is less well-understood ([165]).

([158]) https://www.agriculturedive.com/news/usda-remote-beef-grading-pilot-uses-smartphones-to-assess-quality/705734/

([159]) https://www.usda.gov/media/blog/2011/10/19/new-technology-means-increased-consistency-and-efficiency-grading-beef

([160]) https://academic.oup.com/jas/article-abstract/92/7/3142/4702343

([161]) https://pubmed.ncbi.nlm.nih.gov/17526667/

([162]) https://academic.oup.com/jas/article-abstract/92/7/3142/4702343

([163]) https://www.mdpi.com/2304-8158/11/12/1732

([164]) Ibid.

([165]) https://www.fsis.usda.gov/policy/federal-register-rulemaking/federal-register-notices/notice-request-new-information-8

5.2. Applying graded certification schemes to forestry

5.2.1. Opportunity to shift consumer preferences and facilitate increasing ambition among forest managers

The evidence provided above suggests that consumer behaviour is influenced by various score-based, graded or ranking types of certifications. Graded certification schemes provide consumers with a more granular view of product quality or performance – rather than simply indicating whether a product meets a certain baseline for a standard, the performance certification schemes differentiate based on how well either the product performs (Nutri-Score, Energy Efficiency label, Beef Grades) or the level of standards utilised during production processes (Hygiene Scheme). Such schemes allow consumers to take complex information regarding a product and make a simple and relatively quick comparison with like-products – consumers can make informed decisions by understanding not just whether a product is 'good' or 'bad' but rather how good or bad it is relative to other products. Score-based labels can more effectively influence consumer behaviour because they not only validate compliance, but they also appeal to a consumer's desire for high-quality options, leading to higher sales for top-scoring products and encouraging more discerning choices.

An example of consumer preference for products that have been certified with a high rating under a grading scheme is the relationship between home prices and the energy efficiency label. Studies have found a positive relationship between the energy efficiency rating of heating products in a dwelling and the transaction price of a dwelling per square metre. ([166]) In the UK, the price of a home with an energy label H was on average 45% lower than that of a residential property with an A+ energy label in 2023; even those with an energy label B were worth 28% less. ([167])

With graded certification, consumers can be guided across a spectrum. While a non-score-based system indicates whether a product has met certain criteria, score-based systems guide consumers in choosing the highest quality of options that are available among those complying with the standards in a certification scheme. This is particularly useful in categories where a large proportion of products meet the basic standards in a certification scheme, but some perform better than others. Currently, under the FSC and PEFC certification schemes, there are a lack of opportunities to utilise the schemes' labels as a means of conveying practices going well beyond the baseline of achieving certification. Box 1 provides a case study of how despite going well-beyond the baseline for certification under the FSC, recognition of sustainable forest management practices utilised by foresters such as the Menominee managed forests in the U.S. is not information that can currently be communicated in a direct and easily understandable manner to consumers.

([166]) https://www.sciencedirect.com/science/article/abs/pii/S0140988314003296

([167]) https://sdlsurveying.co.uk/news/uk-watching-as-eu-house-prices-respond-to-green-measures/#:~:text=According%20to%20research%20from%20ING,less%20in%202023%2C%20it%20says.

Box 1: The Menominee tribe's tradition of sustainable forest management

The Native American Menominee tribe in Wisconsin, U.S. utilise traditional forestry practices developed in the 1800s. Outcomes from these traditional practices has resulted in forest under the tribe's management expanding its acreage since 1854 despite harvesting nearly 200 million cubic feet of timber over the past 150 years. The well-being of forest under the tribe's management has been attributed to practices placing the health of the forest above all economic priorities: sick or dying trees, or those that have fallen naturally are harvested first, leaving high quality trees to grow and reproduce. ([168]) Menominee foresters currently cut approximately a third of what the forest grows each year. ([169]) As a result, Menominee managed forests are more mature, with higher tree volume, higher rates of tree regeneration, more plant diversity, and fewer invasive species than nearby non-tribal lands. ([170])

Menominee managed forests are thus considered to be the healthiest managed forest in the United States. They were among the first to be certified by the FSC and are considered by the certification body to be an exemplary model of sustainable forest management – the majority of Menominee forest is rated as HCV by the FSC with large expanses where naturally occurring species exist in natural patterns. ([171]) There is also a price premium among lumber companies purchasing Menominee wood of approximately 5%. ([172]) However, despite this recognition within the forest supply chain, there is currently no means of communicating Menominee practices to consumers. To identify Menominee forest products, a QR code from the FSC must be scanned which identifies its origins – something consumers are unlikely to consider at the point of purchase. Thus, despite being considered as the 'gold standard' of forest management in the U.S., the vast majority of consumers are unaware of such distinctions between sustainable forest management approaches and practices when deciding to purchase a forest-based product.

The potential for a graded certification scheme for forest management is highly dependent on consumer willingness to pay for improved sustainable management practices. While the evidence provided above from other graded certification demonstrates consumer preference for higher quality goods, much of the decision-making process in choosing to purchase higher scoring products is based on personal interest: for the energy efficiency label, consumers consider the potential monetary savings over a period of time due to the lowered levels of energy use; for the Nutri-Score label and the Hygiene Scheme, consumers consider the value of nutrition in a product in relation to their personal health; and for the USDA Beef scheme, consumers are associating a higher quality product with taste and enjoyment. For a sustainable forest management graded certification, consumer considerations of purchase would be almost entirely based on a desire to protect the well-being of forests and an awareness of the environmental benefit of healthy forests. The link between the consumer's well-being and the choice of product to consume is much less direct in comparison with the case studies provided in Section 3 – for example consumers may be less aware of the co-benefits forests contribute to, which directly impact their well-being, such as water quality, decreased air pollution, and climate change mitigation.

([168]) https://courses.washington.edu/dtsclass/TEK-Menominee.pdf

([169]) Ibid.

([170]) https://digitalcommons.dartmouth.edu/facoa/3482/

([171]) https://www.mtewood.com/Content/files/MTEHCVassessmentCAR20144.pdf

([172]) https://www.nytimes.com/2023/04/22/climate/menominee-forest-sustainable-earth-day.html?unlocked_article_code=1.GE4.H87R.-cO7VFPKEs-a&smid=url-share

Evidence does suggest that consumers have developed a growing concern for sustainable forest management ([173]); in particular, in Europe young people between the ages of 18 and 35 are showing increased awareness towards the issue. ([174]) Several studies have demonstrated that a higher level of education is correlated with a higher degree of attention to and knowledge of environmentally sustainable practices. ([175]) ([176]) ([177]) Consumer focus on more environmentally sustainable products has enabled the existence of a niche market for SFM-certified goods. ([178]) Conducting a meta-analysis of over 200 studies estimating consumer willingness to pay for products certified as sustainably managed, Poratelli et al. (2022) estimate that in monetary terms, the average European consumer's willingness to pay ranges from 17% for products with a higher base price, such as furniture, up to 68% for those with a lower price, such as paper. ([179]) Globally, estimates range from 1-39%. ([180])

Several parameters drive consumers to choose certified forestry products, such as socio-demographic factors, prior knowledge of brands and labels, and choice of product attributes. The rationale behind certification of wood products is based on the premise that the end consumer, aware of the benefits of sustainable forest management, when given a choice between two identical products, would choose the certified one. ([181]) Several scientific studies have analysed consumer behaviour in relation to products with forest certifications ([182]) ([183]) ([184]); these studies have shown that indeed consumers do demonstrate an inclination towards purchasing environmentally friendly products. The drivers that lead consumers surveyed to choose certified products are related directly to concerns over sustainable forest management, but also to the benefits that this type of management brings to human health.

Incentivising producers to enact gradual improvements

With changes in consumer behaviour the evidence provided above demonstrates that graded certification schemes have facilitated gradual improvements in both the efficiency of final products (energy efficiency label) as well as hygienic practices for food preparation (Hygiene Scheme) allow for improvements and can facilitate the increasing ambition of a product's quality. In a score-based system, producers are more likely to compete on the quality of their products or production methods to achieve higher scores, leading to overall improvements in the market. As the energy efficiency label demonstrates, when the grading scheme is updated to reflect changes in the overall market (i.e. innovations creating more efficiencies, or a shift of most producers receiving high scores), the score-based system creates a continuous incentive for innovation: to remain competitive, producers need to maintain their high score to be perceived as high-quality by consumers.

([173]) https://books.google.ch/books/about/Consumer_Behaviour.html?id=ESGIeHG3NDQC&redir_esc=y

([174]) https://www.sciencedirect.com/science/article/abs/pii/S0969698920313126

([175]) https://www.tandfonline.com/doi/full/10.1080/10454440903415709

([176]) https://link.springer.com/article/10.1007/s10668-020-01073-6

([177]) https://psycnet.apa.org/record/2016-14811-001

([178]) https://cdrlaw.org/wp-content/uploads/2020/05/c245f12d81a94601bf82dc3e07498ba20a2a.pdf

([179]) https://iris.unito.it/retrieve/1e8776b9-39cd-418b-8001-0747cc2ca108/10.2478_fsmu-2022-0003.pdf

([180]) https://www.sciencedirect.com/science/article/abs/pii/S1104689912000256

([181]) https://academic.oup.com/jof/article/97/2/18/4614020

([182]) https://www.sciencedirect.com/science/article/abs/pii/S0969698920313126

([183]) https://www.proquest.com/docview/220831387?pq-origsite=gscholar&fromopenview=true&sourcetype=Scholarly%20Journals

([184]) https://www.cabidigitallibrary.org/doi/pdf/10.5555/20123321755

A graded label for Closer to Nature sustainable forest management could allow for gradual improvements for foresters aiming to shift towards practices that are approximating towards 'naturalness', providing incentives to go beyond the minimum baseline within current certification systems. In the current non-score-based system for forest management certification, as long as a forest manager meets the minimum criteria under schemes such as the FSC or PEFC, there is less motivation for producers to improve their practices further.

Unlike the Energy Efficiency Directive and the energy label, the Closer to Nature guidelines are a voluntary policy mechanism, and thus not all foresters would be mandated to participate in a graded certification scheme. Therefore, in addition to consumer willingness to pay, another question is whether producers can be incentivised to voluntarily participate in the graded scheme. As discussed above, public pressure is one of the strongest drivers incentivising the adoption of nature conservation measures among foresters. ([185]) Findings reveal that the most valued motivations for forest certification are related to attracting customer attention and the improvement of companies' corporate image. ([186]) ([187]) ([188])

However, one of the main hindering barriers of the adoption of such measures is the current lack of financial incentives. ([189]) The impediment for closer to nature forest management relates to the overwhelming demand for provisioning services, be it in the form of timber or biomass. This translates into an incentive to practice uniform forest management, thus counteracting many principles related to stand or landscape diversity. ([190])

Despite the evidence of a price premium for SFM certification under the PEFC and FSC, multiple studies have suggested that the price premiums are not reflective of the true costs of improving forest management practices. ([191]) The perceptions of forest managers are that in order to gain enough of a competitive edge from certification in relation to non-certified products, certification strategies need to be redeveloped entirely. ([192]) Increasing market demand for high-quality wood products is perceived by foresters as potentially supporting the integration of improved management practices: such demand could strengthen the demand for single tree forest management aimed at producing quality timber and creating structural diversity in forest stands. ([193]) This could be accomplished with an outward facing strategy where differences in management approaches are better communicated to consumers. A graded certification label for sustainable forest management has the possibility to create greater public awareness of different approaches to sustainable forest management as well as drive changes in consumer behaviour. Changes in consumer behaviour in turn can potentially create price premiums for stronger forest management standards, thereby further facilitating financial incentives for producers.

([185]) https://www.sciencedirect.com/science/article/pii/S0301479722021922

([186]) https://www.sciencedirect.com/science/article/pii/S095965262100487X

([187]) https://bnu.repository.guildhe.ac.uk/id/eprint/17750/1/17750_Ioras_F.pdf

([188]) https://www.sciencedirect.com/science/article/abs/pii/S0264837714000751

([189]) Ibid.

([190]) https://academic.oup.com/forestry/article/89/1/1/2465756

([191]) https://www.mdpi.com/2071-1050/10/7/2470

([192]) https://www.mdpi.com/1999-4907/6/8/2879

([193]) https://www.sciencedirect.com/science/article/pii/S0301479722021922

5.2.2. Potential approaches and criteria for certifying Closer-to-Nature forest management performance

Based on the review of other types of certifications reviewed in the previous section, potential approaches for identifying baselines, thresholds and targets for certification could be:

- Scores are converted into a descriptive category that reflects the uniqueness/high quality of the production standards. This could be executed through the creation of one category identifying a baseline where a managed forest meets the minimum score deemed to be 'closer to nature'; an alternative could potentially create multiple categories of forest management based on approaches, such as 'close-to-nature forest', 'multi-functional forest', 'intensive even aged forest', 'short rotation forest'; this would be similar to the USDA beef grades
- A graded certification approach, wherein scores are converted into a grade ranging from low to high, for example, from A=highest grade to G =lowest grade; this would be similar to the Energy Efficiency label and the Nutri-Score

Potential approaches towards determining scores could include the following:

- A single indicator-based scoring system: a scoring system based on an algorithmic calculation measuring for example 'forest management intensity' or 'naturalness of a forested area' in which forest management performance is compared to a baseline; this would be similar to the energy efficiency label
- A multiple indicator-based scoring system: a scoring system based on the conversion of several quantified indicators into an ordinal scale (i.e. 0 to 5, or 0-10), and the converted scores are summed into a final grade; this would be similar to the Nutri-Score

Another alternative approach to the development of a score-based system based on quantified indicators would be to adopt a process-oriented approach, similar evaluation system as the Preferred by Nature certification scheme. This would instead focus on the practices adopted by a forester rather than quantified outcomes. The Preferred by Nature certification scheme certifies existing certification schemes which ensure forest products come from responsibly managed forests, meeting high environmental, social, and economic standards. The scheme is built upon a Sustainability Framework, which encompasses a comprehensive set of requirements designed to promote sustainable practices. The certification process evaluates compliance with environmental regulations, conservation of biodiversity, and engagement with local communities. The scheme primarily evaluates practices rather than direct performance outcomes, and assesses whether organisations have implemented procedures, policies and management systems to ensure sustainability. For example, the certification ensures forest managers have a biodiversity protection plan, but it does not mandate a minimum percentage of set aside areas. An approach to CNF certification could include a checklist of CNF forest management practices included in the CNF toolkit (such as the management of ungulate species at natural carrying capacity).

However, in this section, we will focus potential approaches towards determining a score based on quantifiable outcome-based indicators, which is based on a review of both scientific literature as well as policy approaches towards the identification and estimation of close(r) to nature forest management that could potentially be applicable to the development of a graded certification scheme.

Assessing different types of forestry practice is complicated because of variation both in the nature of the forest resource and in the impacts of different management measures in space and over time. European forests cover a wide range of climatic zones and forest types, ranging from the spruce–pine forests of boreal Scandinavia to the mixed oak and pine forests of

Mediterranean Europe. In addition, there are extensive plantation forests of conifers in Atlantic Europe and broadleaved plantations in Hungary and other Central European countries. In each of these forest types, a range of silvicultural operations can be applied, from intensive systems based on clear felling and artificial regeneration to the fostering of irregular stand structures based on natural regeneration. A forester's selection of silvicultural practices has to be made in a wider context and many factors influencing these decisions are beyond their control.

In general, there are two main approaches in the scientific literature in characterising forest management approaches. The first approach involves the classification of forest management approaches based on multiple indicators. These management categories are used to compare either the 'intensity' of forest management practices, or the approximation of the managed forest towards 'naturalness.' The categories in these classifications include both quantitative and qualitative indicators, which can be utilised to evaluate forest managers in determining either which forest management class they approximate according to the intensity of practices (management intensity) or which forest type they approximate according to the characteristics of the forest (naturalness). Once of the main purposes of these classifications is to identify alternative management approaches and how they vary along a determined set of criteria and indicators. There are many examples of multi-criteria classifications of forest management approaches. ([194]) ([195]) ([196]) ([197])

Naturalness is a characteristic of forest ecosystems resulting from the historical evolution of forests, land use legacies, and current forest management. ([198]) Naturalness is impacted by silvicultural interventions and management intensity that affects the characteristics of the forest. ([199]) For classifications according to naturalness, Hornstein (1950) ([200]) suggested different forest types depending on the naturalness of forest plant community and naturalness of the site. Hornstein's classification of forest types according to naturalness includes primary forests, secondary forests, close-to nature forests, far-from-nature forests, alien-to-nature forests and artificial forest types. Other naturalness classifications, including Buchwald's (2005) terminology for more natural forests, further distinguish forests into categories such as primeval forest, virgin forest, frontier forest, near-virgin forest, old growth forest, long untouched forest, newly untouched forest, specially managed forest, exploited natural forest, plantation-like natural forest, partly natural planted forest, native plantation, exotic plantation, self-sown exotic forest. ([201]) Naturalness classifications focus on the level of impact from human activities on a forest, how human interventions impact species composition and whether the composition of forests approximate that of which would be found in virgin forests. ([202]) Other factors observed in evaluating naturalness include the level of maturity of a forest, whether the forest is regenerated naturally or artificially (or through a combination of both), and whether the structure of the forest has been created artificially with alien species, and how intensively is it cultivated. ([203]) Forests classified as being close(r) to nature under naturalness classifications are usually described as predominantly consisting of native trees

([194]) https://pubs.cif-ifc.org/doi/abs/10.5558/tfc84678-5

([195]) https://www.jstor.org/stable/26269224

([196]) https://www.tandfonline.com/doi/abs/10.1080/02827581.2011.564383

([197]) https://www.sciencedirect.com/science/article/abs/pii/S0378112709005131

([198]) https://bg.copernicus.org/articles/12/4291/2015/

([199]) https://link.springer.com/content/pdf/10.1007/s13280-024-02050-3.pdf

([200]) von Hornstein, F. 1950. Theorie und Anwendung der Waldgeschichte [Theory and application of forest history]. Forstwissenschaftliches Centralblatt 69, 161-177 (In German).

([201])

([202]) Ibid.

([203]) https://balticforestry.lammc.lt/bf/PDF_Articles/2005-11%5b1%5d/39_45%20Saudyte%20Karazija%20&%20Belova.pdf

that are planted or sown, with an uneven-aged structure, mixed species, and significant levels of natural regeneration. ([204])

Classifications of forest management intensity, instead of focusing primarily on the characteristics of the forest, also factor in silvicultural operations practiced and the degree of human manipulation of natural forest development. The focus is on how forest management practices can be mapped along a gradient of intensity of resource manipulation, from low to high. Most forest management intensity classifications have tended to adopt a three-category classification, which contrasts forests that are usually under conservation protection with intensively managed plantations, and some form of an alternative forest management type that approximates close(r) to nature forest management, although varying in the level of strictness in its adherence to the Closer to Nature forestry guidelines outlined in Section 2.4. The three-type classification systems have been criticised as being an oversimplification of the variety and range of forms of silvicultural systems that can be used in managed forests, and thus, more detailed forms of classifications have been formulated. ([205])

The most-oft cited classification of forest management intensity is that developed by Duncker et al (2012), which establishes the basic principles of five different forest management approaches on a scale ranging from passive or low end to intensively managed, for example from unmanaged forest. ([206]) Box 2 below provides an overview of this five-fold typology of forest management intensity. These five categories are not necessarily mutually exclusive, and thus there are often overlaps in the field among the classifications. A limitation of the classification system of forest management intensity is that the diversity in the characteristics of forests, while are important indicators of assessing the impacts of forest management approaches, are challenging to locate within the scale of intensity. ([207])

([204]) https://link.springer.com/content/pdf/10.1007/s13280-024-02050-3.pdf

([205]) Ibid.

([206]) Ibid.

([207]) https://library.wur.nl/WebQuery/wurpubs/435926

Box 2: Duncker's (2012) Classification of Forest Management Approaches

1) Passive – Unmanaged or conservation forests*:* Natural processes and natural disturbance regimes develop without management intervention and ecological goals are given primacy. The primary objective for forest managers is to maintain ecologically valuable habitats and their dependent biodiversity, while also providing a reference for the development of close-to-nature silviculture. The forest can be utilised for recreation and basic applied research. No operations are allowed that might change the nature of the area.

2) Low – Closer to nature forests: The objective is to manage a stand with the emulation of natural processes as a guiding principle. Economic output must occur within this frame. Any management intervention must enhance or conserve the ecological functions of the forest. Timber can be harvested and extracted during these activities, but some standing and fallen deadwood must remain in the forest. Only native or site-adapted species are chosen. The preferred method of regeneration is natural regeneration. Planting can be used to re-introduce native species into a devastated forest, but genetically modified species cannot be used. Species mixture follows the typical composition for the stand type. Guidance on natural processes must be emulated. Selection is based on target diameters and stem quality rather than age. The final harvesting system should stimulate natural disturbance mechanisms. Clear cuts are not allowed. Machine operations are limited to a minimum to protect natural structures.

3) Medium Combined objective forests (described in other literature as 'multi-functional' forests): Ecologic and economic management objectives are combined: in addition to provisioning services, additional objectives include habitat, water, and soil protection, game management and nature protection, fire and flood prevention. Native or introduced tree species suitable for the site are chosen. The preferred regeneration method is natural regeneration, but planting or seeding is acceptable to introduce native or desired species that would otherwise not occur. Products of tree breeding can be planted, but genetically modified planting material cannot be used. Tree species mixtures are typical for the forest type. Site cultivation and or fertilisation can be carried out to enhance the development of the forest, provided that these treatments are necessary to restore vegetation. Chemical pest control can be used in outbreaks. Minor outbreaks should not be treated with pesticides. Rotation length is often longer than the age of maximum mean annual volume increment (MMAI) unless economic objectives are jeopardised.

4) High – Intensive even-aged forestry: The main objective is to produce timber. If ecological aims can be achieved without much loss of revenue, they are normally incorporated. No or relatively small age differences occur among individual trees. The age differences are usually less than 20% of rotation length. Typical stands consist of even-aged monocultures (sometimes with a small percentage of admixed species). Any non-invasive tree species suitable for the site can be chosen. Planting, coppice, seeding, and natural regeneration are all possible regeneration methods. Economic factors are used to decide among the alternative methods. Planting/seeding material can be genetically improved. Typically, monocultures with small percentages of mixed species stands are used to implement this strategy. Site preparation is often used to enhance establishment success. Remedial fertilisation is used to increase growth rates. The rotation length depends on the economic return and is normally similar to or shorter than the age of MMAI. Biomass extraction is commonly limited to solid wood volume but might include whole-tree extraction for energy use. Machine operations are not limited, as long as they do not harm the environment. The final harvest system is preferably clearcut or a combination of shelterwood and clearcut

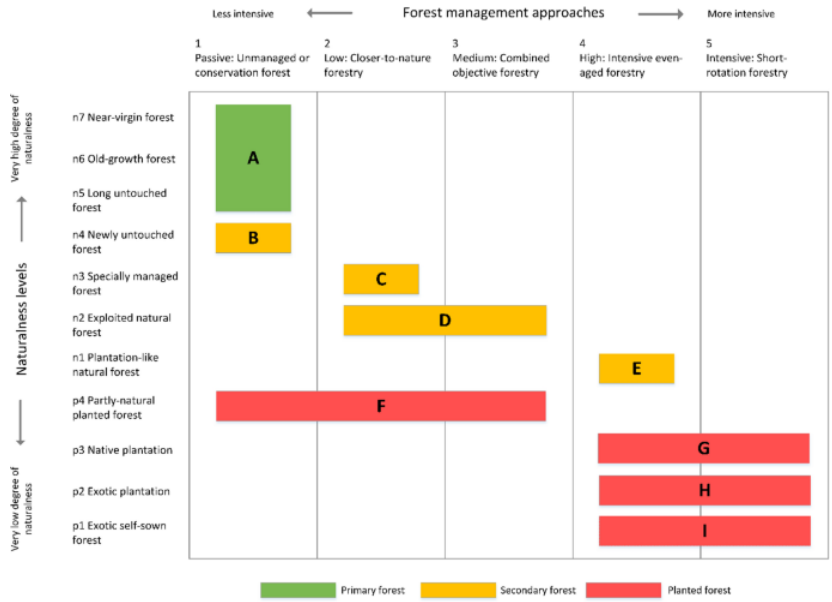
5) Intensive – Short rotation forestry: The main objective is to produce the highest amount of timber or wood biomass for economic purposes. Ecological objectives play a minor role. Tree species selection depends on economic return. No natural colonization by other tree species is permitted if it reduces the growth of the chosen tree species. Sites are mechanically cultivated and can also be drained or irrigated if needed. Fertilisation and liming

are applied to the stands to enhance growth. Chemicals are used to treat pests and diseases and also for weed control. The rotation length only depends on the economic return, is often 20 years or less, and no biological legacies are included. No other habitats are maintained within the stand. The intensity of machine operations is at a maximum compared with the other approaches and is only limited by national environmental laws. The harvesting system is clearcutting combined with removal of all woody residues if there is a suitable market for them.

Barredo et al. (2024) presents an archetype typology of forest ecosystems that combines management intensity and naturalness to account for both aspects. The rationale behind the archetype typology is to provide a framework simplifying the complex links between forest management and naturalness, connecting how forest management impacts the degree of naturalness. The approach is to better encapsulate the diversity of forest types within the forest management approaches. The typology combines Buchwald's (2005) 11 categories of forest naturalness and Duncker's (2012) 5 categories of management intensity, yielding 55 possible combinations. From these 55 potential combinations, Barredo et al. (2024) delivered a set of 9 archetypes organised from high to low degree of naturalness and from less to more intensive management (see Figure 1 below and described in Box 3 below).

While the categories of primary forests (A) and newly untouched forests (B) would be excluded from a graded certification scheme due to the fact that logging in these forests would be prohibited, Barredo et al.'s (2024) archetypes C (specially managed forest under closer to nature forestry) and D (exploited natural forest under closer-to-nature forestry) to I (exotic self-sown forest under intensive even-aged or short-rotation forestry) could be considered for graded categories under a closer to nature. certification scheme. The archetypes ranging from E (plantation-like natural forest under intensive even-aged forestry) through to I (exotic self-sown forest under intensive even-aged or short-rotation forestry) would not be certified as CNF under such a scheme but could nevertheless be considered as categories for a graded scheme that would not be certified as CNF.

Figure 1: Barredo et al.'s (2024) Archetype Typology of Forest Ecosystems ([208])



([208]) https://link.springer.com/content/pdf/10.1007/s13280-024-02050-3.pdf

Box 3 - Barredo et al.'s (2024) archetypal typology of European forests based on management intensity and naturalness ([209])

A = *primary forests*: highest degree of naturalness, characterised by near-virgin forest, old growth and long untouched forest; either unmanaged or managed solely for nature conservation.

B = *newly untouched forest*: moderately high degree of naturalness although they are not considered primary forests; forest operations have been discontinued and is free from direct human disturbances for 60-80 years.

C = *specially managed forest under closer-to-nature forestry:* low intensity and presence of old growth attributes, significant biodiversity value, includes coppice, pasture forests, non-industrial selective logging, stands with protective functions

D = *exploited natural forest under closer-to-nature or combined objective forestry:* managed forest so that the forest structure and species composition is significantly changed from the originally natural state but still consisting of predominantly of self-sown native trees, and without a plantation-like structure

E = *plantation-like natural forest under intensive even-aged forestry:* predominantly consisting of self-sown native trees with high-intensity forest management; forest structure is plantation-like by being even-aged, having relatively low tree ages, fairly regular tree spacing, and only one or two tree species in the canopy layer

F = *partly natural forest under passive to medium intensity forest management:* predominantly consisting of native trees that are planted or sown, these forests have an uneven-aged structure, mixed species, and significant ingrowth of self-sown trees.

G = *native plantation under intensive even-aged or short-rotation forestry*: even-aged forests predominantly consisting of native trees established artificially by planting or sowing with regular spacing. Often monospecific stands, but occasionally two or more species are established together.

H = *exotic plantation under intensive even-aged or short-rotation forestry:* predominantly consisting of even-aged non-native tree species where stand origin is artificial by planting or sowing

I = *exotic self-sown forest under intensive even-aged or short-rotation forestry:* predominantly consisting of self-sown non-native tree species. Forests in this category can spread at an undesirable scale to the extent that it has replaced or seriously suppressed native species previously occupying the area

In utilising different existing potential classification systems for the development of a graded certification for forest management, consideration of potential criteria and indicators, and their feasibility in the development of a scoring system, must be taken into consideration as well. Multiple criteria have been proposed for determining the utility of indicators of forest management intensity and naturalness. For both types of classification systems, criteria and indicators must distinguish between natural and anthropogenic features, they must be reliable in the sense that they are objective and produce consistent and precise results, they must be readily calculable from available data, they must be sensitive to a large range of effects, and they must be appropriate at multiple spatial scales.

([209]) Ibid.

Currently, there is no agreed-upon set of criteria and indicators within the scientific literature on how forest management approaches must be identified and measured, including close(r) to nature forest management. ([210]) Nevertheless, there are criteria and indicators which can be quantified to identify close-to-nature forest management and other approaches. For this report, we collected potential criteria, indicators, and measurements that could potentially be integrated into a graded certification scheme. The extraction of these criteria and indicators comes from existing literature that quantifies closer-to-nature forestry for the purposes of estimating current uptake along with modelling potential future forestry scenarios. Table 29 below provides an overview of Close-to-Nature forestry scientific literature from which indicators and measurements were extracted for the purposes of consideration in the development of a graded certification scheme.

Table 29: Studies consulted on criteria and indicators for this chapter

Scientific studies which utilise close(r) to nature indicators and quantitative measures in the estimation of uptake and/or for modelling purposes for future scenarios	Barredo et al. 2024; Oettel & Lapin 2021 O'Hara 2015 Larsen et al. 2022 Di Fulvio et al. (under review) Bauhus et al. 2013 Brang et al. 2014 Kau & Bauhus 2014 Rosa et al. 2023 Ming et al. 2020 Schutz et al. 2016 Pinnschmidt et al. 2024 Barredo et al. 2024 Collado et al. 2023

We also reviewed existing policy approaches to identifying close(r) to nature forestry, most of which was extracted from sources at the Länder level in Germany. Several forest administrations at the Länder level describe their forest management as 'close to nature'. The management is defined by concrete prohibitions and standards for action as formulated in various forest management programmes or ordinances, which paraphrase the term 'close-to-nature'. Examples are the programme for long term ecological forest development (LÖWE) in Niedersachsen, the concept of 'close to nature forest management' in Baden-Würtemberg, Rheinland-Pfalz and Hessen, or Forest 2000 in Nordrhein-Westfalen. ([211]) Approaches in Germany are largely based on a set of principles/criteria ([212]), but some of the programmes have developed indicators (LÖWE) to reflect the criteria established. ([213])

Lastly, we also consulted with senior researchers ([214]) to further elaborate on the types of indicators and measurements utilised to analyse close(r) to nature forestry and the challenges associated with modelling potential impacts.

Table 30 below provides the result of this review of scientific and policy-based literature, as well as integrating information extracted from the consultation. The table is a non-exhaustive list of potential criteria and indicators as well as a corresponding list of potential means for quantification of the criteria.

Consensus in the scientific literature is that closer to nature forestry involves selective logging, both individual tree selection, and group selection, or a combination of the two to create small openings scattered throughout the stand, occurring in both temperate and boreal biome. Some retention-based systems in the EU system - where partial harvesting allows new stems to grow

([210]) However, Barredo et al. (2024) do provide indicators utilised in the creation of the archetypes described in Box 3 which could provide a first step in the creation of criteria and indicators in the Supplementary Materials.

([211]) https://www.cbd.int/doc/meetings/esa/ecosys-01/information/ecosys-01-inf-05-en.pdf

([212]) https://www.waikereru.org/assets/documents/GermanForests.pdf

([213]) https://www.landesforsten.de/wp-content/uploads/2019/06/loewe2018web.pdf

([214]) Consultation (23.08.2024) with Senior Research Scholar, Integrated Biosphere Futures research Group, Biodiversity and Natural Resources Programme, International Institute for Applied Systems Analysis (IIASA).

up under an overstory of maturing trees – can be considered closer to nature compared to clear cut in cases where long regeneration is enacted (for example 30-40 years in shelterwood, which is the main retention system in the EU). These retention systems would need to have uneven age stands such as those in continuous cover forestry (selection systems). Other criteria include tree species mixtures, non-uniform age & height diameter structures, the presence of old growth trees, and deadwood volumes. For these attributes, the expectation is that they will be increasing when one moves from clear cut management to retention (shelterwoods) and even more so when moving from clearcut to selection systems (continuous cover forestry). Therefore, in a forest with closer to nature forest management, it can be expected that there will be an increasing number of species and broad-leaved species, having trees with at least 2 age classes, with young and old trees growing together, trees that are older than 150 years, and increasing deadwood volumes over a certain threshold specified according to biogeographical region.

Table 30: Potential criteria, indicators, and quantification for the purpose of a Closer-to-Nature certification scheme

Relevant Objective/ Intervention under EU Commission Guidelines for Closer-to-Nature forest management	Criteria	Potential Indicator(s)	Potential quantification of indicator
Increasing structural complexity	Diversified forests sheltering a variety of tree species	Tree species composition Tree species diversity Share of broad-leaved species Share of coniferous species	Stand Structural Complexity Indices used to assess the structural diversity and complexity of a forest stand At least x number of species in the forest Proportion of non-coniferous relative to the current representative management within the same region
Promoting natural forest dynamics	Maintaining and promoting native species	Share of native species Share of alien species	At least x% of native species in the forest Maximum % of alien species in the forest
Promoting natural tree regeneration	Furtherance of the natural regeneration of forests	Abundance of natural regeneration Variable retention Specified length of time allowed for regeneration period, or mean diameter ([215])	Tree seedling per unit area Height of regenerating species and growth rates Proportion of stand is left unharvested Natural Regeneration Index: combines measurements such as seedling density, sapling growth rates into a single measurement
Ensuring respectful harvesting conditions	Sustainable harvesting levels	Harvest increment is aligned with natural regenerative capacity of the forest Designated proportion of annual increment is harvested	Harvest increment ration to current forest management baseline Harvesting rates which maintain the age structure of the forest at the landscape level ([216])

([215]) For example, in Finland forest management guidelines recommend regeneration cutting at the age of 40-120+ years or at the mean diameter of 22-30 centimetres.

([216]) Not delivering ever younger forest due to over-harvesting

	Selective logging and the absence of clear-cutting	Single tree selection – mature, over-mature, diseased trees are selected for removal Group selection – harvesting small clusters of groups of trees, creating larger openings in the canopy. Small enough to allow natural regeneration of the forest Absence of clear cutting	Quantified differences between pre- and post-logging inventories (comparison of post-logging numbers to baseline data). Pre- and post-logging comparison of indicators such as density, species composition, and health of remaining trees.
Optimising deadwood retention	Retention of a specified level of deadwood	Volume of deadwood Volume of lying deadwood Volume of standing deadwood Deadwood dimension	Recommended target for minimum deadwood volume over a certain threshold specified according to biogeographical region (i.e. at least 20-30 cubic metres per hectare in the Boreal region as stipulated by Ekoskog)
Setting areas aside	Network of forest protection areas	Proportion of forest as a set aside	Area calculation of set aside regions
Taking a scale-specific approach	Improvement of forest structure: structural/age heterogeneity ([217])	Non-uniformity in age; non-uniformity in height diameter structures – diameter diversity, forest/tree age Presence of old growth trees Multiple canopy layers Canopy gaps and understory patchiness Presence of late seral stage communities	Having trees with at least 2 age classes, young and old together Basal area increment Number of trees > 150 years (depending on the species)

([217]) Often described as multi-storied forest structure.

The above scientific literature demonstrates that the concepts of 'naturalness' and 'forest management intensity' lend themselves to the creation of categories for graded certification. Such categories would be based on multiple criteria and indicators for each category of forest management approach or forest naturalness type. However, 'management intensity and 'naturalness' have also been developed into indices, ranging from low to high, that are intended to be utilised as measurement proxies for forest management that are quantitative. ([218]) ([219]) Utilising these indices would allow for a certification scheme based on a single score, rather than multiple indicators for different classifications of approaches.

Schall & Ammer (2013) have developed a Silvicultural Management Intensity indicator (SMI) which combines tree species, stand age and aboveground living and dead wood biomass as three main characteristics of a given stand to provide a quantitative measure of forest management intensity. ([220]) The authors suggest that silvicultural management intensity (SMI) of forests managed under close-to-nature objectives can be characterised by two continuous components: the risk of stand loss due to natural hazards (disturbance by, for example, wind throw or bark beetle attack) and relative stand density. Both components represent management decisions: the choice of tree species and the intensity and frequency of tree harvests. The risk component describes the effect of tree species selection and stand age on the probability of a forest to reach an old growth stage. The density component quantifies the relative deviance between biomass carrying capacity of the site and actual stand biomass. Kahl and Bauhus (2014) also have developed a forest management intensity index called 'ForMI', which entails the sum of three components considering: 1. the proportion of harvested tree volume; 2. the proportion of tree species that are not part of the natural forest community; and 3. the proportion of deadwood showing signs of saw cuts. ([221]) Each component ranges between 0 (no sign of management) and 1 (intensive management).

A number of indicators of 'naturalness' have been suggested, based mostly on tree species composition, quantity and decay status of dead wood, and other structural characteristics. ([222]) ([223]) ([224]) ([225]) The main limitation of measuring 'naturalness' is the uncertainty about the spatial scale to be chosen for comparisons and the fact that only very few forests exist around the world free of legacies from former human influence that could serve as reference points for a pristine forest state. Nevertheless, there are examples of single measurements being utilised for this purpose, most notable of which is Bartha's concept of naturalness (also referred to in other literature as hemeroby). Bartha (2004) combines criteria which are assigned evaluation scales (i.e. from 0 to 5 or 0-10) on a number of forest attributes where 'naturalness' ranges from 0 (most intensive land use = 0% 'naturalness') to 25 (natural forest =100% 'naturalness'). ([226]) The final

([218]) https://www.tandfonline.com/doi/abs/10.1080/14004080510041011

([219]) https://www.sciencedirect.com/science/article/abs/pii/S0378112707002174

([220]) https://link.springer.com/article/10.1007/s10342-013-0681-6

([221]) https://natureconservation.pensoft.net/articles.php?id=1354

([222]) https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/ES14-00177.1#i2150-8925-5-9-art113-Mrosek1

([223]) https://www.sciencedirect.com/science/article/abs/pii/S0378112700002772

([224]) https://www.sciencedirect.com/science/article/abs/pii/S0378112710000599

([225]) https://www.webofscience.com/wos/woscc/full-record/WOS:000220166000002

([226]) https://www.webofscience.com/wos/woscc/full-record/WOS:000220166000002

score is based on points attributed to a stand depending on how similar stand structure is to the structure of a reference pristine forest, based on five groups of attributes (for details see Table 31 below): tree composition and structure of the canopy layer, composition of the shrub layer, composition of the herb layer, site characteristics and other structural characteristics (old trees, dead wood amount, regrowth). ([227])

Table 31: Bartha's naturalness index ([228])

Group of criteria	Evaluation scale	Considered criteria
Tree layer	0-5	• Indigenousness • Site tolerance • Mixedness • Character of crown closure • Species distribution • Age structure • Stratification
Shrub layer	0-2	• Species composition • Character of cover
Herb layer	0-4	• Species composition • Character of cover
Site characteristics	0-4	• Humus development • Biological activity • Water balance • Erosion and soil wounding • Soil compaction
Others	0-10	• Occurrence of single or groups of old trees • Amount of deadwood • Occurrence and quality of regrowth
Total	0-25	

The scores from such existing indices could allow for simplicity in the development of a graded certification system – however, such calculations may miss nuances of different silvicultural practices within forest management approaches as well as characteristics of forests as identified in the classification systems, particularly that of Barredo et al. (2024) during the process of evaluation. Therefore, future considerations will need to evaluate the trade-offs between the two approaches in which an index can provide simplicity in the development of a scoring system, whereas a graded system based on classifications would provide greater nuance and may also offer the opportunity to provide consumers more education on the various approaches towards forest management.

([227]) Ibid.

([228]) Ibid.

6. Conclusions and potential next steps

Drawing on the key findings of the five main chapters of the report, three potential pathways for establishing CNF-aligned certification in the EU have been identified. The comparative assessment of existing certification schemes provides a basis for considering how these widely used voluntary forest certification schemes could be adapted to better support and align with a CNF approach as depicted by the Guidelines. The first approach explores working with FSC, PEFC or Ekoskog to align their international benchmarks and national standards with CNF principles. A second approach considers the creation of a new EU voluntary forest certification standard directly linked to the CNF guidelines. The third and final option examines the creation of an EU standard to certify existing certification schemes as CNF-aligned. These three proposed ways forward are described in turn.

6.1. Establishing Closer-to-Nature voluntary forest certification

The comparative assessment of FSC and PEFC national standards in eight EU Member States, as well as the Ekoskog scheme, as presented in Chapters 3 and 4, demonstrates that in some respects, these widely adopted VFCS provide a solid starting point for implementing CNF management practices, despite of the gaps and inconsistencies identified. The Association for Ecological forestry certification (AEFC), which was not assessed in this report since it is still in the development phase as of date, could also offer a potential starting point – but will need to be evaluated against the CNF guidelines at a future date to determine its appropriateness as a starting point.

Given the nature of the comparative assessments, which found that the existing standards represent an imperfect but potential path forward, there is no single, clear option for advancing CNF certification in the EU that emerges. Instead, three potential pathways are apparent, each with its own set of advantages and disadvantages that must be carefully considered.

For one, collaborating with FSC and PEFC to align their international benchmarks and national standards with CNF objectives and intervention tools offers the advantage of leveraging the widespread adoption, established infrastructure, and market recognition of these schemes. This approach could potentially allow for faster implementation of CNF practices across the EU. However, it also carries the risk that the European Commission will have less direct control over the content of the standard, which could lead to compromises in the alignment of the standard with CNF aims due to the need to work within existing systems and stakeholder interests. The Preferred by Nature approach offering a top-up to the FSC, which was not assessed in this report, may be appropriate for a more practice-based approach towards certifying CNF management practices. Their approach may also provide a model for a starting point where a ‘top-up’ could be added to an existing scheme.

On the other hand, establishing a new EU-level voluntary forest certification standard linked directly to the CNF guidelines would provide the European Commission with full control over the standard's development and revision process, ensuring ongoing

alignment with evolving CNF best practices and EU forest policy objectives. This approach would also allow for the creation of a consistent framework for CNF-aligned management practices across the EU. However, it would face challenges in initial market uptake given the established presence of FSC and PEFC certifications, among other barriers.

Finally, a third pathway would be to establish an EU standard for certifying existing certification schemes as CNF-aligned, such as the Ekoskog scheme. This approach could potentially combine the advantages of working with existing schemes while retaining some control over the ultimate ambition of the standards. This approach would allow the European Commission to set clear requirements for what constitutes CNF-aligned certification while leveraging the established infrastructure and market recognition of existing schemes, namely FSC and PEFC. While this option could offer a quicker path to implementation than creating a completely new scheme, it would still face challenges in developing meaningful yet achievable criteria while ensuring voluntary participation and uptake by established international certification schemes.

Ultimately, deciding between these pathways will depend on a careful weighing of the trade-offs involved, considering factors such as the urgency of implementing CNF practices, the available resources and capacity, and the willingness of existing schemes and stakeholders to adapt.

6.1.1. Option 1: Collaborate with FSC, PEFC, or Ekoskog to align their international benchmarks and national standards with CNF principles

Overview

Rather than creating an entirely new certification scheme, the European Commission could build on the strengths of these existing schemes while addressing their weaknesses, as identified by the results of the comparative assessment, in order to promote the widespread adoption of CNF management practices across the EU.

Strengths of existing standards

The results of the synthesis report as described in chapters 3 and 4 show that the Ekoskog standard incorporates most of the key elements of CNF management. A few additional changes could be made to the scheme to ensure full alignment, such as requirements for the management of ungulates at carrying capacity. Both **FSC and PEFC standards also incorporate several key elements of CNF management**, as many national standards in both schemes show a strong alignment with the CNF objective of *increasing structural complexity*, for example. Furthermore, the report highlights that a number of national examples from both of these schemes **exhibit an approach to soil and water protection that aligns well with the CNF guidelines'** emphasis on preserving these essential ecosystem elements. The German FSC standard's quantitative target limiting extraction tracks to 10% of managed forest land, and the consistent inclusion of provisions for protecting water quality and preventing soil erosion in PEFC standards, show how these schemes can operationalise CNF principles effectively.

The **strong focus on landscape-level forest management** observed in several national standards, particularly in Sweden and Slovakia for both FSC and PEFC, provides another solid basis for implementing CNF management practices. The Swedish PEFC standard's requirement for forest management planning to be carried out in a landscape ecological context closely mirrors the CNF guidelines' emphasis on adopting a multi-scale approach to forest management.

There are several advantages to utilising an existing scheme – primary among them is the fact that **there is a level of recognition of these schemes already among consumers**. As discussed above, studies and surveys indicate that there is consumer recognition of these labels, and consumers may actively look for these certification labels when purchasing wood or paper-based products. In addition, both the FSC and PEFC work towards increasing consumer recognition of these labels through marketing campaigns, partnerships with brands, and educational outreach to increase the visibility of their labels and the importance of sustainable forestry practices. However, the main drawback of the Ekoskog scheme is that it does not have the same level of international recognition among consumers as the FSC and PEFC schemes, as it is a relatively newer scheme that has only been implemented in Sweden.

In addition to the existing consumer awareness of the PEFC and FSC schemes, there are administrative advantages to utilising the existing schemes. Namely, **both schemes have established monitoring schemes through third-party certification bodies across several European countries**; the Ekoskog scheme, however, does not currently span across multiple countries, although there are plans to expand to other countries in Europe. Certification bodies ensure that forest managers comply with FSC and PEFC standards, conducting comprehensive assessments and surveillance audits. There is also established networks of stakeholders under these schemes and transparency mechanisms to hold forest managers accountable. There are also existing compliance mechanisms for non-conformities and oversight of corrective actions. These schemes have systems in place for handling complaints from stakeholders, which can be investigated. In addition, there is oversight of the accreditation bodies, for instance with the ASI playing a role in monitoring these bodies for the FSC by investigating complaints and ensuring the transparency and accountability of accreditation bodies. There is also an added benefit through the PEFC in its decentralised structure, which could allow for flexibility and adaptability in the interpretation of criteria and indicators at the Member State level.

Disadvantages of existing standards

However, the comparative assessment also brought into focus a number of areas for improvement. The FSC and PEFC schemes **often lack specific, quantifiable targets** for key aspects of the CNF guidelines, such as deadwood retention and set-aside areas. Moreover, many standards also **fall short in providing detailed operational guidance** for implementing CNF practices, particularly for CNF intervention tools such as *ensuring respectful harvest interventions* and *managing ungulate species at natural carrying capacity*. Taken together, the findings presented in chapters 3 and 4 are demonstrative of the reality that there is a **high degree of variability in the application of CNF objectives and intervention tools across different national standards,** and that both FSC and PEFC schemes, as evidenced by the lack of clear criteria or guidance on natural regeneration versus artificial regeneration.

As discussed above, the clear disadvantage of utilising the Ekoskog scheme is the lack of recognition among consumers, and the limitations of existing in only one country as of date.

Advantages of collaboration

Working with FSC and PEFC to address these gaps and inconsistencies, rather than developing a new scheme from scratch, offers a number of advantages in that it can **leverage the widespread adoption and established infrastructure of these schemes**, potentially allowing for faster and more widespread implementation of CNF practices. This is especially prevalent in some Member States where FSC and PEFC have a large market share, with FSC covering 70.42 million hectares in Europe and over 70% in countries such as Croatia and Poland ([229]), while PEFC covers nearly 86 million hectares in Europe with over 70% coverage in Finland, Estonia, Poland, Austria, and Germany ([230]).

Second, this approach **builds on the market recognition and acceptance** that FSC and PEFC already enjoy **among forest managers and practitioners, retailers, and consumers**. The existing recognition of these labels among consumers in particular could more quickly facilitate consumer choices being influenced by the presence of these certification schemes without the need to establish a new certification brand in the market.

Third, building on the foundation of these existing schemes would **allow valuable elements of existing standards that are already well aligned with CNF principles to be retained**, thereby **avoiding unnecessary duplication of effort**. Due to its high level of alignment with CNF guidelines, the Ekoskog scheme could be a logical starting point from which to build. Alternatively, this approach could, for example, benefit from the existing expertise and stakeholder networks of FSC and PEFC, potentially facilitating more effective implementation and monitoring of CNF practices. In turn, the already established administrative systems for monitoring, compliance and certification could lead to cost savings compared to what would be required to create a new certification scheme from scratch and all the supporting administrative procedures that would entail.

Challenges and limitations

Yet there are challenges to this collaborative approach. To start, the European Commission would have less direct control over the content of the standard than if it were to create a new scheme, which would necessarily lead to compromises in precisely how the existing schemes adapted for CNF. In addition, the observed differences in how national standards interpret international benchmarks may lead to **inconsistent implementation of CNF principles between schemes and participating Member States**. A similar challenge may be inconsistent coverage: the Ekoskog scheme has yet to implement schemes in other Member States besides Sweden; as of date, it is not known whether the scheme will consistently implement CNF principles across multiple

([229]) Maesano, M., Ottaviano, M., Lidestav, G., Lasserre, B., Matteucci, G., Mugnozza, G. S., & Marchetti, M. (2018). Forest certification map of Europe. iForest – Biogeosciences and Forestry, 11(4), p. 526-533. Accessed here.

([230]) Ibid.

Member States. In addition, the resources needed for expanding the scheme beyond a handful of Member States may be beyond their reach in the near-to-medium term.

However, due to their inconsistent implementation of CNF principles, there is also the possibility that **FSC and PEFC may resist significant changes to their established systems**, particularly if these changes are perceived to conflict with other objectives or stakeholder interests. In practical terms, it is unlikely that FSC and PEFC will introduce a new form of or significant modification to their certification that risks diminishing the positive perception of their current labels. Relevant to the establishment of a graded certification scheme, many of the national standards lack quantitative benchmarks for the purposes of assessing the adherence to potential criteria and indicators outlined in Section 5.2.2.

Another important drawback to consider **is the low uptake of both FSC and PEFC certification in some Member States**. For example, in Belgium and Denmark, less than 50% of the forests are certified under both FSC and PEFC schemes, while in countries such as the Netherlands, Sweden and Romania the coverage is below 40%. In Slovenia it is less than 25% and in Italy, Portugal and Spain it is less than 10% ([231]). The extent of this variation appears to be due to a number of factors. For example, in certain Member States, such as Poland, Latvia and Estonia, the national governments have taken policy decisions that explicitly pursue forest management through FSC in particular ([232]). In addition, the degree of fragmentation of a country's forests seems to be a key factor influencing both the willingness to certify the forest and the choice of scheme.

Moreover, this uneven uptake across the EU could lead to inconsistent implementation of the CNF if this option is pursued. Even so, it is important to recognise that this challenge may be more related to the barriers in promoting voluntary uptake of forest certification schemes more generally rather than inherent issues with these two VCFSs in particular. One such prominent barrier is the price premium associated with VCFS, much of which would be driven by the transition to more CNF-aligned forest management practices. As discussed above, products bearing the FSC certification in Europe yield an average price premium of 6.3% ([233]).

Despite these challenges, the evidence presented in this report suggests that collaborating with FSC and PEFC to enhance their alignment with CNF principles offers a potentially pragmatic and effective path forward. The alignment between these VFCS in key areas and the Guidelines as highlighted by the comparative assessment provides a solid foundation upon which to build, while the identified gaps offer clear targets for improvement.

([231]) Maesano, M., Ottaviano, M., Lidestav, G., Lasserre, B., Matteucci, G., Mugnozza, G. S., & Marchetti, M. (2018). Forest certification map of Europe. iForest – Biogeosciences and Forestry, 11(4), p. 526-533. Accessed here.

([232]) Ibid.

([233]) Zubizarreta, M., Arana-Landín, G., Siguenza, W. and Cuadrado, J., 2024. Forest certification and its impact on business management and market performance: The key role of motivations. Forest Policy and Economics, 166, p.103266.

6.1.2. Option 2: Establish a new EU-level voluntary forest certification standard linked directly to the CNF guidelines

Rationale for a new voluntary forest certification scheme

The main findings of the comparative assessment reveal a number of important gaps in how existing VFCS align with and operationalise the CNF management objectives and intervention tools in the selected Member States. While some national standards show promise in certain areas, there are persistent gaps in others, particularly in terms of the **lack of measurable quantitative targets, operational guidance, and in the standards' ability to addressing key elements of the CNF guidelines**, such as *optimising deadwood retention* and *setting areas aside*. Given these findings, establishing a new EU-level voluntary forest certification scheme that is designed to align with the CNF guidelines emerges as a compelling option. This approach would allow for the **creation of a certification scheme that fully embodies the CNF principles, objectives, and intervention tools from the ground up**, addressing the shortcomings identified in existing schemes and providing a consistent, comprehensive framework for CNF-aligned forest management across the EU.

Potential directions for a new scheme

A new EU-level certification scheme could, for example, be built around a set of criteria and indicators derived directly from the 10 CNF objectives and intervention tools presented in the Guidelines and assessed in the synthesis report. For instance, the new scheme could incorporate **specific, quantitative targets for structural complexity, deadwood retention, and set-aside areas** – all elements that were often lacking or inconsistent in the FSC and PEFC standards assessed. The provision of clear, measurable benchmarks would provide forest managers with concrete objectives while at the same time facilitating a clearer assessment of whether CNF management practices are being implemented.

Advantages of a new EU scheme

One of the primary advantages of this approach is the ability to develop **detailed operational guidance on implementing CNF practices**. The main findings generated by the comparative assessment highlighted that even when existing standards recognised key CNF objectives and tools as per the Guidelines, they often fell short in providing actionable guidance for on-the-ground implementation. The new EU scheme could bridge this gap, offering specific, practical instructions for forest managers on how to operationalise CNF concepts across different forest types and conditions. This could significantly enhance the consistent application of CNF practices across the EU. Moreover, an EU-level scheme would provide **consistency across Member States**, addressing the variability observed in national FSC and PEFC standards. This uniformity would be particularly valuable for transboundary forest management and in creating a level playing field for forest products in the EU market.

The creation of a new EU-level certification scheme also presents an opportunity to **increase consumer awareness and demand for CNF practices**. Evidence suggests that there is a consumer preference for forest-based products produced sustainably, and that consumers are even willing to pay a potentially high price premium depending on the product ([234]). For instance, a study by Poratelli et al. (2022) found that consumers were willing to pay price premiums ranging from 17% to 68% for certified wood products, with higher premiums observed for everyday consumer goods such as paper (65-68%) and lower premiums for expensive items like furniture (17-18%), demonstrating a clear market demand for forest products that are perceived as being sustainable ([235]).

In turn, a new CNF-aligned certification scheme could facilitate this awareness. By establishing a distinct CNF certification, signifying a certain level of evidence-based, biodiversity enhancing forest management practices used in the production of the products concerned that goes beyond existing labels, the EU could appeal to this consumer preference for high quality, sustainably produced products, potentially creating a price premium for CNF certified goods. This in turn could provide long-term economic benefits for foresters using CNF practices. There is high levels of consumer trust and recognition for EU labels as reliable indicators of product quality and environmental responsibility, which can drive consumer preference towards an EU certification scheme.

Furthermore, a new EU-level scheme could be designed with a **graded labelling system** from its inception, which would allow for gradual improvements that incentivises foresters to go beyond the minimum requirements for simply obtaining the certification. EU oversight will help to ensure that standards for a certification is regularly reviewed and updated in response to evolving situations – this oversight has been crucial in facilitating the increasing energy efficiency of products under the EU Energy label, in which the baseline for comparison changes in light of technological innovations. Similarly, where forest management standards improve, the EU can facilitate further ambition by revising and adjusting the evaluation process, particularly for a potential graded certification scheme.

Implementation challenges

Developing a new certification scheme would not be without its challenges. One significant disadvantage is the **substantial investment of time and resources** required from the European Commission to develop the standard, establish governance structures, and create auditing and verification systems. This could potentially delay the widespread implementation of CNF practices compared to working within existing schemes.

The main disadvantage of a newly established EU certification scheme is the administrative costs associated with the development and implementation of such a scheme from scratch. One of the main challenges will be the process of setting a standard and developing criteria – while the Closer-to-Nature guidelines provide a foundation for a standard, there is currently no existing standardised evaluation measurement to assess the performance of forest managers according to these guidelines in a quantitative manner. The process of creating a more standardised assessment will involve technical expertise to develop criteria, indicators and

([234]) Poratelli, F., Blanc, S., Pippinato, L., Zanchini, R., Bruzzese, S. and Brun, F., 2022. Willingness to pay for certified wooden products: a critical literature review. Forestry Studies, 76(1), pp.46-63.

([235]) Ibid.

measurements that are scientifically sound, applicable across the EU, and feasible for participants to meet.

In consideration of the potential for a graded certification scheme, additional research will need to be conducted gauging its potential feasibility, as well as the level of interest among foresters as a means of facilitating the transition towards closer-to-nature forestry. The EU has already defined the key objectives and principles that define the core foundation of a grading system. Should a graded system for closer-to-nature forestry be considered as a feasible option, the first major step would be the development of the evaluation criteria for a potential scoring system. These would need to be measurable, preferably in a quantified manner, to reflect the performance expected in achieving closer-to-nature forestry. Coinciding with the development of evaluation criteria and measures, will be the development of a grading scale and decisions regarding the categories of grades. Evaluation criteria may also need consideration of assigned weighting, similar to the Nutri-Score system. Member State approaches to such evaluation criteria may also differ, and thus must also be taken into consideration. Therefore, consultations with experts and stakeholders on how to develop a graded scheme and which indicators and measurements should be utilised and in what manner for evaluating closer-to-nature forestry would need to be carried forward.

There is also a lack of awareness and knowledge among foresters about CNF practices, which could prevent or at least significantly delay adoption. Before a scheme is rolled out, it may also be necessary to test or pilot the graded scheme with selected regions to ensure they are workable but also adaptable to local contexts. The EU will also need to set up an accreditation framework for certifying bodies that will independently verify compliance with this new scheme. This will involve the development of accreditation standards, training programmes for auditors and inspectors, and administrative costs for setting up the accreditation system, whereas these types of accreditation bodies have already been established under the PEFC and FSC. Coordination of the implementation of the scheme across Member States will also involve additional costs in comparison with already established schemes. Economic barriers would be a major challenge, as there are high start-up costs for adopting new practices, while the results may only come to fruition in the long term. The lack of financial and legal incentives and support in national legislation at Member State level could further complicate implementation as well.

In addition to the costs associated with the development of a new scheme, there will also be costs related to creating public awareness in a new certification scheme, involving robust public awareness campaigns both for consumers and for forest managers. For consumers, such efforts will need to be concentrated on providing consumers with an understanding of the meaning and value of the graded certification scheme, which will be critical to its success. For producers, this will involve the promotion of the economic and environmental benefits of participation within the scheme – which, from its initiation may be difficult to persuade as the influence of the scheme on consumer behaviour will be low at this point.

It is unlikely that alternative forest management approaches will be adopted on large scales if they are not financially compatible with economic sustainability. Economic considerations include the expected profit, uncertainty, and flexibility of management alternatives. Even under optimistic expectations, alternative silvicultural approaches are unlikely to reach the short-term financial profitability of intensively managed short-rotation plantations in some temperate regions. ([236]) The economic benefits of closer-to-nature forest management is more favourable in the long-term in temperate and boreal

([236]) https://link.springer.com/chapter/10.1007/978-3-642-19986-8_11.

forests. Tahvonen et al. (2010) demonstrate the economic savings associated with the reliance on natural regeneration, reducing regeneration costs and indicate that closer-to-nature practices have highest net present value in Finnish spruce forests, when considering long-term costs of forest management. ([237]) Long-term savings may also be the more economically viable long-term option in consideration of the increasing risks of natural disturbances facilitated by climate change – evidence demonstrates the increased resilience to natural hazards with closer-to-nature forestry. ([238]) ([239])

Despite the long-term cost savings however, forest managers will inevitably give stronger weight to short-term financial considerations, particularly among smallholders. Upfront costs for transitioning towards closer-to-nature forest management practices include the need for highly trained workers, specialised low-impact machinery, operation and monitoring costs, investments and maintenance costs. Particularly in parts of Europe, such as the boreal north, where there is a lack of tradition in selection systems and partial harvesting practices, substantial investments in research, education and training will be required for implementation.

Broader contextual challenges

The new EU scheme would also need to carefully navigate its relationship with existing schemes, namely FSC and PEFC, to avoid market confusion among consumers. While differentiation is important, complete divergence from established certification norms could create challenges for forest managers and supply chains already aligned with FSC or PEFC standards, and ultimately, harm its voluntary uptake.

The possibility of introducing labelling for the climate performance of products has been under consideration at the EU and Member State level for several years now. Like forest management labelling, several new approaches to climate labelling have emerged in the European market in recent years. ([240]) These encompass climate neutral labels, reduction labels, specific CO2 equivalent specifications, best-in-class labels and multi-level interpretive label. However, these types of labels differ in the messages being communicated to consumers, addressing various dimensions of the product itself and the production processes. The different types of climate labels and their varied approaches can easily lead to misunderstandings. Studies demonstrate that a color-coded sustainability label can effectively inform consumers about the environmental impact of food, aiding them to identify environmentally friendly products. ([241]) Likewise, research on traffic light labelling based on carbon footprint suggests its effectiveness in reducing the environmental impact of food choices. ([242]) ([243]) Recent studies have found that consumers perceive climate-neutral labelling as understandable and beneficial. ([244])

([237]) https://www.sciencedirect.com/science/article/abs/pii/S0378112710001994

([238]) https://www.sciencedirect.com/science/article/abs/pii/S0378112711007201

([239]) https://onlinelibrary.wiley.com/doi/abs/10.1111/gcb.12751

([240]) https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-mandatory-front-of-pack-nutrition-labelling

([241]) https://www.sciencedirect.com/science/article/pii/S0959652621028882?via%3Dihub

([242]) https://link.springer.com/article/10.1007/s10640-019-00328-9

([243]) https://www.sciencedirect.com/science/article/abs/pii/S0195666318315289

([244]) https://onlinelibrary.wiley.com/doi/pdf/10.1002/bse.3838

Thus, one of the main challenges on the consumer side, is that while consumers do respond positively overall to graded/score-based labels, should multiple graded labels be utilised for the purposes of communicating better environmental practices, there may be a potential proliferation of sustainability-based graded labels for products, leading to overall confusion amongst consumers about the differences between such labels and what aspects of a product they are evaluating. The potential for graded certificates for both the climate performance and the sustainable forest management approach for forest-based products carries risks. Too much information can be disruptive to decision-making since an overstrained consumer is likely to make poor decisions ([245]). Nevertheless, despite the risk of information overload, consumers seek detailed information about products ([246]) ([247]).

The case for the introduction of a climate labelling scheme is supported by the significant and urgent nature of the GHG implications of the products they consume and can be based upon relatively reliable measurements of greenhouse gas emissions, and therefore lends itself to a more standardised approach in comparison with sustainable forest management. However, the biodiversity crisis is also an equally pressing crisis. Relying only on climate information for graded certification may risk the oversimplification of issues that are inherently linked to each other – indeed, particularly for forest-based products, there are many co-benefits and trade-offs between practices aiming to maximise their climate mitigation impact and those seeking to protect and restore biodiversity and the overall health of the forest. Therefore, consideration of a more integrated climate-biodiversity approach for a graded certification scheme for forest-based products is warranted.

There are also ecological barriers to consider, in particular the potential impacts of climate change and the legacy of past management practices. In some regions in the EU there is a poor understanding of the natural state of forests, which could make it difficult to establish appropriate benchmarks for CNF practices ([248]). As pointed out by Puettman et al. (2015) ([249]), ecological constraints are one of the main barriers preventing the adoption of closer-to-nature forest management practices by forest managers. Such barriers stem from the current state of forest ecosystems, the legacy of past management practices, and the complex ecosystem dynamics within forest environments. In addition, climate change is altering temperature and precipitation patterns, increasing the frequency and intensity of extreme weather events and shifting ranges of species. ([250]) This can make the adoption of closer to nature practices that rely on stable or predictable ecological conditions challenging. In many regions, the original or ‘natural’ state of the forest ecosystem may be poorly documented, making the achievement of closer-to-nature objectives challenging without a reference or ‘baseline’ to guide transitionary efforts. Based on varying ecological conditions it may be necessary to deviate from or ‘stretch’ the CNF principles. However, it should be noted that the

([245]) https://www.sciencedirect.com/science/article/pii/S095965262303648X#bib33

([246]) https://www.sciencedirect.com/science/article/pii/S095965262303648X#bib6

([247]) https://publications.jrc.ec.europa.eu/repository/handle/JRC127006

([248]) Puettmann, K.J., Wilson, S.M., Baker, S.C., Donoso, P.J., Drössler, L., Amente, G., Harvey, B.D., Knoke, T., Lu, Y., Nocentini, S. and Putz, F.E., 2015. Silvicultural alternatives to conventional even-aged forest management-what limits global adoption?. *Forest Ecosystems*, *2*, pp.1-16.

([249]) https://forestecosyst.springeropen.com/articles/10.1186/s40663-015-0031-x

([250]) Ibid.

Guidelines recognise the need to consider the 'natural state' as a moving target due to the impacts of climate change.

Such variability in ecological conditions may influence the participation of producers in a graded certification scheme. For example, negative climate impacts may shift the structure and species make-up of a forest, potentially impacting the score of a forester on a closer-to-nature evaluation scheme – the risk of a lower grade due to such environmental circumstances, and other potential challenges associated with the lack of control over ecological conditions may disincentivise a forest manager from engaging in such a certification scheme. Therefore, there will need to be consideration of allowing for more flexibility in the adherence of closer-to-nature principles during transitionary periods, for example, with a graded certification scheme, it could initially start with a lower 'baseline' of scores for higher grades – many foresters may be reluctant to enter such a scheme if they are starting from a 'lower-grade' position.

Additionally, the effectiveness of the new certification in changing forest management practices could depend on whether it is mandatory or voluntary, with evidence from other sectors and schemes suggesting that mandatory schemes are often more effective in driving change (e.g., the mandatory Energy Efficiency Label has incentivised manufacturers to improve energy efficiency, the UK Food Hygiene Rating is more effective in changing practices in Scotland and Wales where it is mandatory, but the voluntary Nutri-Score lacks evidence that food processors are changing food recipes to make them healthier) ([251]). Lastly, there is a risk of consumer confusion due to the proliferation of sustainability labels and climate labelling more broadly ([252]).

Despite these challenges, the potential for a truly CNF-aligned, coherent and comprehensive certification scheme offers significant long-term benefits. The introduction of such a scheme could set a new gold standard for sustainable forest management in terms of strengthening biodiversity outcomes, leading to meaningful improvements in the health and resilience of forest ecosystems across the EU.

6.1.3. Option 3: Establish an EU standard for certifying existing CNF-aligned certification schemes

Rationale for a standard to certify existing schemes

A third option emerges that could potentially take advantage of both working with existing schemes and maintaining control over standards at EU level: the establishment of an EU standard that would certify existing voluntary forest certification schemes as being in line with CNF. This approach has a number of benefits, allowing the European Commission to set clear standards for what constitutes CNF-aligned certification while at the same time, leveraging the established infrastructure, market recognition, and operational capacity of existing certification schemes, in particular FSC and PEFC, which would otherwise take years and possibly decades to replicate at an effective scale. For

([251]) Fleetwood, J., Rahman, S., Holland, D., Millson, D., Thomson, L. and Poppy, G., 2019. As clean as they look? Food hygiene inspection scores, microbiological contamination, and foodborne illness. *Food Control*, *96*, pp.76-86.

([252]) Brécard, D., 2014. Consumer confusion over the profusion of eco-labels: Lessons from a double differentiation model. *Resource and energy economics*, *37*, pp.64-84.

schemes such as Ekoskog, this approach could bring wider recognition and adoption across multiple Member States through such recognition at the EU level.

Furthermore, under this system, the Commission would still have the option to develop its own detailed criteria, which it can design with alignment to the CNF principles in mind at the outset, and which certification schemes would then have to meet in order to be certified as CNF-aligned. This would, in effect, create a certification of certifications framework that could help bridge the gap between existing certification schemes and the objectives of the CNF guidelines, while maintaining the consistency that a dedicated EU-level scheme would otherwise seek to achieve.

The approach for this option could be a new stand-alone standard to certify existing schemes that is solely for the purpose of CNF management. This could also serve as a reference for biodiversity crediting schemes or other types of voluntary-based nature crediting schemes. Such schemes are emerging as a financial instrument aimed at conserving and restoring natural ecosystems. Such credits assign value to measurable conservation outcomes and are increasingly discussed as a potential means for channelling private investment. Organisations such as Verra are working towards creating scalable nature crediting frameworks which could provide structured and verifiable means for companies to invest in nature-positive practices and outcomes.

Alternatively, another option could integrate CNF criteria into the EU's Carbon Removal Certification Framework (CRCF). The Commission will approve certification schemes that are able to apply the CRCF rules through decisions, following a comprehensive assessment, typically granting recognition for 5 years. The CRCF aims to integrate biodiversity co-benefits into its certification processes, specifically through its carbon farming initiatives, which includes forest management, in order to ensure that carbon farming projects will contribute positively to biodiversity and sustainability. Currently, methodologies for carbon removal certification activities are being developed through delegated acts. Such methodologies will include consideration of measuring biodiversity co-benefits. This presents an opportunity to integrate CNF management criteria and indicators into such methodologies.

Key components of an EU standard certification

If a stand-alone approach solely for CNF management were to be taken, this certification of certification schemes would still need to develop many of the same basic components that would be required to develop a new EU level certification scheme from scratch. For example, this EU standard certification would need clear accreditation criteria, derived from the CNF guidelines, which would be used to create a minimum benchmark standard on which to base certification, similar to the model of international benchmarks used by FSC and PEFC to develop their respective national standards. Alternatively, such accreditation criteria could be integrated into the CRCF methodologies. These criteria would in turn be complemented by a defined process for evaluating existing certification schemes against these benchmarks. In addition, regular monitoring and review mechanisms would be required to ensure continued compliance with the requirements of EU certification, supported by a clear framework for how certification schemes can successfully communicate their alignment with the CNF to consumers without causing market confusion.

Advantages of an EU standard certification

As indicated above, this option offers several distinct advantages over either working directly with existing schemes (Option 1) or creating an entirely new EU level certification scheme (Option 2). In the absence of a dedicated certification scheme, this option still allows for a significant degree of influence on behalf of the European Commission on the ultimate ambition of the standards that are certified as CNF-aligned, while still benefiting from the existing certification infrastructure of schemes that have been widely used for decades, providing a pathway for multiple certification schemes, both established (i.e. FSC and PEFC) and emerging (i.e. Ekoskog, among others) to demonstrate CNF-alignment, potentially increasing market uptake through multiple existing channels.

This system in turn creates flexibility for schemes to adapt their existing standards, rather than requiring fundamental, wholesale changes (as demonstrated by the results of the comparative assessments in Chapter 3), which could lead to faster implementation compared to establishing a new certification scheme from scratch. In addition, this EU standard certification process would still allow for the gradual improvement of standards across several schemes simultaneously through regular review and updating of their benchmarking criteria. However, this presupposes that there is widespread interest on the part of existing schemes, both established and emerging, to take the necessary steps to align their schemes with EU standard certification, which is by no means guaranteed.

Implementation and contextual challenges

Despite these benefits, the implementation of an EU standard certification of existing certification schemes would face a number of challenges that would need to be carefully addressed. Namely, the development of sufficiently detailed benchmarking criteria that are both meaningful from a biodiversity perspective and achievable for existing schemes, in particular those that currently represent the largest market share (i.e. FSC and PEFC), would be a primary barrier. This, in turn, is linked to the wider challenge of creating an assessment process that can credibly evaluate different approaches to certification, while maintaining a degree of consistency across schemes and the national standards within such schemes in terms of the biodiversity outcomes of their certified forests.

Integrating the CNF benchmarking criteria into CRCF methodologies, which is achievable for existing schemes, may be even more challenging as the focus of schemes to be certified under this framework is namely carbon delivery. As payments will be mainly for the amount of carbon sequestered (or reduced for some categories of carbon farming), there is a risk that project developers will mainly focus on achieving carbon sequestration, as it has yet to be determined how biodiversity co-benefits will be both monitored and integrated into payments. However, a separate, standalone certification scheme has the benefit of solely focusing on the promotion of CNF practices and biodiversity outcomes.

Nevertheless, from an administrative perspective, the alignment of CNF principles, criteria, and indicators into CRCF methodologies has the benefit of avoiding overly burdensome certification processes for foresters who have implemented CNF management practices and are seeking payments for the amount of carbon sequestered. It could also prevent unintended competition between the two types of certification

approaches, as foresters are unlikely to participate in two separate certification processes and thus may opt for the simpler process with higher levels of reward. Such a scenario could potentially have negative implications for ambition levels for either carbon removals or biodiversity outcomes.

There may also be resistance from established certification schemes which view this process of EU standard certification, particularly if pursued as a voluntary standard, as a threat to their autonomy. This challenge is compounded by the need to ensure that the EU standard certification adds real value and does not simply create an additional administrative layer. In addition, the establishment of clear protocols for communicating the EU certification standard, particularly to consumers and producers, would be essential to avoid confusion as to the added benefits of CNF alignment to the environment in the context of existing certification schemes. Ultimately, the success of this EU standard certification would largely depend on its ability to meaningfully influence forest management practices in terms of their ability to preserve and enhance biodiversity, while remaining practical and attractive enough for existing certification schemes to voluntarily adopt.

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