



# To clear-cut or not to clear-cut: Diversifying benefits from small-scale forestry in Sweden



Nataliya Stryamets<sup>a,\*</sup>, Marine Elbakidze<sup>a,b,d</sup>, Lucas Dawson<sup>a</sup>, Thomas Hahn<sup>c</sup>

<sup>a</sup> Faculty of Forest Sciences, School for Forest Management, Swedish University of Agricultural Sciences, Skinnkatteberg SE 73931, Sweden

<sup>b</sup> Department of Geography, Ivan Franko National University of Lviv, Lviv 79000, Ukraine

<sup>c</sup> Stockholm Resilience Centre, Stockholm University, Stockholm SE-106 91, Sweden

<sup>d</sup> School of Natural Sciences, Technology and Environmental Studies, Södertörn University, Sweden

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## ABSTRACT

This study explores the motivations, perceived benefits, and challenges associated with the adoption of clearcut-free forestry by early adopters among non-industrial private forest (NIPF) owners in southern-central Sweden. Clearcut-free forestry, characterized by continuous tree cover and an emphasis on biodiversity, structural diversity, and ecosystem services (ES), is increasingly seen as a sustainable alternative to conventional intensive management based on short rotations and clear-cutting practices. Based on qualitative interviews with 22 NIPF owners who have adopted this approach, the study provides insights into how these early adopters perceive the value of clearcut-free forestry. Reported motivations include environmental concerns, such as biodiversity conservation and climate resilience, as well as strong socio-cultural values linked to family traditions, aesthetic preferences, and community wellbeing.

In this study, we use the multi-level perspective (MLP) framework to conceptualize NIPF owners who have adopted clearcut-free forestry as niche actors and analyze their potential contribution to the emergence of an alternative forest management regime. The findings highlight that early adopters associate multiple benefits with clearcut-free forestry, encompassing enhanced ecosystem services such as carbon sequestration, water regulation, habitat preservation, and socio-cultural enrichment through recreation and relational values. However, the interviewees identify several interrelated challenges, including knowledge gaps, lack of clear definitions and standardized practices, limited advisory services, underdeveloped value chains for high-quality timber, and market barriers, which hinder more widespread adoption. Within the multi-level perspective, owner perceptions linking clearcut-free management with improved forest multifunctionality serve as a key driver of niche-level experimentation. This suggests an alignment between these owners and evolving societal demands for more inclusive, sustainable, and diversified forest use. Policy recommendations include targeted investments in knowledge co-production, infrastructure, market incentives, and certification schemes to support the economic viability and broader adoption of clearcut-free forestry.

## Abbreviations

|          |   |       |                               |
|----------|---|-------|-------------------------------|
| CCF      | Continuous-cover forestry                                     | EU    | European Union                |
| ES       | Ecosystem services  | FSC   | Forest Stewardship Council    |
| NIPF     | Non-industrial private forest                                 | NWFPs | Non-wood forest products      |
| PEFC     | Programme for the Endorsement of Forest Certification Schemes | SDGs  | Sustainable development goals |
| SFM 1–20 | Non-industrial private forest owners' codes                   | UN    | United Nations                |

## 1. Introduction

*'Forests and the forest-based sector provide multiple socio-economic functions and benefits.'*

*Forestry Strategy, European Commission, 2022.*

\* Corresponding author.

E-mail address: [natastr@gmail.com](mailto:natastr@gmail.com) (N. Stryamets).

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Forests are increasingly recognized as vital providers of a diverse range of benefits, services, and values, including those related to biodiversity, human health, bioeconomy, and societal resilience (e.g., United Nations, 2017; IPBES, 2019; European Commission, 2020). The rising importance underscores the need to diversify large-scale silvicultural practices beyond intensive, short-rotation management centered on clearcutting. Such diversification is crucial to balancing environmental, social, and economic interests in alignment with the sustainable development goals (SDGs), adapting to climate change, and supporting the transition towards a bioeconomy (European Commission, 2019, 2023; Erthal Abdenur, 2022; Forest Declaration Assessment, 2023).

Recent European Union (EU) policies and strategies strongly advocate for a shift away from forest management practices based on intensive clearcutting (European Commission, 2021, 2023). For instance, the New EU Forest Strategy for 2030 (European Commission, 2021) establishes a legal framework to promote healthy, diverse, and resilient forests that enhance biodiversity conservation while simultaneously supporting a sustainable bioeconomy. This strategy emphasizes the significant role of non-industrial private forest (NIPF) owners in delivering and maintaining forest benefits, services, and values. The strategy proposes developing a voluntary certification scheme, introducing guidelines for payments for ecosystem services (ES), and expanding the use of alternative forest management practices as measures to mitigate climate change and address biodiversity loss (European Commission, 2021).

However, alternative forest management approaches are rapidly evolving, although many practices still lack clear definitions (Kruse et al., 2023). In European contexts, such practices are often referred to as continuous-cover forestry (CCF) or closer-to-nature forestry (European Commission, 2023) (Table S1). For the purposes of this study, we adopt the term “clearcut-free forestry” to describe such approaches. These practices are defined by their avoidance of large-scale clearcuts and an emphasis on promoting structural diversity, small-scale variability, natural regeneration, and the use of mixed, predominantly native tree species (Puettmann et al., 2015; Pommerening, 2023; Brunner et al., 2025).

Clearcut-free forestry is often described as more beneficial for biodiversity and forest resilience, particularly in the context of climate change (Puettmann et al., 2015). Numerous studies highlight the ecological advantages of clearcut-free forestry, especially in Norway spruce (*Picea abies*) stands, demonstrating its ability to support biodiversity and enhance ecosystem stability (Atlegrim and Sjöberg, 1996a, 1996b; Sténs et al., 2019; Ekholm et al., 2022). Research also shows that clearcut-free forestry can outperform clear-cutting in several contexts, including economic outcomes (Pukkala and von Gadow, 2012; Parkatti et al., 2019), climate benefits and carbon sequestration (Pukkala, 2014; Laurila et al., 2021; Shanin et al., 2021; Brnkalakova et al., 2022), bilberry production (Peura et al., 2018), and improve resilience of peatland forests (Laudon and Hasselquist, 2023), scenic beauty (Eyvindson et al., 2021), and overall forest multifunctionality (Peura et al., 2018; Kuuluvainen et al., 2021).

However, some studies report only minor differences between clearcut-free and clear-cutting forestry regarding climate benefits (Lundmark et al., 2016). Additionally, clear-cutting forestry has been shown to yield higher wood and biomass production (Peura et al., 2018) and may, in some cases, be more economically profitable (Andreassen and Øyen, 2002), with potential for a more favorable carbon balance (Lundmark et al., 2016). In boreal forests, conventional clear-cutting management is sometimes associated with higher rates of carbon sequestration compared to clearcut-free forestry (Kilpeläinen et al., 2016), though Eyvindson et al. (2021) argue the opposite. The narrative that conventional clear-cutting provides greater climate benefits is frequently used by the forest industry to justify increased wood extraction (Hertog et al., 2022). However, the climate benefits of any forest management approach depend significantly on the resilience and

adaptive capacity of forest ecosystems to withstand stressors such as drought, storms, and bark beetle outbreaks. Scholars argue that these risks can be mitigated by more diverse forestry practices, which emphasize structural and species diversity (Felton et al., 2016; Tahvonnen and Rämö, 2016; Hahn et al., 2021).

While clearcut-free forestry has gained attention in recent years, much of the existing literature remains focused on large-scale forest owners, particularly private forest companies (Johansson, 2013; Heder Brandt et al., 2023; Bergstén et al., 2018). In contrast, NIPF owners—despite their significant share of forest ownership in countries such as Germany, Finland, and Sweden—are still underrepresented in academic research (Juutinen et al., 2022; EU, 2022). Existing studies have examined how climate change shapes forest management decisions among NIPF owners (Laakkonen et al., 2018; Mostegl et al., 2019; Juutinen et al., 2022), their adaptation strategies (Eriksson, 2017, 2018), responses to forest disturbances (Kronholm, 2024), and engagement with environmental concerns (Degnet et al., 2022). Moreover, recent research highlights important correlations between socio-economic variables—such as gender, age, and property size—and forest owners’ values, knowledge, and adaptive behaviors (Eriksson and Fries, 2020, 2021; Pröbstl-Haider et al., 2020; Olofsson and Jakobsson, 2024). For instance, new forest owners and women are more likely to emphasize recreational use and the harvesting of non-wood forest products (NWFPs) (Pröbstl-Haider et al., 2020).

Despite these insights, the specific role of NIPF owners as niche actors in the ongoing transition toward clear-cut free forestry remains poorly understood (Feliciano et al., 2017). Previous studies have shown how some NIPF owners experiment with clear-cut free forestry on parts of their land (Hertog et al., 2022). There is a notable gap in research concerning how these owners contribute to innovation pathways by experimenting with clearcut-free practices and how their actions may potentially catalyze broader systemic change within the dominant forestry paradigm. Understanding this role is essential, as it highlights how bottom-up experimentation and diversification may challenge the prevailing clear-cutting model and open pathways toward more multifunctional and ecologically oriented forest management.

This study therefore, aims to understand the role of NIPF owners as early adopters and niche actors in a potential transition toward alternative forest management regimes. We explore the motivations of early adopter NIPF owners for diversifying forest management practices, the perceived benefits they associate with clearcut-free forestry, and their perspectives on the barriers and enabling factors in the process of adopting and maintaining clearcut-free forestry practices within the existing forestry regime in Sweden. Our analysis is informed by the multi-level perspective (MLP) framework, which conceptualizes socio-technical transitions as processes resulting from the interaction between innovations at the niche level, the stability of incumbent socio-technical regimes, and broader pressures from the landscape level (Geels, 2002, 2005, 2011). Within this framework, clearcut-free forestry represents a niche innovation that challenges entrenched practices and institutional arrangements in Sweden’s forestry sector. By examining how early-adopting forest owners navigate these dynamics, this study contributes to a better understanding of their role in shaping potential transitions toward more sustainable and socially valued forestry systems.

As the most forested country in the EU, Sweden provides an excellent case study due to its high proportion of NIPF owners and its long history of intensive forest management focused on clear-cutting of even-aged monocultures based primarily on two commercial species—Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*). Currently, most Swedish forests are managed through such intensive management approaches, with clearcut-free forestry practiced on less than 3% of the forested land (Hertog et al., 2022; Skogsstyrelsen and Naturvårdsverket, 2023; Högberg et al., 2021). Recently, Sweden has faced increasing pressure from the EU to diversify its forest management practices by transitioning toward clearcut-free forestry (Fridén et al., 2024).

In response, the Swedish government has highlighted the need for a deeper understanding of the benefits of clearcut-free forestry, as well as the drivers and barriers to its implementation (Swedish Forest Agency, 2023; Skogsstyrelsen and Naturvårdsverket, 2023). Furthermore, efforts are underway to identify and promote tools that encourage forest owners to adopt clearcut-free practices (Appelqvist et al., 2021; Sustainable Forests, 2022; Skogsstyrelsen and Naturvårdsverket, 2023). The transition to clearcut-free forestry is expected to mitigate the increasing risks associated with climate change-induced forest disturbances, such as the spread of pests and diseases, while also addressing other critical forest functions and services, including water quality regulation, biodiversity conservation, and the preservation of cultural and social values (Lidskog and Sjödin, 2014; Reyer et al., 2017; Knez et al., 2018). These considerations are gradually being integrated with traditional functions like timber production (Sandström et al., 2011).

## 2. The multi-level perspective as an analytical framework

The MLP conceptualizes sustainability transitions as dynamic and non-linear processes that unfold through interactions across three analytical levels: niches, socio-technical regimes, and the socio-technical landscape (Rip and Kemp, 1998; Geels, 2002, 2005). Each of these levels represents a configuration of actors, institutions, and technologies, characterized by varying degrees of stability and coherence. The MLP has been increasingly used to study forest management transitions (Hertog et al., 2022; Dawson et al., 2025; Kiisel and Remm, 2022; Halonen et al., 2022).

Niches are protected spaces where radical innovations can emerge and mature, relatively shielded from dominant market dynamics and regulatory pressures (Geels, 2011). Niche actors—such as entrepreneurs or innovators—often develop approaches that diverge from mainstream practices. However, transitions towards more widespread adoption of these innovative approaches often face significant challenges due to misalignments with regime-level systems, including entrenched infrastructures, policy frameworks, markets, and user cultures (Kemp et al., 1998; Schot and Geels, 2013).

The socio-technical regime level refers to the prevailing configuration of institutions, practices, technologies, and actor networks that together stabilize current systems (Geels, 2004, 2011; Holtz et al., 2008). Regimes fulfill essential societal functions—such as timber production in forestry—and are characterized by internal consistency, path dependency, and resistance to disruptive change. Change within regimes typically occurs incrementally, shaped by institutional lock-ins, vested interests, and the alignment of technical standards, policies, and market norms.

The landscape level comprises exogenous trends and contextual factors that influence both regimes and niches but are largely beyond their immediate control (Rip and Kemp, 1998; Geels, 2004, 2011). These include slow-moving macro developments such as demographic shifts, geopolitical conflicts, climate change, and evolving societal values. Although typically stable, the landscape may be disrupted by sudden shocks—such as environmental crises or political reforms—which can destabilize regimes and open windows of opportunity for niche innovations to scale (Smith, 2006).

In this study, we conceptualize our NIPF owners interviewees as niche actors who are already experimenting with and implementing clearcut-free forestry. These early adopters in our study represent a bottom-up source of innovation, developing alternative practices within a protected niche—enabled by private ownership, personal values, social networks, and place-based knowledge. They operate within a dominant forestry regime that remains oriented toward industrial-scale production based on clear-cutting, maintained by large forest companies, production-oriented institutions, national policies, industrial knowledge, technologies, and market structures. By exploring their motivations, perceived benefits, and the barriers they face, this study helps to understand how early adopter NIPF owners might contribute to

a forest management transition in Swedish forestry, contributing to the emergence of an alternative forest management regime.

## 3. Methods

### 3.1. Sweden as a case study

Since 1993, the Swedish forestry sector has been tasked with balancing production and environmental objectives, which are officially considered of equal importance (Bill, 1992). The Swedish forestry model is built on the principle of “freedom with responsibility” (Danley et al., 2021), supported by a shared understanding among the state, industry, and forest owners that prioritizes timber production (Lidestav and Westin, 2023). Despite widespread certification by the Forest Stewardship Council (FSC) or Programme for the Endorsement of Forest Certification Schemes (PEFC), or both (D’Amato et al., 2022), the absence of strong legal instruments has drawn criticism for enabling the continued prioritization of timber production over other ecosystem services (Beland Lindahl et al., 2017). Contrary to the EU Forest Strategy, Swedish forest policies generally frame the bioeconomy and climate change mitigation as justifications for increasing wood production (Beland Lindahl et al., 2017).

This study focuses on NIPF owners, a group that collectively owns 48% of Swedish forests and whose decisions have significant national policy implications (Lidestav and Westin, 2023). Currently, Sweden has approximately 313,000 NIPF owners, with an average age of 61 years and an average forest holding size of about 36 ha (Swedish Forest Agency, 2023). Historically, this group has played a vital role in the forestry sector and the national economy (Sörlin, 2019). However, trends indicate a decline in the number of forest owners residing and working on their properties, alongside a rise in non-residential ownership and co-ownership of forest land (Lidestav and Nordfjell, 2005; Haugen et al., 2016).

Simultaneously, reliance on forest-based income among small-scale forest owners is diminishing, while the importance of other societal functions and values is growing (Matilainen et al., 2023). Consequently, their management objectives are shifting toward a broader range of products and services, including tourism, non-timber forest products, biodiversity conservation, and cultural values (Hugosson and Ingemarson, 2004; Jonsson et al., 2019). Social values, such as recreation, gathering non-wood forest products, and hunting, are increasingly prioritized over timber production (Lidestav and Westin, 2023). These findings underscore the diversity within the small-scale forest owner group and the complexity of their motivations and management approaches.

Within this context, clearcut-free forestry (in Swedish: *hyggesfritt skogsbruk*) emerges as a promising alternative to conventional clear-cut-based forest management. However, it remains a contested and debated practice in Sweden. The Swedish Forest Agency defines it as forest management on productive forest land that maintains continuous tree cover, avoiding clear-cut areas larger than 0.25 ha (Appelqvist et al., 2021). This often involves the use of long-lasting shelter trees, although if natural regeneration beneath these shelter trees is systematically removed to prevent the development of a fully uneven-aged forest, it does not qualify as clearcut-free forestry.

Other variations of clearcut-free forestry include small clear-cuts of approximately 0.25 ha, spatially distributed in a pattern resembling a chessboard, resulting in small, even-aged forest stands. An older method, *blädning* or selective harvesting (Brnkalakova et al., 2022), involves cutting and removing individual trees, maintaining a diverse, uneven-aged forest structure. Considered the Swedish approach most similar to CCF, *blädning* focuses on harvesting larger trees while preserving forest diversity. However, *blädning* practices remain relatively rare in Sweden (Lundqvist et al., 2009; Lundmark, 2020).

### 3.2. Data collection and analysis

A total of 20 qualitative, semi-structured interviews were conducted with 22 forest owners between January and April 2023. We employed snowball sampling and advertisements in local forestry newspapers. The interviewees, all NIPF owners, were from ten counties in central and southern Sweden: Dalarna, Örebro, Värmland, Västmanland, Gävleborg, Uppsala, Västra Götaland, Östergötland, Skåne, and Kronoberg. All interviewees had adopted clearcut-free forest management and identified themselves as such. Forest holding sizes varied from 5 to 1,300 ha (Fig. S1), with clearcut-free approaches applied on 2%–100% of these holdings. All 22 interviewees resided on their forest properties, which was a selection criterion, and 12 interviewees had owned their forests for more than two generations. All but one participant had additional income sources outside of forestry. The age of the interviewees ranged from 37 to 84, averaging 63 years old. The sample was 86% male and 14% female (Section 6).

The interview manual included questions about perceived benefits, motivations for the transition, perspectives, and challenges, as well as opportunities associated with transitioning to clearcut-free forestry. Interviews were conducted primarily in English, except for one in Swedish, which was facilitated by an interpreter. Oral consent was obtained from all interviewees prior to each interview, ensuring they fully understood the purpose of the study, the nature of their participation, and how their data would be used. Interviewees were informed that their responses would be anonymized and treated confidentially to protect their identities. They were also made aware that participation was voluntary, and they could withdraw from the study at any time without providing a reason.

After obtaining consent, all interviews were audio-recorded to ensure the accurate capture of interviewees' responses and to facilitate detailed transcription and analysis. Each interview lasted between 50 and 90 min. All interviews were transcribed and analyzed using qualitative content analysis (Bryman, 2008).

To comprehensively capture the perceived benefits attributed to forests, the ecosystem services framework was employed. Ecosystem services (ES) refer to the benefits people derive, directly or indirectly, from ecosystems, including provisioning, regulating, cultural, and supporting services (MEA, 2005). While much ES research has focused on the supply side—mapping ecosystem properties through spatial analysis—recent studies highlight the importance of addressing the demand side, which involves understanding the perspectives and interests of diverse stakeholder groups (Elbakidze et al., 2017). This approach aligns with the study's aim to explore how forest owners perceive ESs in the context of clearcut-free forestry.

The transcribed data were systematically organized into thematic categories, including motivations for diversifying forest management, perceived benefits categorized by ecosystem service types, and challenges and opportunities to implementing clearcut-free forestry in Sweden. The thematic analysis provided a structured framework for identifying key insights, and relevant quotes were selected to illustrate findings (Table S2).

## 4. Results

### 4.1. Diverse interpretations of clearcut-free forestry

All interviewees expressed significant confusion regarding the terminology and definitions associated with clearcut-free forestry, emphasizing the need for clear and precise definitions to better understand its scope and objectives (Fig. S2). This lack of clarity led to differing interpretations of the term, making it challenging for forest owners to align their practices with consistent management frameworks.

Some interviewees identified their practices as “clearcut-free forestry”, while others used terms like “continuous cover forestry”, “continuation forestry”, or “multi-use forestry”. As one interviewee

(SFM8) explained, “I think that there is a lot of confusion concerning terminology. Continuous forestry is a term I use. After talking to people, I use the terms *hyggesfritt* [clearcut-free] or *blädning* [selective cutting]. There is a definition by Skogsstyrelsen [the Swedish Forest Agency], which states that it should never be clear-cut, just a two-layer forest, and no clear-cut. There is also another definition of *hyggesfritt* [clearcut-free] that includes clear-cut areas smaller than 0.25 ha. But for me, continuous forestry is more like you have trees of all species and all sizes; you do only selective cutting. Trees of all dimensions should be in the forest.”

This highlights the diverse ways in which clearcut-free forestry is interpreted, even among practitioners who actively engage in such methods. However, several interviewees stressed that practical implementation was more important than the terminology itself. As one interviewee (SFM20) pointed out, “The term continuation forestry is broad and wide, but the terms do not matter. What matters is what happens on the ground and that you can demonstrate all the benefits that clearcut-free forestry is expected to provide.”

Additionally, one interviewee (SFM6) emphasized the critical role of government in defining and standardizing diverse forest management approaches: “There are no clear definitions, and I think that they have to be defined. That is what the government has to work with more.”

This call for government intervention reflected a broader sentiment among interviewees that clear guidelines and terminology were essential for fostering coherence and facilitating transitions to alternative forest management practices.

These responses underline the diversity in both practices and perspectives among NIPF owners. While terminology remained a contentious issue, the interviews revealed a shared perception that practical outcomes—such as biodiversity conservation, sustainable timber production, and maintaining ecosystem services—were ultimately more important than the labels used to describe these practices.

### 4.2. Motivations for transition to clearcut-free forestry

All interviewees emphasized the importance of environmental sustainability and biodiversity conservation as key motivations for transitioning to clearcut-free forestry. Forests managed using these methods were perceived as more natural and healthier compared to plantations. Concerns about the impacts of climate change, such as forest fires, droughts, and extreme weather events, were prominent among interviewees. Many believed that clearcut-free forestry could reduce these impacts and enhance forest health by improving resilience to disturbances and degradation. As one interviewee (SFM11) explained, “Resilience against factors such as climate change, wind, drought, bark beetle, etc., is crucial. Variation in the forest is key to its future success for my children. This is why we arranged for continuation forestry.”

One participant (SFM15) recounted their alarming experience during the 2018 drought, “It was so scary when we didn't have rain for months. The forest was extremely dry. We had fires all over the neighborhood. Since then, we've been collecting rainwater in reservoirs and digging out ponds to have water, just in case drought happens again.”

Interviewees also highlighted the ecological and recreational value of clearcut-free forests. According to SFM14, “We manage the forest for nature ... It is a more interesting forest both for the ecosystem and for humans to be in.”

Economic viability also motivated many forest owners. Interviewees noted that transitioning to clearcut-free forestry could result in higher incomes due to better timber quality, despite lower overall volumes. SFM20 explained, “The timber volume is smaller, but of higher value and quality. More money but less volume of timber.” In addition to timber, some forest owners diversified income streams by using their forests for tourism activities, selling hunting rights, or renting camping spaces.

Clearcut-free forestry was also seen by many as a way to preserve socio-cultural values that could not be measured in monetary terms.



Interviewees with deep family ties to their forests expressed emotional connections to the land, motivating them to adopt more sustainable practices. For example, SFM4 shared, “My grandfather never allowed clear-cuts.” Others emphasized personal enjoyment and creativity as drivers for their approach. SFM8 stated, “I do it because it’s fun. I think the same as for many others—I can manage and use the forest and still keep it.”

Finally, the impact of clearcut-free forestry on community relationships and wellbeing was another key motivation. Some interviewees shared negative social consequences they had experienced due to clearcutting, which motivated them to adopt alternative practices. SFM1 recounted, “My neighbor told me, ‘I hate you because you did a clear-cut.’ It prompted me to consider using alternative forestry methods.” Similarly, SFM16 reflected on the consequences of hiring a forestry entrepreneur for clearcutting, “They plowed everything. All the mushrooms, small bushes, lingonberries, and blueberries are gone. I met an old couple, and they said, ‘Have you seen what they have done to our mushroom spot? It’s all gone.’ And I had to confess that it was me who hired them to do the clear-cut. I felt terrible ... We are humans, and we need this recreational aspect of being in our forest, also for our neighbors.”

#### 4.3. Ecosystem services attributed to clearcut-free forests by forest owners

**Supporting ES.** In total, interviewees attributed eight supporting ES to their clearcut-free forests, of which the most frequently observed were related to biodiversity, species, and nutrient cycling.

Many interviewees emphasized that clearcut-free forests provide better habitats for a wide variety of species, including plants, fungi, birds, and game animals. For example, one interviewee (SFM14) highlighted the importance of biodiversity as a central goal of their forest management, “These areas are alive. I bought this forest for wildlife, hunting, and biodiversity. I think biodiversity is the most important outcome of our [clearcut-free] management. We have a plan for how to achieve the highest biodiversity.” Similarly, another participant (SFM12) pointed to the benefits for fungi, large trees, lichen, and mosses, stating, “It is good for biodiversity. By performing continuation forestry, I think more fungi survive, along with more large trees, lichen, and mosses.”

Interviewees also associated increased forest resilience with a transition from even-age spruce monocultures to mixed, uneven-age deciduous-coniferous forests. For instance, SFM17 explained, “It is very important for species that the forest is diverse, not so much monocultures.” Another forest owner grows seedlings to move from monoculture and to plant in his forest (Fig. S3).

The role of deadwood in supporting specific species was another key theme raised by several participants. As one interviewee (SFM15) elaborated, “We leave all deadwood for small organisms.”

**Provisioning ES.** Beyond timber and firewood, interviewees attributed a diverse range of provisioning services to forests managed using clearcut-free forestry, including wild food (berries, mushrooms, and game meat), fresh water, and fiber for the pulp industry (Fig. 1).

Several interviewees specifically emphasized the high quality of timber from clearcut-free forests. For example, one interviewee (SFM16) remarked, “The quality of timber is fantastic, and we have lots of building projects from this timber.” Another interviewee (SFM4) highlighted plans to use this high-quality timber for personal projects, “I have cut those elm trees, and I will cut them into pieces. Then I will make bookshelves here from my timber; it is so beautiful.”

Some forest owners also explored innovative uses of their forests. One interviewee (SFM5) described converting their forest into a forest garden, cultivating nuts, fruits, and berries for personal consumption: “We do agroforestry to grow our forest for firewood, and nuts and fruits for food.”

The importance of wild food provision, such as berries, mushrooms, and game meat, was also frequently mentioned. These resources were

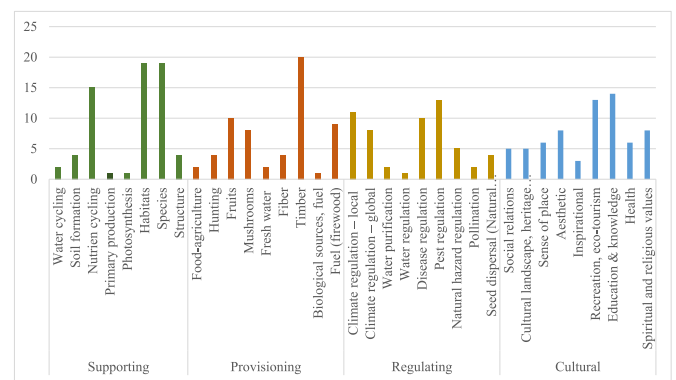


Fig. 1. Ecosystem services attributed to clearcut-free forestry and the number of interviewees identifying them.

valued not only for the subsistence of family members but also for their contribution to surrounding communities. Interviewee SFM1 elaborated, “The forest is much more than just wood; it is berries, mushrooms, all the animals, and all the people who want to go there.”

For some, recreation tied to wild food gathering was a key motivation. SFM20 stated, “I collect hundreds of liters of mushrooms.”

Others recognized the economic potential of non-timber provisioning services. SFM18 emphasized, “If you save the forest without clear-cutting, then over time, it contributes as much or even more economic value to people picking berries and mushrooms than the whole timber price for 80 years.” Many interviewees noted the detrimental effects of clearcutting on non-timber provisioning services, including fresh water and wild food. For instance, SFM14 explained, “Trees are very important for mushrooms. Clearcut forestry damages the ground, and I don’t think mushrooms or berries like that very much either, except for raspberries.”

**Cultural ES.** Interviewees associated nine cultural ES with clearcut-free forest management. Education and knowledge transmission, along with recreation and eco-tourism, were the most frequently mentioned cultural ES. Recreational activities such as birdwatching, walking, hunting, and collecting berries and mushrooms often overlapped with provisioning services. One interviewee (SFM11) highlighted how their family preserved parts of their forest for recreation, saying, “My father has preserved much of the forest for recreational purposes, identifying the best spots for mushroom picking, hunting, or simply enjoying life.” Another interviewee (SFM1) expressed a preference for hunting in clearcut-free forests, stating, “I have been hunting moose all my life; it is more enjoyable to hunt in the forest than in the clear-cut areas.” SFM20 added, “Recreation with berry and mushroom picking is important for me.”

Interviewees emphasized that forest management decisions significantly impact large numbers of users due to Sweden’s freedom of public access (Hahn, 2000), the “right to roam” (*Allemansrätten*), which allows the public open access to private forest land for recreational purposes free of charge. Some interviewees expressed a responsibility to preserve the recreational and relational value of their forests, including respecting neighbors’ cherished spots. As one interviewee (SFM11) stated, “In rural areas, there are other individuals who enjoy spending time in my forest. Forest owners should also heed the voices requesting not to disrupt their mushroom and berry spots with clear-cuts, spots they cherish for their forest experiences.”

Clearcut-free forests were frequently associated with sustaining quality of life, offering mental, physical, aesthetic, and existential benefits. Many interviewees described how spending time in their forests positively influenced their wellbeing. SFM6 explained, “Just the beauty of the place. The health of the forest, and my wellbeing, I don’t know how you measure that.” Similarly, SFM19 remarked, “It is not only about money. It is also important to have a forest that is nice to walk in. There are more things in life than money.”

Clearcut-free forests also fostered community benefits and social cohesion. Several interviewees noted the negative aesthetic impact of clearcuts on forest landscapes. SFM3 described clearcuts as “ugly,” while SFM14 likened them to “a big desert.” SFM16 added, “The forests which are managed using the clearcut system are hard to walk in. With clearcut-free forestry, you don't create such a devastating landscape as with clear-cut. I can see that ugly clearcut from my window, but I don't want to.”

Education and knowledge transmission were highlighted as significant cultural services provided by clearcut-free forests. Forest owners shared their experiences with neighbors and visitors, often engaging with the media to discuss the pros and cons of this management approach. One interviewee (SFM14) emphasized the importance of education, stating, “We have to educate communities, advise people owning a forest, and inform them about the benefits that clearcut-free forestry can provide.” Another (SFM6) described being inspired by others, “I heard about selective cutting and found it very inspiring. It has both economic and ecological benefits, and I thought that it would be a good method on these slopes.”

Maintaining cultural traditions within families also emerged as a key theme. Many interviewees expressed a sense of place and belonging tied to their family forests and the clearcut-free methods practiced by previous generations. SFM2 stated, “I am the sixth generation of forest owners [in our family]. My grandfather worked with horses till the 1970s. Every winter, he took 100 m<sup>2</sup>, sold the timber to sawmills, and this kind of forestry is what we have done all the time in southern Sweden.”

Some interviewees shared symbolic and emotional connections to their forests. SFM5 showcased a tree by a water spring, stating, “This is the spring coming out of the tree of life in Scandinavian mythology. It is the well of life. The spring is coming out of the tree roots. We will not cut it.” SFM6 captured the emotional depth of this connection, saying, “You have a connection with your forest ... for myself, walking in the forest is an amazing thing. Not only psychologically, but emotionally, spiritually.”

**Regulating ES.** Interviewees attributed ten regulating ES to their clearcut-free forests. Among these, pest and disease regulation, along with local and global climate regulation, were the most frequently mentioned, followed by water regulation, natural hazard regulation, and seed dispersal.

Local climate regulation was emphasized as a critical benefit of clearcut-free forestry. Many interviewees highlighted how these forests improve microclimate conditions, particularly by cooling the ground and reducing the harshness of heat during summer. As SFM11 explained, “The local climate is better with continuation forestry. I cannot talk about the planetary climate, but the local climate in the forest that is managed this way is much better. It helps to cool the ground. One year after a clear-cut, it's a desert. In the middle of the summer, the heat is disturbing. So the local climate definitely benefits from continuation forestry.”

Enhanced carbon sequestration was another widely recognized benefit. Interviewees pointed to the ability of clearcut-free forestry to store more carbon in both the soil and standing trees, emphasizing the role of uneven-aged and mature forests in extending the carbon turnover cycle. The importance of fungi in soil carbon retention was also frequently mentioned. “Clearcut-free forestry preserves more carbon in the ground and in the standing wood. The local climate is better when you have a wide diversity of different species in an old forest.” (SFM7).

Water regulation was another frequently cited regulating ES. Many interviewees expressed concerns about runoff water from clear-cuts, describing its negative impact on water quality in rivers and coastal areas. Others noted that clear-cuts contributed to reduced water availability in the surrounding environment. “Runoff water from clear-cuts is like Coca-Cola, and it is going downstream to lakes ... runoff water from continuation forests is much cleaner than the runoff water from clear-cut areas.” (SFM13).

Pest and disease regulation were also significant concerns among forest owners, particularly related to bark beetle infestations and spruce rot. Interviewees saw clearcut-free forestry as a means to achieve more resilient and healthier forests, reducing susceptibility to these threats.

Natural regeneration was identified as another key benefit of clearcut-free forestry. Interviewees noted that this method provided sufficient quantities of healthy seedlings without the need for soil preparation, which was seen as detrimental to soil structure and biodiversity. Avoiding soil preparation was also viewed as beneficial for maintaining the health of fungi and mycorrhiza, which are essential for soil quality. “The soil, mycorrhiza, and all biodiversity is better [in clearcut-free forests].” (SFM7).

#### 4.4. Perceived barriers and opportunities for transition to clearcut-free forestry

All interviewees emphasized a variety of barriers associated with transitioning from conventional clear-cut forestry to clearcut-free forestry, encompassing economic, educational, socio-cultural, and market-driven conditions.

Economic barriers were frequently mentioned by forest owners who needed quick financial returns from their forests, for example, to repay loans. Clearcut-free forestry was perceived as requiring long-term financial planning, whereas clear-cut forestry provided an immediate lump sum.

Clearcut-free forestry was also described as more time- and labor-intensive, requiring hand labor and specialized, often expensive, machinery, which was scarce since most equipment was designed for clear-cutting. As one interviewee (SFM16) stated, “It is simpler to do a clear-cut. It's a lot easier to just ask the forest company to take down the trees and send them to the company, and they send money back ... small machines cost too much.”

A lack of specialized skills and practical knowledge for implementing clearcut-free forestry was another significant challenge. Interviewees noted gaps in knowledge about tree selection, forest dynamics, and appropriate management practices at various growth stages. Many also lamented the lack of research and evidence-based knowledge on clearcut-free forestry practices. As one interviewee (SFM18) explained, “The government should support research on clearcut-free forestry ... Sometimes I feel like I'm in the dark. I don't know if I'm doing it right or wrong. I have simple theories and try to apply them, but it is not like growing potatoes or wheat. The growth of the forest takes more than my life before you see the results.”

Others emphasized the need for education and knowledge-sharing across the sector. “We need to educate the forest entrepreneurs with big machines ... We need more scientists who could help us with knowledge from different forestry disciplines.” (SFM17).

Socio-cultural barriers included overcoming strong norms and traditions associated with conventional forestry. Some neighbors viewed clearcut-free forestry practices skeptically. “Our neighbors think we are crazy to do clearcut-free forestry and leave deadwood in the forest.” (SFM19).

Market-related barriers were also significant. Many interviewees pointed out that large timber company purchasing practices, which favor bulk volumes of timber, were not supportive of clearcut-free forestry. There was little demand for the smaller volumes of high-quality timber produced by these methods.

Despite these challenges, interviewees also identified numerous opportunities associated with transitioning to clearcut-free forestry. Economically, these practices were seen as offering long-term income generation, reducing costs associated with planting and disease treatment, and diversifying household income streams. For example, SFM1 described clearcut-free forestry as, “The clearcut-free forest is like a bank, and you can get income every time and still have a forest.”

At the societal level, interviewees believed clearcut-free forestry could create more jobs and opportunities for rural communities. SFM20

noted, “It is not for fast cash. The revenues are spread out for many years. It is equivalent to many years. In total, it is equivalent to clear-cut. You take the interest and still have a forest.”

Interviewees also highlighted the importance of knowledge transmission to support a transition to clearcut-free forestry. Sharing knowledge with other forest owners, community members, and stakeholders (e.g., schools) was seen as vital. Forest owner associations were identified as a potential platform for collaboration, learning, and innovation. As one interviewee (SFM14) stated, “We [the forest owners who perform clearcut-free forestry] have to educate communities, advise forest owners, and inform about the values that clearcut-free forestry can give.”

Opinions about governmental support, such as subsidies for clearcut-free forestry, were mixed. Some interviewees supported subsidies as an incentive, while others doubted their long-term efficiency, emphasizing forest owners’ preference for autonomy.

“I think that subsidies are such a great message from the government. If the government provided subsidies, it would have a great impact on encouraging forest owners toward clearcut-free forestry,” explained interviewee SFM14.

Several interviewees mentioned certification schemes as a potentially effective tool to promote clearcut-free forestry. While some doubted their usefulness, others saw certification as a way to increase the area of clearcut-free forestry and appeal to consumers who value sustainably managed forests. “I think that certification of the timber that comes from clearcut-free forestry would be a good instrument to increase the area of clearcut-free forestry in general. At least for some people, it matters if timber comes from properly managed forests, with no clear-cut,” told SFM14.

## 5. Discussion

### 5.1. Clearcut-free forestry as a niche innovation

Our findings indicate that early adopters perceive clearcut-free forestry as a multifunctional approach to forest management that aligns more closely with their objectives and values compared to the intensive management approach that is otherwise dominant in Sweden. Three core themes emerge from the data that illustrate how niche innovation is grounded in NIPF owners’ lived experiences. First, interviewees consistently identified biodiversity conservation as a primary motivation for adopting clearcut-free forest management. This objective was not only framed as a personal value but also seen as aligned with broader environmental policies and societal expectations—an indication of how niche practices resonate with, and/or respond to, increasing landscape-level pressures towards ecological sustainability and biodiversity protection.

Second, early adopters appear to perceive clearcut-free management as a crucial niche-level practice offering an effective resilience strategy capable of mitigating climate-related risks, while providing more stable and predictable economic outcomes in the event of disturbances. Interviewees highlighted the greater compatibility of a clearcut-free approach with forest landscapes adapted to contemporary conditions, particularly under the growing pressures of climate change. For example, uneven-aged, mixed-species forests were perceived by interviewees as more resilient to droughts, storms, and pest outbreaks. This aligns with recent studies (Lidestav and Westin, 2023; Matilainen et al., 2023; Augustynczyk et al., 2020; Hahn et al., 2021, 2023), which underscore the ability of clearcut-free forestry to provide regulating ecosystem services such as climate regulation and natural hazard mitigation. We argue that, in the context of our study at least, early adopters are not merely reacting to external (landscape level) pressures but are actively shaping more resilient forest management approaches that might inform future regime transformation.

Third, early adopters perceive clearcut-free forestry as a more flexible management approach capable of better accommodating the

diverse and evolving priorities of forest owners and better aligning management practices with evolving societal demands for multifunctional landscapes that balance ecological, economic, and cultural objectives. Rather than being merely pragmatic, the shift to commence experimenting with clearcut-free forestry undertaken by our interviewees was deeply rooted in a sense of stewardship, cultural heritage, and long-term ecological responsibility. Many interviewees described their forests as spaces deeply connected to family traditions, community wellbeing, and personal identity. These values frequently outweighed economic considerations. Recreational and aesthetic benefits were particularly emphasized, with owners associating clearcut-free forestry with more visually pleasing landscapes that supported activities like mushroom picking, walking, and birdwatching. These activities not only enhanced their own quality of life but also contributed to community wellbeing, underscoring the shared value of maintaining accessible, ecologically diverse forests. These findings are consistent with recent studies (e.g., Küsel and Remm, 2022; Olofsson and Jakobsson, 2024; Lidestav and Westin, 2023; Bjärstig and Sténs, 2018; Angelstam and Dawson, 2025) that emphasize the multifunctional perceptions and increasingly diverse management objectives of small-scale private forest owners in Sweden, Estonia, Finland and similar contexts, including their willingness to adopt environmentally oriented forest management practices (Häyrinen et al., 2025).

Therefore, we argue that clearcut-free forestry—as implemented by early adopters—demonstrates how niche innovations can emerge at the intersection of personal values, practical experimentation, and landscape-level pressures. These practices represent a form of locally embedded adaptation that prefigures potential trajectories for regime change. This highlights the importance of understanding clear-cut free forestry as a place-based, value-pluralist alternative that challenges the dominant socio-technical regime of industrial clear-cut forestry, which remains focused on economic value. By framing clearcut-free forestry as both an ecological and economic risk management strategy and support for rural cultural values, our findings show how early adopters are co-creating alternative visions for forest stewardship—ones that are better aligned with multi-objective sustainability imperatives and to a changing world.

### 5.2. Systemic barriers and the need for knowledge and support

Despite its perceived benefits, our findings support recent studies (Hertog et al., 2022; Mason et al., 2022; Elbakidze et al., 2018; Dawson et al., 2025) and a recent report to the Swedish government (Skogsstyrelsen and Naturvårdsverket, 2023) concerning the systemic barriers that adoption of clearcut-free forestry faces in Sweden, and in Europe more broadly. A critical issue highlighted by our interviewed early adopters was the perceived lack of practical knowledge and adequate advisory services. Forest owners reported significant gaps in expertise related to tree selection, forest dynamics, and the long-term planning required for clearcut-free management. Compounding these challenges is the limited access to skilled labor and machinery, most of which is designed for conventional clear-cut forestry. These results align with previous studies that emphasize how current knowledge and technologies for forest management in Sweden are entrenched in the needs of the intensive management regime (Hertog et al., 2022; Kruse et al., 2023).

Additionally, interviewees pointed to confusion surrounding the terminology and definitions of clearcut-free forestry as a barrier to its adoption. Many described their practices using a variety of terms, reflecting the absence of a unified framework. While some owners downplayed the importance of definitions, arguing that practical outcomes matter more than labels, others stressed the need for clearer guidelines to standardize practices and facilitate broader uptake. These findings reflect a broader trend of “freedom-with-responsibility,” wherein forest owners tailor clearcut-free practices to their specific contexts. Often, this involves hybrid approaches, applying clearcut-free methods to parts of their holdings while continuing conventional

practices elsewhere. This echoes Hertog et al. (2022) and Dawson et al. (2025), who observe that clearcut-free forestry in Sweden remains experimental and lacks a stable framework as a coherent alternative to conventional management.

Our findings, however, suggest a more nuanced perspective on knowledge constraints than in some previous studies. Some interviewed early adopters were undeterred by a lack of knowledge, viewing learning-by-doing as a practical way to overcome such barriers. Others perceived a lack of knowledge as a more significant initial hurdle to overcome. Several interviewees expressed an urgent need for science-based knowledge, particularly concerning complex forest dynamics when transitioning existing forests to clearcut-free systems. These owners emphasized that the full implementation of such practices could take decades, depending on forest stand composition and age. This underscores the importance of sustained research, targeted education, and tailored advisory services to support clearcut-free forestry—a need echoed in other studies (e.g., Puettmann et al., 2015; Hertog et al., 2022). Moreover, our results reveal a critical need to better acknowledge the place-based aspects of forestry transformations and the visions and local knowledge of individual forest owners (Reimerson et al., 2024). To effectively assess the transferability of lessons from innovation niches, it is essential to understand the specific contexts of these niches and the agency of early adopters. This underlines the significant role that early adopters can play in facilitating knowledge co-production concerning clearcut-free management, in collaboration with forest owners, forest entrepreneurs, and advisors from forest owner organizations. Notably, our findings indicate that many early adopters are willing to actively engage in such a role.

Another barrier perceived by early adopters concerned market opportunities for high-quality timber in Sweden. Although many interviewees recognized the potential of clearcut-free forestry to yield superior timber quality, such benefits were said to be undermined by the lack of developed value chains for high-quality timber. The Swedish forestry sector remains heavily oriented towards the bulk production of raw commodities, with insufficient infrastructure—such as sawmills capable of processing larger logs—necessary for value-added production (e.g., Konczal et al., 2023; Lidestav and Westin, 2023). Addressing these market deficiencies would require targeted investments in local and regional value chains to support high-quality timber production (Mason et al., 2022). Our interviews with early adopters indicate that strengthened connections between forest owners, value chain participants, and end-users may be crucial to unlock the economic potential of clearcut-free forestry. For example, although some interviewees highlighted price premiums on high-quality timber as an important opportunity supporting their experimentation with this management approach, it appears likely that a coordinated effort to build capacity within the value chain is necessary to scale up this benefit. Existing solutions, such as communication and trust-building (Vulturius et al., 2018), or forest owner networks focused on clearcut-free forestry, digital forums, and marketplaces, could be expanded to enhance these connections.

An alternative to a quality-based price premium could involve direct state subsidies to incentivize clearcut-free forestry. However, this approach elicited mixed reactions from interviewed early adopters, reflecting a wider ambivalence of Swedish forest owners towards government intervention. While some interviewees viewed subsidies as a practical way to encourage the adoption of alternative practices, others expressed concerns about losing autonomy over their forest management decisions. Our findings in this regard align largely with recent studies showing that the management decisions of NIPF owners are less responsive to subsidies and market incentives compared to large forest owners (Sikkema et al., 2024) and that voluntarism is the most preferred governance mode by forest owners in Sweden (Eriksson and Sandström, 2022). An alternative to state subsidies could therefore be to gradually increase the share of clearcut-free management to 20%–30% on state-owned forest holdings (Skogsstyrelsen and Naturvårdsverket,

2023). It is envisioned that this will stimulate both suitable knowledge production and market opportunities for clearcut-free management. A similar proposal has recently been raised in a recent comprehensive inquiry concerning future management strategies for the considerable forest holdings owned by the Swedish Church (Swedish Church, 2024).

Promoting certification schemes that reward sustainable practices was also noted by several interviewees as a promising avenue. Certification of timber sourced from clearcut-free forests and conservation/ecosystem service payments could create incentives for both producers and consumers, reinforcing the market's capacity to support this alternative forestry model. However, while such instruments are often emphasized in the literature as crucial for enhancing the economic viability of clearcut-free approaches (Puettmann et al., 2015; Juergees et al., 2020; Bergkvist et al., 2024), there is a lack of appropriate incentives in Sweden (Nikinmaa et al., 2024).

Finally, an important insight from our study is that transitioning to clearcut-free forestry does not have to be an all-or-nothing decision. Many of our interviewed early adopters have chosen to experiment with clearcut-free methods on portions of their holdings while continuing conventional practices elsewhere. This incremental approach allows for adaptive management, enabling owners to explore and refine alternative methods without exposing their entire property to potential risks. Such experimentation not only reduces uncertainty but also provides a practical pathway for broader adoption in the face of continued knowledge gaps (Dawson et al., 2017), allowing owners to gradually shift toward more diversified and sustainable forest management practices. Programs by the Swedish Forest Agency that support mentorship and pilot projects among forest owners could provide a model to foster experimentation with clearcut-free methods on small areas of forest holdings while maintaining conventional methods on the rest of their land as a pragmatic strategy for supporting broader adoption, reducing risks, and addressing conservative social norms (Hertog et al., 2022).

## 6. Limitations of the study

This study explores the experiences and insights of a small group of early adopters—NIPF owners from central and southern Sweden—who have begun transitioning away from conventional clearcutting methods to practice clearcut-free forestry on their holdings. Consequently, the results offer a focused account of the nuanced motivations, perceived benefits, and systematic barriers associated with transitioning to clearcut-free forestry as perceived by individuals actively engaged in alternative forest management approaches, rather than a representation of the broader population of private forest owners.

Due to the lack of a public registry of clearcut-free forest practitioners, random sampling was not feasible. Instead, recruitment was conducted using snowball sampling and advertisements, which may have led to an overrepresentation of forest owners with stronger pre-existing interest in clearcut-free forestry. The value-driven motives of these early adopters may therefore have been over-emphasized in this sample.

Additionally, the gender distribution in the sample was skewed (86% male, 14% female), which does not align with national ownership statistics—where women account for approximately 38% of NIPF owners—which may have limited the diversity of viewpoints, particularly regarding gendered perspectives on forest management (Pröbstl-Haider et al., 2020).

## 7. Conclusions

Our findings illustrate that non-industrial private forest owners who have already adopted clearcut-free forestry operate at the intersection of ecological resilience and socio-cultural enrichment. The application of clearcut-free forestry practices by these early adopters addresses critical environmental challenges, including biodiversity loss, climate change, and forest degradation, while simultaneously strengthening the



relationships between forest owners, their communities, and the landscapes they steward. High-quality timber was perceived as a benefit, complementing broader socio-cultural motivations, such as family traditions, community relationships, and aesthetic values.

Within the MLP framework, our findings highlight forest multifunctionality as a key driver of niche-level experimentation, enabling owners to explore management approaches that align with evolving societal demands for more inclusive, sustainable, and diversified forest use. Clearcut-free forestry, in this context, emerges not just as an alternative technique but as a value-driven innovation responding to both ecological imperatives and landscape-level shifts in public expectations. From this perspective, the adaptive, experimental practices of early adopters represent an important starting point for shaping more multifunctional, climate-resilient, and culturally attuned forestry regimes.

However, any potential transition towards clearcut-free management in Sweden is constrained by persistent regime-level barriers, including the lack of practical knowledge and advisory services, and limited access to appropriate machinery and labor. These challenges are compounded by insufficient market incentives to support alternative practices. These findings point to the broader institutional inertia that niche actors face when attempting to innovate within a stable regime. Overcoming such inertia will require coordinated action across multiple levels aimed not only at technical support but also regime reconfiguration, including policy adjustments, investment incentives, and new institutional arrangements aligned with multifunctional and climate-resilient forestry futures.

### CRedit authorship contribution statement

**Nataliya Stryamets:** Writing – review & editing, Writing – original draft, Data curation, Conceptualization. **Marine Elbakidze:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Lucas Dawson:** Writing – review & editing, Writing – original draft, Methodology, Data curation. **Thomas Hahn:** Supervision, Methodology, Writing – review & editing, Funding acquisition, Writing – original draft, Conceptualization.

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### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The authors declare no competing interests.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.fecs.2025.100401>.

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