



# Unlocking a transition to alternative forest management in intensive management contexts: Stakeholder perceptions of constraints and opportunities in Sweden

Lucas Dawson<sup>a,\*</sup>, Jayne Glass<sup>b</sup>, Ulrika Widman<sup>a</sup>, Jenny Friman<sup>b</sup>, Sara Holmgren<sup>c</sup>

<sup>a</sup> School for Forest Management, Swedish University of Agricultural Sciences, PO Box 43, SE-739 21 Skinnkatteberg, Sweden

<sup>b</sup> Natural Resources and Sustainable Development, Department of Earth Sciences, Uppsala University, Sweden

<sup>c</sup> Division of Environmental Communication, Department of Urban and Rural Development, Swedish University of Agricultural Sciences, Sweden

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## ABSTRACT

Forests are increasingly recognized as providing key nature-based solutions for societal challenges related to climate change, biodiversity loss, and sustainable development. This is driving a shift towards greater consideration of alternative forest management (AFM) approaches that promote ecological integrity and social values alongside economic viability. This study investigates constraints and opportunities influencing the adoption of AFM practices in contexts dominated by intensive management. Using a case study of Sweden, we conducted a literature review and a workshop with 53 expert participants to identify 26 topic clusters related to the transition from intensive management to AFM. Key findings reveal that knowledge gaps, socio-cultural norms, and institutional support are perceived as the most significant factors affecting AFM adoption. Participants highlighted conservative traditions and inadequate advisory services as major constraints, while increasing interest among forest owners and potential regulatory support from the European Union were recognized as opportunities for change. Notably, economic and biophysical factors were ranked as less important than socio-cultural, institutional, and knowledge/technology themes. The results indicate that AFM has not yet gained sufficient traction in Sweden to challenge intensive practices, suggesting that incremental change is the most likely outcome in the short term. However, growing public awareness of the limitations of intensive management, societal demands for sustainability, and changes in ownership demographics may catalyse more substantial changes. These opportunities have received less attention in the reviewed literature and the findings therefore emphasize the need for enhanced knowledge dissemination, collaborative networks, and supportive policy and economic instruments to facilitate uptake of AFM. The Swedish case also offers insights for international efforts to support a transition away from intensive forest management.

## 1. Introduction

The increasing crises of climate change, biodiversity loss, and unsustainable resource exploitation have prompted a significant international response in forest governance, albeit with limited success to date (Kleinschmit et al., 2024). As countries grapple with the dual challenges of mobilizing forest resources for a sustainable bioeconomy (e.g., European Commission, Joint Research Centre., 2021) and recognizing forests as vital nature-based solutions (e.g., Seddon et al., 2021), the need for a paradigm shift in forest management practices has never been more pressing (Degnet et al., 2022). The European Green Deal emphasizes the multifaceted roles of forests, while the European Union (EU)

Forestry Strategy (2021) highlights the necessity of integrating environmental considerations into forest management (Sutherland and Huttunen, 2018; Westin et al., 2023). This evolving policy landscape has led many European countries to advocate for greater inclusion of alternative forest management (AFM) approaches that better promote ecological integrity alongside economic viability (Axelsson and Angelstam, 2011; Puettmann et al., 2015; Felton et al., 2020; Mason et al., 2022).

In this paper, we use AFM as an umbrella term that encompasses multiple similar forest management approaches that have (re)-emerged in recent decades – such as continuous cover forestry (CCF) and closer-to-nature forestry – that prioritize multifunctionality and a broad

\* Corresponding author.

E-mail address: [lucas.dawson@slu.se](mailto:lucas.dawson@slu.se) (L. Dawson).

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spectrum of ecological, social, and economic benefits of forests (Puettmann et al., 2015; Mason et al., 2022; Kruse et al., 2023). Despite the multiplicity of AFM practices, they share a set of fundamental principles, including the avoidance of clearcutting to maintain forest structure and biodiversity; an emphasis on structural diversity and variability in terms of density and age classes within and across stands to promote resilience across different spatial scales; the deployment and natural regeneration of mixed tree species to enhance ecosystem stability; and the avoidance of intensive site-preparation methods to minimize disruption to the forest ecosystem (Puettmann et al., 2015). AFM contrasts sharply with intensive forest management practices (hereafter “intensive management”), which typically emphasize short-rotation forestry and clearcutting. Intensive management is conventionally used in several countries with well-developed forest sectors such as Sweden, Finland and Canada with the aim to maximize industrial-scale raw commodity production.

Despite growing interest in AFM, key questions persist concerning agreed definitions, how to implement specific practices, and the varied impacts of these practices on forest ecosystems and local communities. The economic and industrial benefits driving intensive management practices must be weighed against potential benefits of AFM, including enhanced ecosystem resilience and social equity, as well as non-monetary values. In response, several studies have begun to explore drivers of AFM at global, European, and national scales (e.g., Puettmann et al., 2015; Elbakidze et al., 2018). Collectively, these studies highlight a wide range of interconnected factors influencing the adoption of AFM, including institutional and administrative challenges (e.g., Mann et al., 2021; Kiisel and Remm, 2022; Nikinmaa et al., 2024), economic and logistical barriers (e.g., Eyvindson et al., 2021; Mason et al., 2022; Konczal et al., 2023), knowledge and educational gaps (e.g., Ontl et al., 2018; Mann et al., 2021; Mason et al., 2022; Nikinmaa et al., 2024), socio-cultural and historical factors (e.g., Mölder et al., 2021; Konczal et al., 2023), and biophysical and ecological considerations (e.g., D’Amato and Palik, 2021; Mölder et al., 2021; Mason et al., 2022). This study adds empirically to this expanding AFM literature by focusing on Sweden, a context where an AFM transition largely entails a transition away from intensive management.

With approximately 28 million hectares of forest, of which 84% is classified as productive (Statistics Sweden, 2020), Sweden is the second-largest producer of roundwood in the European Union (Eurostat, 2023). Sweden’s forestry sector has historically prioritized timber production through short-rotation systems, albeit with increasing nature consideration in recent decades in response to changes to the *Swedish Forestry Act* (1993), which officially equates nature conservation and production objectives and provides forest owners a lot of freedom in terms of management. However, Sweden’s soft governance “freedom with responsibility” approach has resulted in the continued dominance of economic outputs over environmental objectives nationally, raising urgent questions about the need for more multifunctional landscapes that better balance support for diverse forest ecosystems and a wide range of societal values with the demand for raw materials and economic profitability (Skogsstyrelsen, 2022; Zhang et al., 2022; Fridén et al., 2024). To date, despite policy advances, the uptake of alternative methods to clearcutting has remained relatively stagnant (Skogsstyrelsen and Naturvårdsverket, 2023). In this regard, Sweden is far from alone. Many European countries are grappling with how to incentivise private owners to adopt new management practices to secure a more diverse range of forest benefits (Maier et al., 2014; Weiss et al., 2019; Koskela and Karppinen, 2023). However, the adoption of AFM in Sweden appears to be low compared with most other EU countries (e.g., Mason et al., 2022). Given its extensive forest resources and industrial-scale forest management sector, Sweden serves as an interesting case for exploring the constraints and opportunities for a transition from intensive management towards AFM.

In recent years, the Swedish forest industry has nurtured a climate change mitigation narrative to justify intensive management as a means

to enhance wood production and carbon uptake (Fischer et al., 2020). Recent studies have also highlighted entrenched economic, institutional and governance structures, which continue to frame the industrial intensive management model as the only rational option, as significant barriers for AFM in Sweden (e.g., Bennich et al., 2018; Holmgren et al., 2022; Olofsson and Jakobsson, 2023). Several studies have explored a diverse range of “hard” and “soft” factors influencing adoption of AFM in Sweden – such as property size, importance of forest income, association membership, forestry knowledge, cultural identity of “foresters”, and forest aesthetics and curiosity (e.g., Eggers et al., 2014; Holmgren and Arora-Jonsson, 2015; Bergstén et al., 2020). However, studies adopting a broader, more systematic approach are generally few. Bennich et al. (2018) adopts a complex systems approach to analyse the development of a forest-based bio-economy. Elbakidze et al. (2018) make a comprehensive knowledge assessment of direct and indirect drivers of changes in forest management across Europe and Central Asia with a main focus on biodiversity and ecosystem services. Focusing on Europe, Aggestam et al. (2020) identify and rank 38 drivers of integrated forest management but do not situate them theoretically in a framework of change to analyse how these factors together shape forest sector dynamics. In a recent study, Hertog et al. (2022) adopt a transition theory framework and identify a range of barriers for a large-scale uptake of CCF in Sweden, including low economic profitability and a prevailing culture focused on intensive management.

Against a rapidly-evolving backdrop of shifting policies and societal values, and increasingly polarized debate about management of forest resources in Europe, the present study provides a timely update on perspectives from a diverse range of forest stakeholders regarding the adoption of AFM in contexts currently dominated by intensive management. Our aim is to analyse current constraints and opportunities for a transition towards AFM. Specifically, we conduct a case study in Sweden, using a multi-method approach combining responses from a workshop with 53 expert stakeholders with a literature review to capture a holistic overview of factors that influence the adoption of AFM in the country. Within a complex systems framework, we use socio-technical transition theories (Geels, 2005; Geels and Schot, 2007) as a guiding theoretical lens to situate identified constraints and opportunities across three levels – niche, regime, and landscape – and assess and characterize the current phase of the Swedish AFM transition, and possible future trajectories. Finally, we discuss potential mechanisms for unlocking and accelerating a transition, providing timely insights for actors and decision-makers seeking to support AFM in Sweden and similar contexts. By considering a broad range of both constraining and enabling factors, and situating them in a transition framework, we develop an analysis that complements and allows comparison with previous studies (e.g., Hertog et al., 2022; Aggestam et al., 2020). Additionally, by taking a broad view of AFM approaches, we hope that our findings will more easily inform both continued future theory-building and stakeholder decision-making concerning drivers of change in forest management domains. Our specific research objectives are to: 1) identify the main constraints and opportunities as currently perceived by expert forest stakeholders in Sweden, 2) examine how these factors correspond with constraints and opportunities previously identified in the literature, particularly in relation to the management decisions of forest owners, and 3) analyse what these constraints and opportunities mean for a systemic transition away from current intensive management towards AFM.

## 2. Theoretical framework

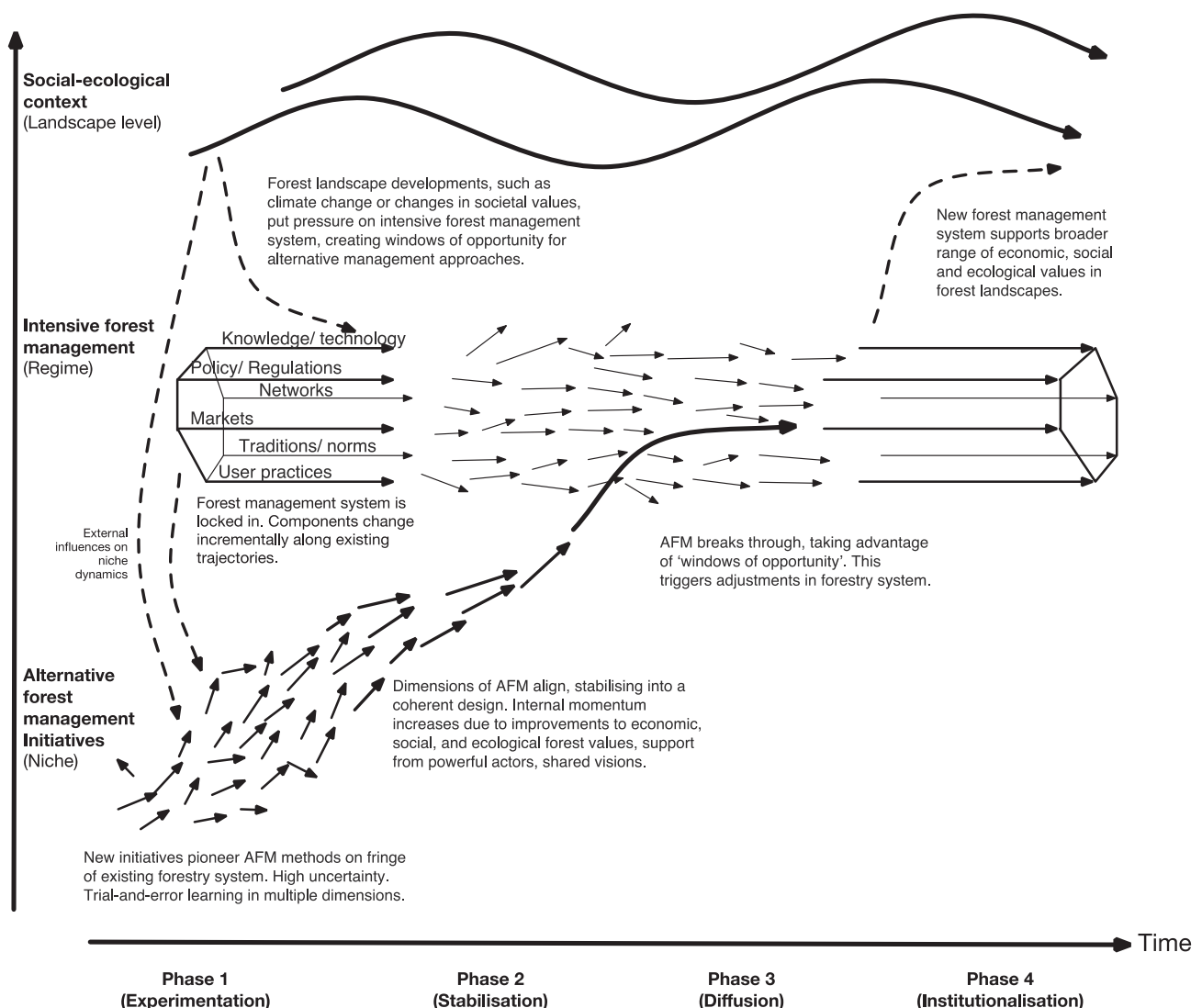
We adopt a complex systems perspective, which posits that forest management decisions do not occur in isolation but emerge from interactions between the agency of forest actors and the multi-level contexts in which they are embedded (Deuffic et al., 2018; Weiss et al., 2019). These contexts encompass an array of interconnected structural elements (Puettmann et al., 2015; Elbakidze et al., 2018; Bennich et al.,

2018; Hertog et al., 2022). We used the broad categories identified in aforementioned studies to organise our data and structure our analyses: socio-cultural, knowledge and technology, institutional, economic, and biophysical elements. The categories are partly overlapping, in particular the socio-cultural and institutional dimensions. To distinguish between the two, we categorize institutions as regarding more formalised programs, rules and procedures (rules on paper). The socio-cultural category refers to social practices that include informal understandings of appropriate behaviour, common frames of reference and routinized activities (rules in use) (Young, 2002 p 5–6).

To understand how and to what extent identified constraints and opportunities may shape changes in forest management in the Swedish context, we employed the social-technical transitions (STT) framework, which is rooted in complex systems theories (Geels, 2005; Geels and Schot, 2007). This framework has been increasingly used to understand land use change and natural resource management, including shifts in forest management (e.g., García et al., 2020; Halonen et al., 2022). We applied the STT framework in three ways. First, we utilized its multi-level perspective to categorize and map identified constraints and opportunities at three different levels: niche, regime, and landscape. Dynamic interactions among these levels influence the potential for

transitions to AFM (Fig. 1). The *niche* level represents protected spaces for innovative practices, enabling early adopters to gain recognition and support for alternative management approaches. In our case, we understood AFM as innovative practices and sought to understand which of the identified constraints and opportunities were most directly related to the use of these practices. At the *regime* level we tried to understand which, if any, of the identified constraints and opportunities reflected dominant practices and cultures associated with intensive management, or with existing policies and industry norms. At the *landscape* level, we assessed whether identified constraints and opportunities referred to broader socio-economic and environmental drivers, such as rising public concern over climate change or shifting societal values, which might plausibly exert pressure for change in forestry practices.

Second, we examined our findings in relation to the temporal dimensions of the STT framework to assess whether a transition towards AFM in Sweden is underway and, if so, to characterize its current phase. We did this by comparing identified constraints and opportunities, individually and together, against characterisations of the four phases of transition outlined by the STT framework (Fig. 1): the initial phase involves high degrees of *experimentation* and uncertainty; the second phase, *stabilization*, sees innovations establishing footholds in market



**Fig. 1.** We applied the socio-technical transitions framework (adapted from Geels, 2005; Geels and Schot, 2007) to understand how and to what extent identified constraints and opportunities may shape the potential for alternative forest management in Sweden. We considered three main levels at which identified constraints and opportunities influence AFM adoption – niche, regime, and landscape – and compared these, individually and together, against characterisations of four phases of transition – experimentation, stabilization, diffusion, and institutionalization.

niches; the third phase is characterized by wider *diffusion* into mainstream markets, driven by improvements and structural opportunities; and the final phase signifies the *institutionalization* of new approaches, reshaping the existing regime. These phases illustrate the complex dynamics of transitioning to AFM, emphasizing the interplay between innovation, societal acceptance, and structural change.

Third, based on these steps and our findings more generally, we make a broad assessment of potential trajectories for transitioning to AFM in Sweden in relation to four fundamental transition pathways outlined by Geels (2019) and Geels and Schot (2007): *incremental change*, where incumbent forest management actors adapt their strategies in response to gradual landscape pressures, e.g., concerning policy changes or shifts in societal values; *reconfiguration*, by which some of the more symbiotic AFM innovations are integrated into the intensive forest management regime, prompting adjustments that result in substantial changes in the Swedish forest sector over time; *substitution*, where significant landscape pressures catalyse the emergence of AFM innovations that effectively replace existing intensive forest management practices; and *dealignment/realignment*, which emerges when rapid landscape changes, for example major climate-induced storms and/or wildfires, create opportunities for multiple AFM innovations to surface, with the potential to dominate and reshape the forest sector in Sweden. These pathways underscore the complex and non-linear nature of transitions, illustrating how the interplay between niche innovations, regime dynamics, and landscape pressures can shape the future of forest management in Sweden and similar contexts.

Finally, following Valkering et al. (2017), we utilize the insights gained from our application of the STT framework to identify and structure potential mechanisms for unlocking and accelerating a transition towards AFM in intensive management contexts. We analyse our identified constraints and opportunities in relation to five key mechanisms: *Upscaling* involves increasing the number of members, supporters, or users associated with AFM initiatives to spread new ways of thinking, doing, and organizing. *Replicating* refers to the adoption of AFM practices by different actors to disseminate these innovations. *Partnering* emphasizes the pooling of resources, competencies, and capacities to exploit synergies and ensure the continuity of innovative AFM practices and associated value-chain activities. *Instrumentalizing* involves leveraging opportunities provided by the multi-level forest governance context to strengthen local AFM initiatives, e.g., through awareness-raising or outreach. Finally, *embedding* focuses on aligning old and new forest management practices to integrate them into existing governance patterns.

### 3. Methodology

#### 3.1. Stakeholder workshop

In October 2023, we facilitated a workshop session involving 53 participants, representing a diverse array of expertise and interests within Sweden's forest landscapes (see Table 1). The workshop was part of the one-day event hosted by Formas, the Swedish Research Council for Sustainable Development, to launch and discuss a range of research projects on 'New forest management practices for multiple societal goals'. Workshop participants were selected in three main ways: through

an open invitation published by Formas on their website, through invitational emails distributed through Formas' networks of relevant forest stakeholders and government agencies, and by direct invitation by participating researchers.

To avoid confusion arising from the multitude of AFM methods currently under discussion in Sweden, as well as the existing knowledge gaps regarding their definitions, we posed the following question to workshop participants: "What are the main opportunities and constraints for transitioning away from intensive forest management based on clearcutting (*trakthyggesbruk* in Swedish) towards alternative methods?" This question was prominently displayed for all participants throughout the workshop.

Participants were first instructed to individually identify up to five opportunities, which they recorded on separate Post-it notes of a uniform color. Subsequently, they were directed to identify up to five constraints, which they noted on Post-it notes of a different color. Participants were then asked to rank their identified opportunities and constraints in *descending* order of self-rated importance, with 1 denoting highest importance, followed by 2, and so forth (NOTE: for the sake of simplicity, we subsequently reversed the order of importance during our analysis to reflect a "high" means "high" logic. In our Results section below, 5 denotes highest importance, followed by 4 and so forth). Opportunities and constraints were ranked as distinct subsets.

Finally, drawing on previous research on AFM (Puettmann et al., 2015; Elbakidze et al., 2018; Hertog et al., 2022; Aggestam et al., 2020), we wrote five theme headings on large whiteboards at the front of the room: "economic", "institutional", "social/cultural", "technological/knowledge", and "other", and instructed the participants to place their Post-its under the theme they felt reflected their identified constraint and opportunity. For practical reasons concerning lack of physical space on the whiteboards, we did not include a "biophysical" heading, instead allowing participants to place these responses under "other". We assumed that responses concerning biophysical factors would be relatively unambiguous and therefore more easily identifiable during subsequent data processing compared with responses under other themes (see 5.3 Limitations). One facilitator wrote out the contributions from online participants and placed them on the physical whiteboards in the workshop room, in accordance with each participant's instructions.

#### 3.2. Workshop analysis

The processing of workshop data involved a systematic approach comprising several steps. First, we reviewed and excluded responses that were either illegible or unclearly expressed. Second, we reassessed the thematic categorization assigned by participants to ensure coherent classification across the entire dataset. This reassessment resulted in the reclassification of 11 individual responses. In some cases, it appeared that participants simply placed their Post-it notes under the wrong heading when putting them on the whiteboard during the workshop. However, in most cases this concerned conceptual overlaps between themes (see 5.3 Limitations). Rather than allowing multiple thematic classifications for the same concept, we classified responses referring to the same concept under the theme where most other participants also categorised it. Third, we reclassified responses initially categorised as "other", the majority of which pertained to biophysical factors. This reclassification led to a distinct "biophysical" theme. Fourth, we employed an open-coding methodology (Flick, 2023) to iteratively aggregate individual responses into topic clusters based on conceptual similarity. Following these steps, we calculated descriptive statistics for the dataset on both a per theme and per topic cluster basis. Finally, we ranked the topic clusters according to their perceived importance as ranked by workshop participants. Importance scores were derived from the average rank assigned by stakeholders to all responses within each thematic cluster, excluding non-ranked responses. These scores were further weighted by the total number of responses within each cluster in relation to the mean number of responses, thereby reflecting confidence

**Table 1**  
Workshop participants by type.

Type of participant	Number of participants
Forestry industry	5
Government agency	16
Media	2
Non-Governmental Organizations	3
Owner association	6
Researcher	19
Sami/ reindeer husbandry	2



in the findings based on the volume of observations.

### 3.3. Literature review

As the workshop responses were written on Post-its, these often lacked depth. To nuance and contextualize the contributions from the workshop participants, and support our analysis, we therefore conducted a narrative review of the recent scientific literature on AFM in Sweden. Combining the workshop data with the findings of the review enables us to explicate possible measures identified by workshop participants for unlocking and accelerating an AFM transition in Sweden.

A narrative review is useful for detecting themes, theoretical perspectives and identifying knowledge gaps (Snyder, 2019), making it suitable for contextualizing the workshop results. Our application of the narrative review method includes a ‘semi-systematic’ approach (Snyder, 2019) by employing a clear literature selection strategy with inclusion and exclusion criteria, to minimize selection bias and lack of reproducibility that are often associated with standard narrative reviews (Paré et al., 2015). We built search terms from the five themes used to categorize the workshop results and from two foundational papers that are closely linked to our research: Puettmann et al. (2015) and Hertog et al. (2022). During an initial search in Scopus and Google Scholar to identify relevant articles: “*alternative*” NEAR “*forest management*” AND “*owner\**” AND “*decision*” AND “*Sweden*”. We specifically highlight the owner perspective because forest owners in Sweden exercise strong freedom in their management decisions and are powerful actors in shaping forest management (Blanco et al., 2017; Juerge et al., 2020; Lawrence et al., 2020). To find literature related more specifically to the thematic classification of the workshop contributions, we added the words “*knowledge*”, “*socio-cultural*”, “*institution*”, “*economic*” and “*biophysical*” in five further searches. We prioritized articles in peer-reviewed journals that are approved by the Norwegian Register for Scientific Journals and that were published between 2020 and 2024. This allowed us to build on and extend the review conducted by Hertog et al., 2022 of literature published between 2010 and 2020. We screened articles for relevance to the research questions, and to ensure they focused on the Swedish context or included Sweden as a case study, resulting in 27 articles that are included in the qualitative synthesis that follows. The two foundational papers were added to this literature sample, as were a further eight relevant papers that cite the foundational articles and were published since 2020, and which were not identified in the search process described above. A more detailed description of the literature search can be found in the supplementary materials.

Following a suggestion made during peer-review, we repeated our literature search of the same databases in January 2025 using an expanded set of search terms: “*alternative*” OR “*multi\**” OR “*systemic*” OR “*integrative*” OR “*close to nature*” OR “*close-to-nature*” OR “*continuous cover*” OR “*nature oriented*” OR “*CCF*” NEAR “*forest management*” AND “*owner\**” AND “*decision*” AND “*Sweden*”. These additional terms more fully accounted for the range of AFM approaches studied in Europe (Mason et al., 2022) and also ensured that our literature search was up-to-date prior to publication. After the same screening process, this second search resulted in an additional five papers that are included in the qualitative synthesis.

In total, 42 papers were included in the review – a full list of the sources is included in the supplementary materials.

Identified topic clusters from workshop responses guided our reading of the selected papers, enabling us to better understand and contextualize the perspectives of participants concerning factors influencing changes in forest management approaches in Sweden. Correspondence between workshop and review datasets was therefore high, as is indicated in the main result texts (Sections 4.2–4.6). We structure these sections by first identifying and describing workshop results for a topic cluster within a given theme, and then in an immediately following paragraph by describing the review findings concerning this topic

cluster.

## 4. Results

### 4.1. Overview

Workshop participants provided a total of 185 responses concerning constraining factors and 147 concerning opportunities linked to a transition away from intensive clear-cut-based management towards AFM. The most frequently identified themes among constraints concerned *socio-cultural* and *knowledge and technology* factors, which received 55 and 54 responses respectively (Table 2). These themes also received the largest share of high-ranked responses, with the latter also receiving the highest average rank. *Economic*, *institutional* and *biophysical* constraints received fewer responses (7, 36 and 31, respectively), with biophysical factors receiving the lowest average rank across all responses.

The most frequently identified themes among identified opportunities related to *socio-cultural* and *institutional* factors, with 45 and 39 responses respectively (Table 3). These themes also received the highest average ranks, calculated across all responses within the themes. A total of 34 opportunities were identified concerning *knowledge and technology* factors followed by *economic* factors (19 responses) and *biophysical* (10 responses). *Biophysical* opportunities had the lowest average rank across the themes.

Open-coding of individual workshop responses identified 26 main topic clusters in total (Table 4). The most important topics, based on workshop participant rankings and weighted by number of responses, related to *knowledge and competence* and *traditions and norms*. Following our open-coding protocol, many topics contained responses from different themes and contained both constraints and opportunities.

### 4.2. Socio-cultural theme

A total of 14 topic clusters were linked to socio-cultural factors, with five topics most strongly associated with this theme. *Traditions and norms* emerged as the most frequently identified topic in this category and the second most frequently identified topic overall, receiving the second highest importance score of all of the constraints (Table 4). All workshop responses within this topic were perceived as constraints, with most indicating a tendency among forest stakeholders to maintain the status quo concerning established practices. Some workshop participants linked this to lack of knowledge and creativity, the high average age of forest owners in Sweden, or a cultural loyalty to the belief that forestry is historically integral to Sweden. Others noted that many foresters view forests as cultivation systems rather than ecosystems and believe that intensive clear-cut management is the only viable option.

Our literature review confirmed workshop findings concerning conservative traditions and norms in Sweden, emphasizing that these factors are continuously reproduced in different social domains. Several studies highlight how social norms concerning “proper” forest management are embedded in local and family traditions and are often intertwined with gender identities, underlining the difficulty of initiating novel management practices that challenge deeply ingrained behaviors and beliefs (e.g., Bergstén et al., 2020; Kronholm, 2024). Norms and traditions underpinning the perceived authority of conventional foresters are continuously reproduced through seemingly neutral forest modelling approaches, management decision support systems, and forestry education programs at universities and research institutions (Puettmann et al., 2015; Hertog et al., 2022; Hallberg-Sramek et al., 2023). However, Bergstén et al. (2020) highlight that both female owners and absentee owners may experience more freedom from norms surrounding intensive management.

The topic cluster concerning *forest owner interest and engagement* in AFM methods included 25 responses. Most responses highlighted opportunities arising from a growing awareness among forest owners and

**Table 2**

Frequency of stakeholder ranked constraints for a transition away from intensive clearcutting towards alternative forest management in Sweden, by theme. The most frequently identified and highest ranked constraints were linked to socio-cultural factors, followed by knowledge/technology and economic factors.

Importance rank	5 (high)	4	3	2	1 (low)	– (not ranked)	Total	Average rank
<b>Themes</b>								
Socio-cultural	14	11	13	6	5	6	<b>55</b>	3.1
Knowledge/Technology	18	18	8	6	3	1	<b>54</b>	3.7
Economic	14	7	6	2	2	5	<b>36</b>	3.4
Institutional	9	10	7	2	0	5	<b>33</b>	3.3
Biophysical	2	2	1	0	0	2	<b>7</b>	3.0
<b>Total</b>	<b>57</b>	<b>48</b>	<b>35</b>	<b>16</b>	<b>10</b>	<b>19</b>	<b>185</b>	

**Table 3**

Frequency of stakeholder ranked opportunities for a transition away from intensive clearcutting towards alternative forest management in Sweden, by theme. The most frequently identified and highest ranked opportunities were linked to socio-cultural factors; fewest were linked to economic and biophysical factors.

Importance rank	5 (high)	4	3	2	1 (low)	– (not ranked)	Total	Average rank
<b>Themes</b>								
Socio-cultural	23	9	5	2	0	6	<b>45</b>	3.8
Institutional	12	15	4	3	0	5	<b>39</b>	3.5
Knowledge/Technology	9	12	3	3	3	4	<b>34</b>	3.3
Economic	2	5	7	2	1	2	<b>19</b>	2.9
Biophysical	1	3	3	0	1	2	<b>10</b>	2.7
<b>Total</b>	<b>47</b>	<b>44</b>	<b>22</b>	<b>10</b>	<b>5</b>	<b>19</b>	<b>147</b>	

**Table 4**

Identified topic clusters among responses concerning constraints and opportunities for a transition away from intensive clear-cut-based management towards alternative management methods in Sweden, ordered by importance. Importance scores were calculated based on the average importance rank given by stakeholders to all responses within each topic cluster and were weighted using the total number of responses within each cluster compared to the mean number of responses.

Topic cluster	Importance score	Constraint	Opportunity	Total responses	Themes
Knowledge and competence	19.54	42	19	61	Knowledge & Technology (52), Socio-cultural (8), Institutional (1)
Traditions/ norms	9.64	30	0	30	Socio-cultural (30)
Advisory services/ wood buyers	6.99	10	11	21	Institutional (17), Knowledge & Technology (4)
Institutional and political support	6.46	8	16	24	Institutional (24)
Forest owner interest/ engagement in alternative management methods	6.37	5	20	25	Socio-cultural (25)
New technologies/ methods/ organizations	4.69	13	5	18	Knowledge & Technology (12), Institutional (4), Socio-cultural (2)
Forest sector lock-in	4.60	14	0	14	Economic (8), Institutional (4), Socio-cultural (2)
Economic viability	4.51	14	1	15	Economic (15)
Uncertainty and risk	4.42	16	1	17	Knowledge & Technology (7), Economic (6), Socio-cultural (3), Biophysical (1)
Multifunctionality/ multiple benefits	3.98	0	9	9	Socio-cultural (6), Biophysical (2), Institutional (1)
Demand for sustainable forest products/ new markets	3.63	1	11	12	Economic (10), Institutional (1), Knowledge & Technology (1)
Incentives	3.54	4	10	14	Economic (9), Institutional (4), Socio-cultural (1)
Increased demand for forest biomass	3.27	6	0	6	Economic (4), Institutional (2)
Societal awareness/ value shifts	2.74	1	9	10	Socio-cultural (9), Institutional (1)
Good examples/ inspiration	2.56	2	9	11	Knowledge & Technology (6), Socio-cultural (5)
Vision & goals	2.48	3	3	6	Economic (4), Institutional (2)
Biophysical forest dynamics and processes	2.21	8	0	8	Biophysical (6), Knowledge & Technology (2)
Collaboration and Networks	1.95	1	6	7	Institutional (3), Socio-cultural (2), Knowledge & Technology (2)
Fears for decreased supply of forest materials to industry	1.33	2	0	2	Economic (2)
Environmental impact	1.06	0	6	6	Biophysical (4), Socio-cultural (2)
Lobbying/ opinion-shaping	0.97	2	2	4	Institutional (2), Socio-cultural (2)
Forestry plans	0.88	0	2	2	Knowledge & Technology (2)
Certification	0.53	0	2	2	Economic (1), Institutional (1)
Climate & biodiversity crisis	0.44	0	4	4	Biophysical (4)
Power of forestry industry	0.44	3	0	3	Institutional (3)
Social skills	0.35	0	1	1	Socio-cultural (1)

forestry students of the need for change and an increasing interest in learning about and testing AFM. Lifestyle changes and a generational shift among forest owners were also stated as contributing to this growing interest. However, some participants stated that some owners

are constrained by concerns about being perceived by other owners as deviating from conventional practices or as mismanaging their forests. Geographical distance between forest owners' residences and their forest locations was also identified as a potential constraint to engagement

in AFM, while *social skills* were recognized as an opportunity to facilitate learning and mediation towards a transition. *Multifunctionality and multiple benefits* of AFM approaches were also seen as opportunities, with several participants highlighting their potential to support multiple forest values simultaneously. This included recreational, aesthetic, and social values, particularly in peri-urban forests, as well as carbon sequestration, habitat provision, dispersal corridors, green infrastructure, and increased property values. Concerning these topics, our review showed that non-industrial private forest owners (NIPFs) in Sweden prioritize values such as well-being and recreation alongside economic value (e.g., Olofsson and Jakobsson, 2023), and cultural and local demands can lead to calls for alternatives to the prevailing management approach (Fridén et al., 2024). Sikkema et al. (2024) demonstrate that while Swedish forest owners prioritize intensified forest management for timber production, this interest varies significantly based on the size of their forest holdings, with owners of smaller areas showing the least interest in applying more intensive practices.

Although *societal awareness and value shifts* within the wider community were primarily stated by workshop participants to offer a growing opportunity for AFM, the reviewed literature suggested that these factors are not necessarily strong drivers of a forestry transition. For example, Hertog et al. (2022) note that intensive management remains resistant to significant change despite growing public demand for change and decades of criticism of the Swedish forest sector.

#### 4.3. Knowledge and technology theme

Nine topic clusters were linked to knowledge and technology, with five primarily associated and therefore categorised within this theme for further examination. *Knowledge and competence* was the most frequently identified and highest ranked topic (Table 4). Approximately two-thirds of responses regarding this topic highlighted a perceived lack of knowledge, competence, and experience among forest owners, entrepreneurs, machine operators, and forest sector officials as a constraint to the adoption of AFM. Participants linked this knowledge gap to the perceived complexity of a transition, including challenges in communicating forest owners' needs when procuring forestry services, and emphasized a need to modernize traditional forestry education programs to include more training about AFM. Conversely, many participants also identified a growing research focus on AFM and the potential for forestry education and ongoing learning among forest owners as opportunities to support a transition.

Our literature review supports workshop results concerning the lack of knowledge and suitable skills among forest owners as a significant constraint to AFM in Sweden. Despite its increasing availability, integrating scientific knowledge concerning AFM with local and practical knowledge, and its translation to concrete operational guidance, remains challenging (Puettmann et al., 2015; Andersson et al., 2020; Kruse et al., 2023). Several studies highlight the rigid focus on intensive management in forestry education, strong group identity among forest professionals, and a production-oriented industry, as contributing to 'knowledge lock-in' (Puettmann et al., 2015; Hertog et al., 2022; Gonçalves, 2024). Many forest owners, irrespective of place of residence or gender, lack confidence to perform AFM and may have managed their forests as coniferous monocultures for generations (Deuffic et al., 2018; Eriksson and Fries, 2021; Hahn et al., 2021). Increasingly complex management decisions such as those concerning AFM are therefore more likely to be outsourced to forest advisors (Eriksson and Fries, 2020; Andersson and Kesitalo, 2021). However, several studies highlight a lack of experienced forestry advisors knowledgeable about AFM and a hesitance among forest management organizations to adopt unfamiliar approaches, particularly in the face of growing uncertainty related to climate change (Puettmann et al., 2015; Lidestav and Westin, 2023; Nikinmaa et al., 2024).

Workshop responses concerning *uncertainty and risk* were associated with knowledge and technology, economic and socio-cultural themes.

These responses were primarily identified as a constraint, particularly by non-research participants, with many citing uncertain outcomes and economic risks as key factors hindering a transition. While some responses portrayed uncertainty as an inherent constraint, others pointed to uncertainties concerning how AFM can address climate change and other biophysical drivers, such as storms and root rot. *Good examples and inspiration* were linked to both knowledge and technology and socio-cultural themes, with many stakeholders recognizing the spread of successful examples as an opportunity to enhance learning about AFM.

The reviewed literature highlights the limited impact of expert-driven communication on matters related to the environment and climate change on forest owners (Vulturius, 2020). This is a challenge in relation to risks and uncertainty, as forest managers often rely on their own observations and experience (Nikinmaa et al., 2024; Hallberg-Sramek et al., 2023). Furthermore, the integration of risk management into climate-adaptive forest planning remains in an early development phase (Girdziūšas et al., 2021), with little practical guidance available for practitioners (de Pellegrin Llorente et al., 2023). Conversely, discussion by, and successful examples from within, the forestry sector can enhance motivation to implement AFM (Olofsson and Jakobsson, 2024), particularly concerning conservation measures (Konczal et al., 2023).

Responses relating to *new technologies, methods, and organizations* were more often seen as constraints. These responses primarily addressed the lack of appropriate machinery for AFM approaches, such as equipment that is too large for tight spaces or inadequate for handling varying trunk sizes. Additionally, technical planning, management, and evaluation systems were not adapted for AFM, nor was there sufficient infrastructure for processing raw products. Opportunities related to new technologies included digital tools for improved forecasting and decision support, as well as the potential for creating dynamic *forestry plans* that incorporate multiple-use forestry. The literature review highlights the potential role of new technologies, such as machine learning, remote sensing and digital inventory tools and interactive learning tools, to support for the adoption of AFM and foster discussions on forest transitions more broadly (Wilkes-Allemann et al., 2021; Alarcon, 2023; Konczal et al., 2023; Wising et al., 2024). However, existing technologies and machinery for planning, harvesting and transport remain optimised for large-scale forestry (Lidestav and Westin, 2023; Hertog et al., 2022).

#### 4.4. Institutional theme

Fifteen topic clusters were linked to institutional factors, with five most strongly associated with this theme including *advisory services and wood buyers* and *institutional and political support*, which received the third and fourth highest importance scores among all identified topic clusters (Table 4). Approximately half of the responses concerning advisory services and wood buyers identified the need for new, independent forest advisory services tailored to alternative methods as a significant opportunity. Participants stated that improved support and knowledge for advisors in forest owner associations and Swedish Forest Agency representatives would facilitate a transition. Conversely, many responses highlighted a lack of informed, independent advisory services and the prevalence of advice from wood buyers, who primarily serve industrial interests, as constraints. Our review supports a perception that the lack of independent forestry advisors who are sufficiently knowledgeable concerning AFM hinders a transition, with several studies indicating that forestry advisors remain focused on a resource-centred logic rather than an owner-centred logic despite the growing diversity of owner priorities (Lodin and Brukas, 2021; Matilainen et al. 2023; Lidestav and Westin, 2023; Nikinmaa et al., 2024).

Of the 24 workshop responses concerning institutional and political support, 16 were identified as opportunities for transitioning away from intensive management. These were primarily related to changes in EU strategies, regulations, and guidelines. Constraints pertained to national policies, legislation, and political interests favouring intensive

management. Participants also identified the *power of the forestry industry*, in terms of economic and institutional resources, as a constraint, particularly concerning its ability to influence decisions through *lobbying and opinion-shaping*. The reviewed literature indicates that a policy shift at the European level, evidenced through the new EU Forest Strategy, supports alternatives to clear-cutting (Fridén et al., 2024; Kruse et al., 2023). However, the institutional structure of the Swedish forest sector, particularly given the power of the forest industry, and its continued efforts to resist changes in EU policy remains a barrier for AFM (Fridén et al., 2024; Hertog et al., 2022).

*Collaboration and networks* were perceived as opportunities by workshop participants for disseminating new knowledge about AFM approaches. However, one participant noted that many existing networks and organizations in the forest sector are influenced by industry agendas or support intensive management. Collaboration among different actors, particularly through cross-sectoral cooperation, dialogue and social networks, was also frequently identified in the literature review as necessary to mobilize new forest management strategies, more active management among forest owners, and to support creative learning environments at various levels (Eriksson and Fries, 2020; Wilkes-Allemann et al., 2021; Grundel et al., 2022; Nebasifu et al., 2024). The potential contribution of forest owner associations to support owner engagement in AFM was also identified (Lawrence et al., 2020). However, several studies highlighted the negative influence of established forestry norms, industrial production objectives, lack of shared understanding and lack of trust on collaborative initiatives in Swedish forests (Eriksson and Fries, 2020; Grundel et al., 2022; de de Pellegrin Llorente et al., 2023; Lidestav and Westin, 2023; Bjärstig et al., 2024).

#### 4.5. Economic theme

Of the eight topic clusters linked to economic factors, seven were strongly associated with this theme, including *forest sector lock-in* and *economic viability*, which were ranked seventh and eighth in terms of importance (Table 4) and were almost exclusively identified as constraints. Many participants identified forest sector lock-in, relating to the rigid structures designed to support bulk production through clearcutting, as an economic constraint. Only one participant stated that AFM presented an economic opportunity by providing a more stable cash flow for forest owners. Most responses concerning economic viability indicated that the perception of AFM as less profitable than intensive management was a significant constraint.

The reviewed literature emphasizes the importance of economic viability, with rising management costs and the perceived lower profitability of AFM often cited by forest owner associations and forestry companies as a reason against their adoption (Puettmann et al., 2015; Hertog et al., 2022; Brandt et al., 2023; Nikinmaa et al., 2024). Forest management planning, logistics chains, the sawmilling industry and wood markets are all typically oriented towards bulk production of medium-sized logs (Puettmann et al., 2015; Konczal et al., 2023; Lidestav and Westin, 2023; Mason et al., 2022). However, the financial benefits of AFM are gaining attention in Sweden due to potentially higher income from higher-quality timber (Gonçalves, 2024), and greater economic resilience to disturbances compared to clear-cutting (Hahn et al., 2021; Knoke et al., 2023).

Workshop participants linked potential economic *incentives* for AFM to opportunities, while the absence of such incentives was also cited as a constraint. Many participants perceived *growing demand for sustainable forest products/ new markets* as an opportunity, noting that consumer interest in alternative products could help forest owners earn income beyond raw commodities. However, one participant cautioned that the current lack of such markets posed a constraint. Conversely, several participants pointed to *increased demand for forest biomass* and conventional products, and *fears for a decreased supply of forest materials to industry* as constraints to moving away from intensive management. *Certification schemes* were seen as opportunities for transition,

particularly for compensating forest owners for non-economic values. Concerning *visions and goals*, some participants noted a lack of shared vision regarding AFM as a constraint, while others highlighted the growing diversity of objectives among forest owners as a potential opportunity.

Although certification schemes, and conservation payments and financial incentives within them, are highlighted in the literature review as potentially important to address the economic viability of AFM (Puettmann et al., 2015; Juerges et al., 2020; Bergkvist and Nikoleris, 2024), there is currently a lack of suitable incentives in Sweden (Danley et al., 2021; Nikinmaa et al., 2024). However, despite a general support for new instruments, willingness to accept subsidies for AFM is complicated by adherence to intensive management traditions for some forest owners (Juutinen et al., 2022). Sikkema et al. (2024) show that NIPF owners are often less responsive to subsidy schemes and market incentives to drive changes in management approaches compared with large forest owners. Sandström et al. (2020), on the other hand, found that the forest industry and some private forest owners have high confidence in the effectiveness of economic and financial instruments to guide management decisions. 'Softer' incentives, such as information campaigns and advisory services were preferred by other stakeholder groups such as those representing recreation and rural development (Sandström et al., 2020), but have yet to motivate large-scale adoption of AFM (Lidestav and Westin, 2023).

Additionally, while fostering new markets for the bio-economy has emerged as a forest policy focal point in Sweden (Fridén et al., 2024), the absence of a value chain for novel wood products and continued lack of suitable markets for higher-quality timber present challenges for forest owners seeking buyers for small volumes or thick logs (e.g., Hertog et al., 2022).

#### 4.6. Biophysical theme

A total of five topic clusters were linked to biophysical factors, with three strongly associated with this theme. *Biophysical forest dynamics and processes* was the highest ranked topic in this theme and ranked 17th in total (Table 4). Workshop participants perceived this topic as a constraint to transitioning from intensive management to AFM, noting the challenges and lengthy timeframes required to shift from simplified, homogeneous monoculture plantations to complex, multi-structured forests. Additional challenges included the lack of appropriate species, particularly in the context of climate change, and the management of reforestation processes to support alternative objectives. Conversely, both the *climate and biodiversity crises* and negative *environmental impacts* of clear-cutting were viewed as opportunities, due their impact on the awareness of stakeholders and society in general of the need to change. Participants recognized the potential for AFM methods to yield fewer negative impacts and even positive environmental outcomes, particularly for biodiversity.

Findings from the literature review largely align with constraints and opportunities identified by workshop participants. Nikinmaa et al. (2024) emphasize that the long timescales governing forest ecological processes hinder the adoption of AFM, particularly due to the mismatch between the time required to observe results from management changes and the rapid shifts in climate and forest policy. While diversification of tree species is generally regarded by forest professionals in Sweden as important for the adaptation of forests to climate change (Roitsch et al., 2023), several studies highlight challenges in managing afforestation processes linked to natural regeneration, such as seed production, herbivory/browsing pressure from ungulates, and understory competition, with particular difficulties for light-demanding species compared to shade-tolerant species (Puettmann et al., 2015; Felton et al., 2024; Gonçalves, 2024). In the Swedish context, studies indicate a risk of Norway Spruce dominating other commercially important species, such as Scots Pine and desirable broadleaf species, in the absence of clear-cutting (Felton et al., 2020). Furthermore, many NIPF owners are



hesitant about using alternative tree species despite being generally open to avoiding clear-cuts (Kronholm, 2024). Reviewed studies also highlight the negative environmental impacts of intensive management, particularly concerning species diversity (Felton et al., 2020; Ekholm et al., 2023). However, Felton et al. (2024) also note that different AFM practices involve varying trade-offs with biodiversity. Conversely, Puettmann et al. (2015) and Hahn et al. (2021) report positive impacts of AFM on biodiversity, including the creation of diverse wildlife habitats and increased resilience to external shocks, such as storms. Furthermore, Hahn et al. (2021), Konczal et al. (2023) and Sikkema et al. (2024) highlight the limited attention given by forest owners and stakeholders to climate change and adaptation efforts, which both support and constrain a shift towards AFM. Sikkema et al. (2024) highlight, however, that the most preferred climate adaptation measures concerned clearing or pre-commercial thinning and selection of viable trees.

## 5. Discussion

### 5.1. Constraints and opportunities for a transition towards alternative forest management

Our study identified 26 topic clusters reflecting the main constraints and opportunities recognized by a large, diverse group of expert forest stakeholders in Sweden regarding the potential transition from intensive management to AFM practices. Participants reported a greater number of constraints than opportunities, and the six most important identified topics ranged across knowledge and technology, socio-cultural and institutional themes. All five themes and many topic clusters contained both constraints and opportunities, in some cases indicating related phenomena that pull forest management in opposing directions simultaneously. For example, within the socio-cultural theme workshop participants identified *traditions and norms* as a strong constraint to owners transitioning away from intensive management, while at the same time identifying increasing *forest owner interest and engagement* in AFM as a major opportunity. Similarly, within the institutional topic cluster concerning *advisory services and wood buyers*, workshop participants found currently available services to be a constraint but identified that if such services could be developed to support forest owners instead of industrial actors and be better tailored to AFM then they could provide a major opportunity for a transition. Such findings highlight the range of perspectives among actors, but importantly, they also underscore the complexity of a transition in forestry contexts that are currently reliant on intensive approaches.

Our study indicates significant overlap between forest stakeholder perceptions and the existing literature concerning the main factors influencing AFM in Sweden. This overlap, while not entirely unexpected given the inclusion of researchers among workshop participants, corroborates previous findings and underlines inadequate knowledge, conservative traditions and norms, the role of advisory services, and institutional support as key factors affecting a transition away from intensive management approaches. Economic factors, on the other hand, were not generally ranked as highly by our participants compared to some recent studies (e.g., Aggestam et al., 2020; Hertog et al., 2022). Biophysical factors were also under-identified and ranked as less important by our expert participants compared to other themes. For instance, although some participants linked AFM with broadly more positive environmental outcomes, more specific biophysical issues such as browsing pressure from ungulates were notably absent from participant discussions. This contrasts with previous studies, which emphasize the critical role of biophysical factors in the economic viability of AFM (e.g., Puettmann et al., 2015; Mason et al., 2022). Hertog et al. (2022) also found that regime actors and government stakeholders, such as our experts, usually identify biophysical factors as key constraints. Although these differences with previous findings might imply ongoing shifts in stakeholder perceptions, e.g., due to studies showing more positive

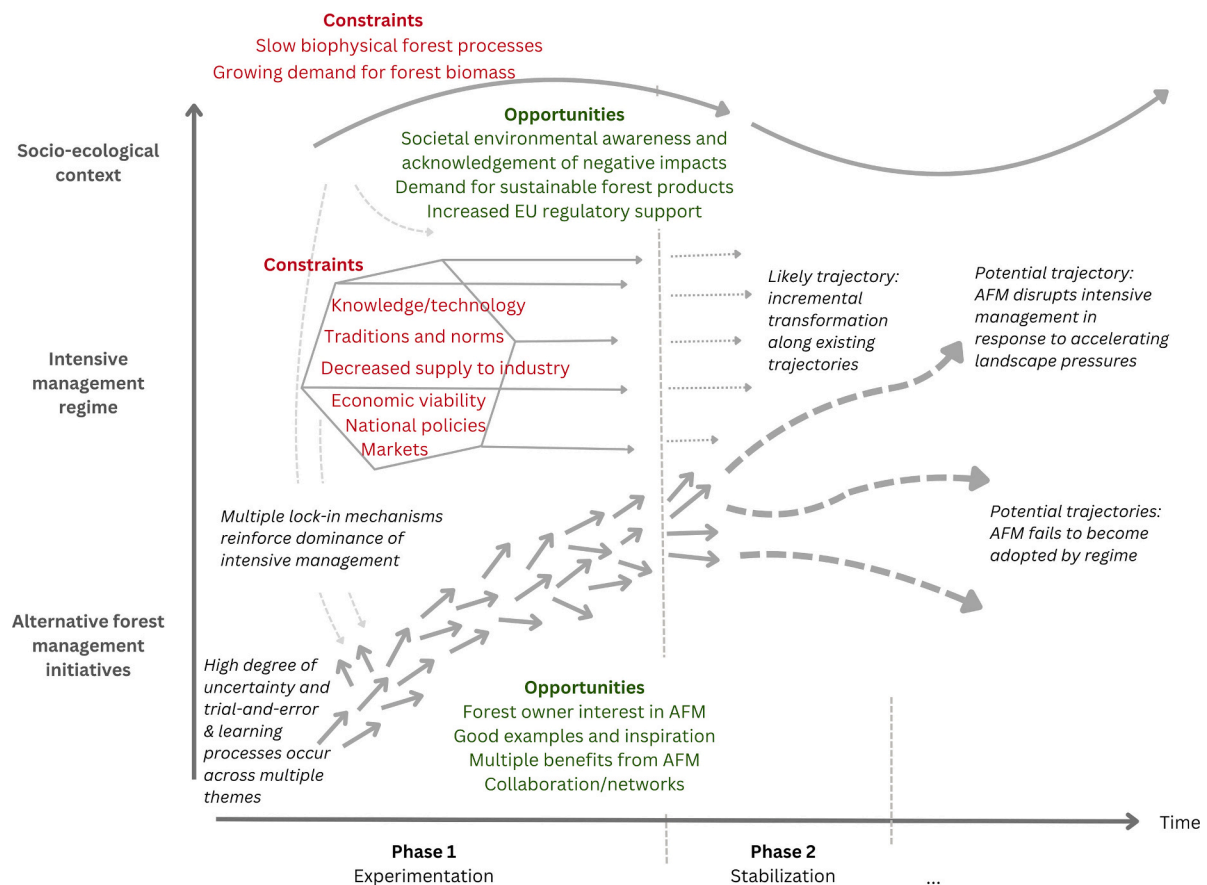
economic outcomes associated with AFM approaches (e.g., Peura et al., 2018; Gonçalves, 2024), they may also be a result of methodological differences between studies.

Interpreted through the lens of the STT framework, our findings suggest that the broader landscape level context surrounding forest management in Sweden is characterized by drivers of change that both constrain and facilitate a shift away from intensive management (Fig. 2). Slow biophysical forest processes and the growing demand for forest biomass in response to climate imperatives were each identified by participants as constraints. In the opposite direction, our findings also suggest that growing regulatory support at the EU level may provide a favourable context for Sweden and other EU member states with large intensive forest sectors to transition to AFM (Kruse et al., 2023; Fridén et al., 2024). Furthermore, although they were not highly ranked by our participants, slow-changing factors concerning societal environmental awareness due to the accelerating impacts of climate change and biodiversity loss, along with a growing acknowledgement of the negative impacts associated with conventional practices, may together represent more long-term landscape-level drivers. These, in turn, may support identified opportunities such as growing demand for sustainable forest products, further motivating forest owners to explore management alternatives that better align with ecological and sustainability goals. However, Deuffic et al. (2018) cautions that, although environmental problems have become a political and unavoidable imperative in forest management decisions, forest owners often reframe environmental discourses in ways that seek to counterbalance interpretations put forward by environmentally-motivated actors.

At the regime level, our workshop findings support several previous studies (e.g., Bennich et al., 2018; Hertog et al., 2022) in highlighting the extent to which intensive management is perceived to have become deeply entrenched in Sweden, characterized by multiple lock-in mechanisms that reinforce its dominance and play a crucial role in maintaining the status quo. Many of the constraints identified by our participants (Fig. 2) align with the array of techno-economic and political-institutional lock-in mechanisms that often face socio-technical transitions (e.g., Geels, 2019). Moreover, both workshop participants and our literature review identified that a strong conservative mindset with attendant socio-cultural norms and traditions in the Swedish forest sector promotes adherence to established practices. This conservatism may be compounded by other identified constraints such as fears regarding the potential negative impacts on supply of raw materials to industry and uncertainties surrounding the economic performance of AFM.

Regarding the development of innovative practices at the niche level, our findings indicate that AFM approaches in Sweden remain largely immature. According to Geels and Schot (2007), the maturity of a niche can be assessed through several indicators, including the stabilization of learning processes into a dominant design, strong expectations of price/performance improvements, and the extent to which innovations achieve a significant market share. However, as suggested by the growing proliferation of definitions for AFM explored in the literature – covering more than 50 semi-synonyms denoting AFM types (Kruse et al., 2023) – our findings indicate that a stabilization of learning processes towards a dominant set of practices is yet to occur in Sweden, and scepticism surrounding economic performance remains prevalent. Also, as in many other heavily forested contexts, only a very small share of Sweden's forests are currently managed using alternative approaches (roughly 3%), with minimal growth in recent years (Skogsstyrelsen, 2023). These factors indicate that AFM practices have not yet gained sufficient traction to challenge the clear-cutting paradigm in contexts dominated by intensive management. An absence of established market niches for alternative products further exacerbates this situation (e.g., Jonsson et al., 2019).

Taken together, the strong lock-in mechanisms at the regime level and relative immaturity of niches indicate that a potential transition away from intensive management approaches towards AFM in Sweden



**Fig. 2.** Highly ranked topic clusters of constraints and opportunities mapped against the socio-technical transition framework. Most constraints were identified at the regime level, while most opportunities were identified at the niche and landscape levels.

remains in an experimental phase, with necessary conditions for innovation and adoption not yet in place (Fig. 2). This is largely in line with Hertog et al. (2022). Further, based on the workshop responses, it appears that many forest stakeholders perceive landscape-level drivers as having only a moderate influence on forest management decisions, which may be insufficient to catalyze change despite growing interest among forest owners for AFM. While many potential trajectories for any eventual transition remain possible, we therefore argue that incremental change is most likely in Sweden in the near term. This trajectory presupposes the absence of major external shocks and suggests that most forestry actors, especially large-scale actors, will only slowly reorient their development paths and innovation activities in response to the mounting landscape pressures, such as changing technical problem agendas, evolving visions and goals, and shifting regulations and perceptions of opportunities (Geels, 2019).

However, there are indications that some large-scale actors are already considering a shift away from intensive management including a recent comprehensive inquiry made by the Swedish Church concerning future management strategies for its considerable forest holdings (Swedish Church, 2024). The report based on the inquiry proposed to increase the use of AFM approaches from roughly 3% to 33% of the Church's 406,000 ha of productive forest land in order to "contribute to creating a varied and multifunctional landscape with a diversity of management methods where multiple values can be delivered simultaneously, such as spiritual and existential values, economic returns, biodiversity, climate benefits, other ecosystem services, and social welfare" (Swedish Church, 2024 p.13). The report highlighted that its proposals are in part a response to shifts in landscape level drivers, including international and EU policies and frameworks, and societal expectations (Swedish Church, 2024 pp. 11, 14). Such proposed shifts in

policy by large forest owners in Sweden suggest that as the frequency, amplitude, and scope of changes at the landscape level increases – due to accelerating climate change, biodiversity loss, and societal responses to these crises, including regulatory shifts, societal demands for sustainability, and changes in ownership demographics – pressures for significant alterations in the forest sector architecture will likely intensify and may encourage other large-scale actors to follow suit. Incremental change processes risk being perceived as insufficient, inflexible or too slow, particularly as awareness of the negative environmental impacts of clear-cutting rises alongside consumer demand for sustainable forest products and regulatory frameworks that increasingly prioritize ecological considerations. However, internal conflicts within the regime may further complicate these processes, potentially undermining support for necessary changes (Geels, 2019). For example, at the time of writing, there has been a mixed response from forest stakeholders and within the Church itself to the proposals made in the recent inquiry, which may strongly curtail the extent to which its ambitious reform program is adopted.

## 5.2. Potential mechanisms for unlocking alternative forest management in intensive management contexts

Addressing knowledge and capacity building is crucial for upscaling innovations that are currently developing at the niche level. Although some workshop participants highlighted the growing research interest in AFM as an opportunity, the perceived inadequacy of knowledge, technology, and methods for AFM was nevertheless identified as a predominant constraint, particularly given the uncertainties and risks associated with shifting away from intensive approaches. However, we argue that it is important to problematize an apparently widespread

perception concerning lack of knowledge as a constraint to AFM. Although there is clearly a need for more research and systematic evaluation of the impacts of AFM initiatives on the ground (Angelstam and Dawson, 2025), existing research does not primarily emphasize inadequate or lack of scientific knowledge as a key barrier to AFM uptake, but rather highlights insufficient education, training and understanding among forest owners, advisors, and industry professionals (e.g., Hertog et al., 2022; Nikinmaa et al., 2024). Targeted educational initiatives and training programs are needed to make existing and new knowledge accessible to forest owners, advisory services, and other actors and to equip them with the necessary skills to adopt AFM practices and learn from each other. To this end, there is also a crucial need to re-evaluate and reform formal forest management education programs to include a greater focus on AFM approaches. We argue that ensuring that future forest professionals have relevant capacities and tools needed for grappling with growing sustainability challenges is an ethical responsibility of employers and forestry educations. Furthermore, our findings underline the importance of supporting the development of impartial, norm-critical advisory services that empower forest owners and acknowledge public values in order to counteract knowledge lock-in effects in contexts dominated by intensive management (e.g., Matilainen and Andersson, 2023; Pülzl et al., 2024).

Our findings indicate that, by fostering collaboration and trust among diverse stakeholders, good examples of innovative practices and case studies demonstrating the economic viability of AFM can be shared beyond niches through networks, promoting their broader adoption. Given the polarized debate within the forestry sector in Sweden and similar contexts (e.g., Elbakidze et al., 2022), it is crucial to support both new and existing networks and other fora that build trust and facilitate knowledge-sharing and creative learning (e.g., Eriksson and Fries, 2020; Wilkes-Allemann et al., 2021). Such networks are useful for replicating AFM practices and approaches outside of innovative niches to support targeted outreach, education and dialogue among different types of forest owners to create a shared vision for multifunctional forest management and help align diverse interests (e.g., European Commission and Directorate-General for Environment, 2023). Such replication measures could also help to challenge both traditional norms and socio-cultural conservatism in forestry, and entrenched beliefs that clear-cutting is the only viable option. A key challenge in this regard lies in encouraging more NIPF owners to attend educational courses on new forest management options (Kronholm, 2024). Furthermore, some of our workshop participants highlighted that many existing forest networks in Sweden are dominated by intensive management actors and perspectives, making them less likely fora for constructive discussions about AFM.

Workshop participants identified demand for sustainable forest products and services as an opportunity for forest owners to diversify their income streams beyond raw commodities, whilst highlighting a lack of infrastructure and market access as barriers. Our review confirms stakeholder perceptions that current value chains in Sweden are largely locked in to bulk production models (e.g., Konczal et al., 2023; Lidestav et al., 2023). Along with good examples and institutional support (e.g., Angelstam and Dawson, 2025), this suggests the need for new *partnerships* between forest owners, machine operators, mill owners, nature-based tourism entrepreneurs and many other actors to develop innovative value chains, suitable processing infrastructure and markets for a more diverse range of sustainable forest products and services, to further foster consumer awareness and demand and thereby enhance the economic viability of AFM methods. In line with previous studies (Deuffic et al., 2018; Mason et al., 2022; Hertog et al., 2022), we argue that developing local and regional markets can assist NIPF owners who may otherwise have difficulty in accessing and navigating logistical chains associated with national and international markets for high-quality logs or forest services. Initiatives aimed at connecting owners with entrepreneurs specializing in clear-cut-free methods and smaller, local specialty sawmills are essential. Our review highlights the

potential role of digital technologies to facilitate this process by providing internet-based marketplaces and forums for diverse actors, services, and products related to AFM approaches, or by supporting and coordinating AFM-adjacent markets, including those for forest-based tourism (e.g., Wilkes-Allemann et al., 2021; Wising et al., 2024). Our findings also underline the need for digital tools for planning and decision support of non-timber products and services, and for machine technologies better suited for AFM.

Our analysis identifies several institutional and economic constraints and highlights a need to facilitate the development of more transparent and detailed policy *instruments* that outline how to achieve a diverse forest ecosystem, including both hard and soft instruments, as well as more measurable goals to facilitate transparent AFM transition. New regulatory frameworks are needed to balance flexibility, clear rules, political motivations, and long-term economic thinking to address ecological, social, and cultural values (e.g., Johansson et al., 2018; Mann et al., 2021; Konczal et al., 2023). Eggers et al. (2019) suggest that conflicts of goals and interests among production, ecological, social, and cultural values deserve more attention in the design of new forest policy instruments, as well as in the implementation and integration of policy goals at the forest management level. Our workshop participants identified that increased requirements from EU strategies and regulations promoting more sustainable approaches to forest management provide a supportive backdrop for a transition towards AFM. However, there is a need to harmonize national regulations with EU directives to foster the development of niches for alternative management (e.g., Fridén et al., 2024; Nebasifu et al., 2024). This includes the development of clear criteria and indicators for AFM, focusing on the suite of desired ecosystem goods and services (Puettmann et al., 2015; Elbakidze et al., 2018). A lack of legal imperatives, quantitative goals, detailed plans, and incentives, and the perception of AFM as primarily a complement to clear-cutting in national policies contributes to confusion about their practical implementation (SFA 2022). The growing emphasis on biomass production further complicates this landscape (SOU, 2020; European Commission. Joint Research Centre., 2021).

Current economic structures within intensive management-focused forest sectors, characterized by a lock-in to bulk production models and lack of markets for alternative products, limit financial incentives for forest owners to adopt new practices (e.g., Mason et al., 2022; Skogsstyrelsen and Naturvårdsverket, 2023). Our findings underline the need for a framework of economic *instruments* to address widespread perceptions of poor economic viability attached to AFM compared to intensive management and to promote alignment with other sustainability goals, e.g., relating to biodiversity conservation (e.g., Eggers et al., 2020; Skogsstyrelsen., 2022; Lidestav et al., 2023). Such a framework could encompass certification schemes, ecosystem service payments, reverse auctions for conservation and carbon sequestration, and stricter environmental standards in public procurement, and could capitalize on market opportunities relating to broader trends in sustainability and consumer preferences. Although several existing European frameworks provide economic incentives that could be used to support AFM (European Commission and Directorate-General for Environment, 2023), these frameworks mainly benefit intensive management (e.g., Mason et al., 2022), and some studies question the impact of monetary incentives on small-scale forest owners (e.g., Mostegl et al., 2019; Sikkema et al., 2024). Kleinschmit et al. (2024) similarly emphasize that most current economic instruments continue to favour short-term profits over more sustainable approaches to forest management. It is therefore essential that economic instruments to support AFM going forward are made more accessible also for small-scale forest owners (e.g., Sikkema et al., 2024).

Finally, our study highlights both the constraining influence of industry power and lobbying efforts on the one hand, and the growing interest among forest owners on the other as important factors for a transition towards AFM. These factors point to a need to better *embed* the needs, perspectives and values of a more diverse range of forest owners



and stakeholders in forest planning and forest-focused policy-making processes to address long-standing power imbalances and to disrupt path-dependent lock-in mechanisms (Juerges et al., 2020; Matilainen and Andersson, 2023). In alignment with the EU's objective of a more inclusive and integrated forest governance (European Commission, 2021), this implies more consideration of non-traditional forest owner perspectives, including the growing number of absentee and passive owners. In this regard, a demographic shift towards younger, female, urban-based, and professionally educated forest owners and foresters, who are more aware of climate and biodiversity crises, presents a significant opportunity to engage a new cohort of forest actors who may be more receptive to innovative AFM methods. However, given the contested nature of forestry in many contexts, it is crucial not to overestimate the potential of collaborative governance processes for supporting AFM. Bjärstig et al. (2024), for example, underline the key role of elected decision-makers to support the feasibility and accountability of forest policy processes. Supporting previous studies (e.g., Puettmann et al., 2015), our study highlights a need for AFM educational initiatives that are tailored towards such decision-makers. Furthermore, while leadership was not explicitly identified in our results, the role of strong intellectual, political, and administrative leadership is vital in shaping public and professional opinions that challenge established norms in support of a transition (Brukas and Weber, 2009; Kleinschmit et al., 2024).

Simultaneously, however, there remains a need to meaningfully integrate the heterogeneous goals and perspectives of local stakeholders to ensure that forest policies become embedded in the unique contexts of communities directly impacted by management practices (Arnould et al., 2022; Ekström et al., 2024; Kleinschmit et al., 2024). Several opportunities identified by our workshop participants, including linking AFM with multiple forest benefits and the growing demand for a suite of new and sustainable forest products, connect to the increasing interest in multifunctional forest management in many European countries.

However, in Sweden, the Forestry Act (1993) does not adequately address intermediate approaches that support diverse forest values, despite accommodating a broad range of management practices. Nor does Sweden's forest governance system satisfactorily account for informal institutions or public good functions of forests. This hampers coordination and consolidation of goals and rules, exploitation of synergies, and negotiation of trade-offs in implementation (e.g., Sandström et al., 2011). Municipalities may play a key role in this regard, given that they are often large forest owners themselves and have overlapping roles for planning and regulating local land use. In Sweden, for example, several municipalities have begun implementing AFM in peri-urban forests to enhance recreational and health values for residents, to support property values – an important source of municipal income – and to support local cultural identity, e.g., by constructing public buildings using timber sourced directly from local municipally-owned forests managed and harvested using AFM approaches. Linking local public works-projects with AFM may be a useful strategy for integrating new values and practices associated with AFM with deeper held societal norms and expectations, facilitating long-term change.

### 5.3. Limitations

The methodology employed in this study is subject to several limitations that may influence the interpretation of findings. First, the workshop did not differentiate responses across stakeholder groups. This limited our ability to discern the distinct perceptions of constraints and opportunities among different groups. Furthermore, participants were invited based on forest sector expertise and presumed interest in AFM. Selection of participants and representation of stakeholder groups was not controlled. The number of participants was relatively even across three main stakeholder categories – public (16), forest management representatives (14), and academics (19). However, forest management representatives consisted of both industrial actors (5), owner

associations (6) and non-governmental organizations (3). Potential imbalances in the participation of different stakeholder groups could lead to an over- or under-representation of constraints and opportunities that are of particular relevance to certain groups, especially if perceptions of constraints and opportunities are relatively homogeneous within groups. It is possible for example that the under-representation of economic and biophysical factors is due to an under-representation of forest management stakeholders. Similarly, it is possible that factors that are highly relevant to Sámi communities (e.g., Turunen et al., 2020) may be under-represented in the study. Although the main interests in the forest sector were represented by at least one participant, some stakeholder interests may not have been represented at all.

Second, the inclusion of digital participants was facilitated by a dedicated facilitator; however, some misunderstandings may have occurred during the workshop. Given that very few participants attended digitally, the overall impact on the results is likely negligible.

Third, responses recorded on Post-it notes varied in clarity and legibility, with some comments being vague or difficult to read or interpret. A total of three very unclear responses were removed from the analysis. The use of differently coloured Post-its aided in the interpretation of responses, particularly in distinguishing opportunities linked to specific themes, such as climate change.

Fourth, the multi-dimensional and cross-sectoral nature of many responses resulted in many topic clusters that did not align neatly within main themes. For example, some responses relating to the negative impacts of clearcutting were relevant as both biophysical phenomena and socio-cultural perceptions. Furthermore, in some cases it was difficult to distinguish socio-cultural factors from institutional or knowledge factors, with several responses bridging across these themes. In our Results section, in cases where similar responses were classified by participants in different themes, we categorized topic clusters into the theme with which they were most frequently associated by participants. In total, we reclassified 11 of 332 responses; the impact of reclassification on results is therefore likely limited.

Fifth, findings concerning topic clusters perceived as both constraints and opportunities may result from differences in stakeholder perspectives but also from the accumulation of multiple types of forest management practices under the umbrella of AFM, or the national scale of the study. Future context-specific analyses may be necessary to better assess the ultimately constraining or facilitating roles of some factors.

Finally, this paper does not account for interdependence between technological developments, social practices, and institutional changes. A deeper analysis of such complex dynamics falls outside the scope of this paper.

## 6. Conclusions

This study provides a timely appraisal of stakeholder perceptions concerning a transition from intensive management towards alternative forest management (AFM) in Sweden. The results reflect the complexity and multidimensionality of a transition to AFM in contexts dominated by intensive management. Expert stakeholders ranked knowledge and competence concerning AFM approaches, conservative traditions and norms, the role of advisory services, and institutional support as among the most important factors influencing a transition. Interestingly, economic and biophysical factors were not ranked as highly as factors related to socio-cultural, institutional and knowledge/technology themes.

The review of recent scientific research combined with an analysis of current insights from a wide range of forest stakeholders strengthens and brings up-to-date the existing evidence base concerning the potential for AFM in contexts characterized by intensive management regimes. Our analysis of the broad range of identified constraints and opportunities using the socio-technical transitions framework indicates that AFM has yet to gain sufficient traction and momentum to challenge the intensive management paradigm in Sweden. Incremental change of the forest



sector seems therefore most likely in the short term, in the absence of major external shocks.

While challenges remain, public and political awareness of the negative impacts of intensive management is growing, and some NIPF owners and the EU are driving change in the Swedish forest sector. Together, these factors may lead to more radical changes, especially if responses from the forest industry are perceived as inflexible or inadequate for incorporating alternatives into the management and policy mix. Importantly, our analysis presents an overview of several potential mechanisms for unlocking a transition to AFM, both in Sweden and similar contexts. These include addressing communication and training gaps in relation to knowledge and experience of AFM, development of collaborative networks, and new partnerships to help develop value chains, suitable processing infrastructure and markets for a more diverse range of forest products. At the same time, new (hard and soft) policy and economic instruments are needed to provide measurable goals for AFM and to incentivise a shift away from intensive management. In addition to further research exploring these and other mechanisms in relation to AFM, there is an urgent need for future studies evaluating impacts on the ground and actual contribution to key societal goals.

Finally, the theoretical framework presented in our paper provides a comprehensive lens through which to examine the dynamics of change concerning forest management in Sweden. This approach can support future research that explores the long-term impacts of AFM practices on biodiversity, ecosystem services, and community resilience as well as informing broader discussions on how innovations in sustainable practices can be more effectively implemented and scaled in various sectors.

#### Author statement

All authors acknowledge that the material presented in this manuscript has not been previously published, except in abstract form, nor is it simultaneously under consideration by any other journal.

#### CRediT authorship contribution statement

**Lucas Dawson:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Jayne Glass:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Data curation, Conceptualization. **Ulrika Widman:** Writing – review & editing, Writing – original draft, Investigation, Data curation. **Jenny Friman:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Sara Holmgren:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization.

#### 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.

#### Data availability

Data will be made available on request.

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#### Appendix A. Supplementary data

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