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ORIGINAL PAPER

Setting Sweden's route to Paris: designing policy instruments for climate mitigation in forestry

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Abstract
The role of forest ecosystems in mitigating climate change has gained increasing prominence in international climate negotiations, particularly within the Paris Agreement and in the strategies and regulations of the European Union. This paper aims to enhance ongoing policy discussions on how Swedish forests can support climate mitigation goals by identifying which policy instruments, incentives, and climate strategies forest stakeholders prioritize, while advancing social science understandings of governance, stakeholder participation, and the socio-political conditions shaping forest management. Specifically, we examined the acceptance of, and perceived need for, alternative policy instruments designed to accelerate the climate transition through three novel mitigation scenarios for Swedish forestry. These scenarios explore the allocation of responsibility for achieving climate targets – whether it rests primarily with the state, the market, or individual landowners. Our findings draw on two participatory workshops involving 27 stakeholders and rightsholders engaged in Swedish forest management. The results reveal significant challenges in management and policy, particularly regarding responsibility for climate mitigation, justice claims, and power sharing. Furthermore, they underscore the need for stronger policy integration across sectors and administrative levels, as well as innovative policy instruments to facilitate the implementation of forest-climate objectives. We call on policy makers to reassess the current forest policy framework, extend policy instruments targeting climate mitigation, and support landowners who are prepared to contribute to the objectives outlined in the Paris Agreement.

Keywords Climate mitigation · Forestry · Paris Agreement · Stakeholder participation · Scenarios · Sweden

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1 Introduction

Adapting life to a changing climate and limiting global warming to well below 2 °C, with efforts to keep it within 1.5 °C as outlined in the Paris Climate Agreement (2015/2018) (hereafter the Agreement), necessitates a rapid and profound transition across various sectors of society (Linnér & Wibeck, 2021; Meinshausen et al., 2022; United Nations Environment Programme, 2025). Achieving this transition requires joint efforts requiring not just states, but a range of public and private actors to take responsibility for climate action (Hölscher et al., 2018; Linnér & Wibeck, 2021). Therefore, the Agreement has actively promoted inclusive forms of climate governance, which have redefined and broadened the climate policy landscape, thereby providing ample flexibility for Parties to address climate change, tailored to the specific conditions in each country or region (Savaresi, 2016; Skjærseth, 2021).

Additionally, within the framework of the Agreement, forested areas possess substantial mitigation potential, with forests specifically emerging as a crucial element of the Agreement (Grassi et al., 2017; Korosuo et al., 2023). To align with the Agreement, the European Commission underscores the key role of European forests in attaining the objectives of the European Green Deal for climate neutrality by 2050, including the interim target of achieving at least a 55% net reduction in greenhouse gas emissions by 2030 (Aggestam & Giurca, 2021; Korosuo et al., 2023). Further, to increase the chances of achieving the EU's climate goals, the EU Forest Strategy for 2030 highlights the need for protecting the EU's last remaining primary and old-growth forests to ensure forest restoration and reinforced sustainable forest management for climate adaptation and forest resilience, and to provide financial incentives to landowners and other forestry operators to store and sequester carbon in forests (European Commission, 2021). However, these and other such strategies do not stipulate how such ambitions should be put into practice, leaving several possible options for different countries. Yet the role of European forests in achieving climate targets should not be overstated (Blattert et al., 2023), as countries must weigh trade-offs and introduce policies that are perceived as reasonable and fair by landowners, the public, and other stakeholders (Johansson, 2018; Priebe et al., 2022).

Sweden is one of the most forest-rich countries in Europe (about 28 million hectares of forest land or 70% of the total land area (Swedish University of Agricultural Sciences, 2022), making it a country of particular interest capable of contributing significantly to the European solution of ecosystem-based climate change mitigation. Of central importance to climate mitigation in the land use sectors are the carbon removal requirements set out in the EU's Land Use, Land Use Change and Forestry Sector (LULUCF) regulation, which was enhanced under the EU's legislative package Fit for 55. The targets stipulate that Sweden should provide the EU's largest carbon sink, with an additional 4 million tons by 2030 compared to the carbon dioxide uptake of 2016–2018 (Ministry of Climate and Enterprise, 2022). In recent decades, annual growth in Swedish forests has become increasingly variable, with fluctuations in both magnitude and frequency posing challenges to achieving national commitments on EU carbon sequestration and climate mitigation targets (Laudon et al., 2024, 2026). Yet the land use sector remains a substantial carbon sink and, for 2023, a net uptake of just under 32 million tonnes of CO_2 equivalents is reported (Swedish Environmental Protection Agency, 2025). In 2017, Sweden set a goal to become the world's first climate-neutral, fossil-free welfare nation by 2045 (Gov. Bill 2016/17:146). However,

current policies fall short, requiring additional measures (Sweden's Climate Policy Council, 2025) and a clearer, more unified strategy, particularly regarding the role of forests in climate policy (Sweden's Climate Policy Council, 2023).

Although the Agreement primarily targets states, private landowners play a crucial role in achieving Sweden's climate goals in forestry. Allocating responsibilities and identifying effective policy instruments for them is therefore necessary for climate mitigation in the sector. Yet it is well known that various stakeholders frequently express divergent views on the utilization of forests for society regarding biomass extraction, biodiversity conservation, and climate change mitigation (Sandström et al., 2020; Holmgren et al., 2022). Additionally, identifying effective policy instruments to enhance Sweden's ability to meet the EU's climate targets has proven challenging, particularly in the land use sector, where political divisions are distinct (Sweden's Environmental Objectives Committee, 2025).

The Swedish forestry model, which emphasizes the use of voluntary policy instruments rather than command-and-control regulations, adds to the complexity of this task (Beland Lindahl et al., 2017). In the Swedish discourse, it is evident that there are divergent perspectives on the optimal management of forests to maximize overall climate benefits (Eriksson and Klapwijk, 2019; Holmgren et al., 2022; Andersson et al., 2022; Olsson & Johansson, 2025). Two opposing alternatives have emerged as strategically significant: conserving forests to enhance the short-term carbon sink, or logging forests for active forestry, wherein growing forests sequester carbon and substitute products derived from fossil fuels (Skytt et al., 2021; Petersson et al., 2022; Peichl et al., 2023; Olsson & Johansson, 2025). Past research has shown that Swedish landowners generally support carbon substitution in forestry, though they tend to prioritize timber production over carbon storage, the latter being a key concern primarily for environmental organizations (Eriksson & Klapwijk, 2019). Additionally, scholars have noted that the prevailing logic within the Swedish forest sector emphasizes maximizing production – a management strategy criticized for being pursued without adequately considering adaptation measures, which undermines its long-term resilience (Andersson & Keskitalo, 2018). Irrespective of these developments, many private landowners continue to support the Swedish model, emphasizing voluntary action to achieve various forest management objectives (Danley, 2019; Eriksson & Sandström, 2022). However, there remains a significant need to improve these policy instruments so they align with the diverse motivations and objectives of forest owners (Danley, 2019). Further, preferences for policy instruments vary considerably across stakeholder groups (Sandström et al., 2020).

This paper aims to enhance ongoing policy discussions on how Swedish forests can support climate-mitigation goals by identifying which policy instruments, incentives, and climate strategies forest stakeholders prioritize, while advancing social-science understandings of governance, stakeholder participation, and the socio-political conditions shaping forest management. It further contextualizes proposed measures in specific local settings and identifies policy pathways and instruments to close current implementation gaps and accelerate progress toward the Agreement's targets. These insights can guide more effective and stakeholder-driven climate action in the forestry context. To achieve these insights, we convened two participatory workshops with stakeholders and rightsholders pertinent to Swedish forestry. Specifically, we examined the acceptance of, and perceived need for, alternative policy instruments designed to accelerate the climate transition through three novel mitigation scenarios for Swedish forestry. These scenarios explore the allocation of

responsibility for achieving climate targets – whether it rests primarily with the state, the market, or individual landowners. We address the following research questions: (1) What alternative pathways exist for fulfilling the Agreement's climate targets, and what implications do these pathways have for forest ecosystems and their utilization? (2) Which climate mitigation strategies in forestry do stakeholders consider most credible, and who should bear the primary responsibility for implementing these measures? (3) Which incentives and policy instruments are perceived as most effective for enhancing the climate benefits of forests and closing current implementation gaps?

The remainder of this paper is structured in four main sections. The next section outlines our analytical framework, with particular emphasis on the design and preferences of policy instruments. The third section describes the participatory methodology, including the use of the Heureka decision support system to simulate forest management scenarios. The fourth section presents the empirical findings, synthesizing results from two participatory workshops. Finally, the concluding section provides critical reflections on the lessons learned from the Swedish case study and discusses their implications for stakeholder engagement in forest management and climate change mitigation.

2 Policy instrument design and preferences

The use of policy instruments is a classical way in which governments aim to steer human behavior and markets. These instruments are the tools by which policy objectives can be achieved (Bali et al., 2021). There are a variety of policy instruments that governments may use and combine (Table 1). Broadly speaking, these can be divided into two groups: procedural instruments and substantive instruments. *Procedural instruments* affect policy processes, influencing the formulation and implementation of policy goals and means, and

Table 1 Types of policy instruments. Inspired by (Bali et al., 2021) and (Howlett, 2023)

Instrument group	Instrument type	Examples
Procedural instruments	For policy design	Consultation/public hearing/inquiry/commissions/advisory committees/dialogue/enhancement of collective action/ interest group funding and regulating/government reviews/ forecasting/ backcasting/scenario analysis
	For policy implementation	Collaboration/planning/dialogue/enforcement mechanisms/ enhancement of collective action/co-production/mechanisms to detect non-compliance/administrative procedures
	For policy evaluation	Impact assessment/evaluation/monitoring/data collection
Substantive instruments	Laws and regulatory	Bans/rules/requirements/standards/laws/acts/legal norms/ quotas
	Economic and financial	Tax/subsidy/credit system/compensation/payments for ecosystem services/tradable permits/charges/ fiscal transfer/ grants/loans/government insurance
	Social and information-based	Guidance/learning/training/education/information dissemination/awareness raising/certification/environmental labelling/registers/ award schemes
	(Voluntary) self-regulation	Voluntary agreements/self-regulation/corporate social responsibility/code of conduct
	Rights-based and customary	Human rights/indigenous rights/access rights/use rights/ property rights/collective rights/customary law/community right to know/individual empowerment

thereby indirectly shape policy outcomes. These instruments are used throughout the stages of policy design, implementation, and evaluation to manipulate policy outcomes, as well as the behavior of involved actors. Whilst primarily targeted at policy makers and implementers, they play an important role in generating policy legitimacy in society overall. Examples of procedural instruments include consultation, dialogue, collaboration, setting up advisory committees or administrative procedures, enforcement mechanisms, and impact assessments. *Substantive instruments*, in contrast, impact policy outcomes directly. By either encouraging or discouraging certain behavior and practices, these instruments directly or indirectly influence human behavior and markets (Bali et al., 2021; Howlett, 2023).

Traditionally, environmental policy makers have focused on command-and-control regulation. The early 1990s, however, witnessed a shift toward "new" environmental policy instruments such as certification schemes and tradable permits (Jordan et al., 2018). Substantive instruments are often divided into three categories: "the stick", *legal and regulatory instruments* (e.g., laws, regulations, standards, supervision, agreements, environmental targets), "the carrot", *economic and financial instruments* (e.g., taxes, subsidies, charges, payments for ecosystem services, carbon credits), and "the sermon", *social and information-based instruments* (e.g., certification, information campaigns, advice) (Vedung et al., 1998). However, there are further categories of substantive instruments that policy makers could make use of, including *(voluntary) self-regulatory instruments* (e.g., codes of conduct, corporate social responsibility, voluntary agreements) (Wurzel et al., 2019) and *rights-based instruments and customary norms* (e.g., participation, transparency, accountability, capacity building, human rights, justice). This latter category of substantive instruments, highlighted by IPBES for supporting biodiversity and human well-being, is widely endorsed in global agreements and rights frameworks but remain largely undeveloped in practice (Rounsevell et al., 2018).

Which kinds of policy instrument are most appropriate and effective to use in order to reach the desired policy objectives depends on multiple factors and is context dependent. Aspects that may play a role in instrument appropriateness and effectiveness include, for example, the cultural, social, political, and economic context (which may increase the appropriateness of, and provide greater legitimacy to, some instrument types over others); the available governance resources (e.g., economic, authority, and organizational resources); behavioral characteristics of the targeted actors (e.g., willingness to trust information stemming from government authority, willingness to be influenced by government-imposed penalties, proscriptions, gains, and losses, and willingness to enter into partnership with government authorities and receive goods and services); and temporal factors (e.g., time-frame, tempo, and timing). Furthermore, other policy instruments that are already in place also impact appropriateness and effectiveness, as some instruments may function better together than others (Capano & Howlett, 2023; Howlett, 2023). In most instances, multiple policy instruments need to work together to create the required behavioral and market changes (Rogge & Reichardt, 2016) and, ultimately, they can only work effectively toward reaching policy objectives when they are perceived as acceptable by the targeted actors. The acceptance of an individual policy instrument may be dependent on how it is combined, or interacts, with other policy instruments (Ingold et al., 2019) and in many cases it can be challenging to evaluate the overall support or outcomes of different approaches and policy instruments (Leong et al., 2022). In the following section, we describe how we used mul-

tiple policy instruments for evaluating stakeholders' perceptions and preferences of climate strategies related to forest management.

3 Methods

3.1 Participatory workshops

We conducted two full-day participatory workshops focused on how Swedish forests can support climate mitigation goals. The core purpose of both workshops was to investigate the potential of Swedish forests to enhance their contribution to the Agreement by collectively generating knowledge with diverse key stakeholders and rightsholders relevant to the utilization of Swedish forests ($n=27$). We focused specifically on understanding their perspectives regarding which entity should bear responsibility for meeting climate targets – the government, the market, or landowners – as well as their perceptions of suitable policy instruments to achieve the stated goals. In return, participants would acquire insights into methods for maximizing the climate benefits of forests through the presented scenarios (see Sect. 3.2).

Workshop 1 took place in December 2022 at the premises of the Royal Swedish Academy of Agriculture and Forestry in Stockholm, Sweden. We gathered 13 stakeholders and rightsholders representing different organized forest interests – forest companies, forest owner associations, environmental NGOs, reindeer husbandry, and public agencies. The participating individuals were selected either because they were spokespersons for forest and/or environmental policy in their organization or because they had been recommended by their organization to participate. The broad range of actors is representative of Swedish forest policy, although the sample cannot be said to encompass or represent the entire forestry sector or all actors who in one way or another influence forest policy. Workshop 2 took place in June 2023, outdoors in the Vindeln Experimental Forests outside of Umeå in Västerbotten county, northern Sweden. This group was comprised of 14 stakeholders and rightsholders. Most of the participants were small-scale forest owners from nearby municipalities using their forests for commercial timber production. However, some of them represented forest companies, forest owner associations, or reindeer husbandry organizations. One participant represented a UNESCO Biosphere Reserve. Thus, while workshop 1 was aimed at representatives from organized national interests and authorities, workshop 2 took a bottom-up perspective focusing on actors working with and in forests locally.[1]

The exercises used in the two workshops were adapted to the types of stakeholders participating in each workshop. In short, workshop 1 participants were first asked to discuss a total of four scenarios – the three novel scenarios plus business-as-usual (BAU) – focusing on the following questions: Does the scenario take us to Paris? What other effects could such a route result in? Second, the participants were asked to choose and discuss two preferred scenarios focusing on the following question: If Swedish forestry decided to depart from BAU and instead aim for one of the other scenarios, what would be required in terms of policy instruments? We asked the participants to consider forest use as a holistic approach

[1] Before both workshops, we obtained informed consent from each participant, ensuring they were aware of the research focus, data storage, voluntary participation, withdrawal rights, and the use of workshop results in further research.

by considering all forest land in Sweden in each scenario. The participants were also asked to prioritize the use of different policy instruments to achieve each individual scenario. They presented their ideas by attaching post-it notes to each scenario on boards mounted with flipchart paper. Finally, the participants had the possibility to provide separate reflections on the scenarios and evaluate the workshop activities through a questionnaire, to which 10 responded.

Workshop 2 participants were first asked to reflect on, discuss, and write down their perspective on forest management advice given by different actors in the forest sector and how such knowledge is disseminated. Second, we asked them to produce two ranking lists: one concerning how the goals of economy, biodiversity, social values, and climate benefits guide them as forest owners, and one regarding their views on each scenario's ability to fulfil the Agreement. We also asked them about their views on getting paid to use parts of their forest exclusively for climate change mitigation measures. Third, we asked about which actions they were willing to undertake to mitigate climate change and which policy instruments they encounter as forest owners. In addition, we asked which policy instruments they considered most appealing to obtain their preferred scenario of the four. Finally, the participants had the opportunity to provide separate reflections on the scenarios and evaluate the workshop activities in a questionnaire. Eleven of the participants took this opportunity. Participants were tasked with independently evaluating the relevance of the scenarios and discerning potential consequences for various forestry policy objectives. Moreover, during both workshops, significant time was dedicated to interpreting the implications of each scenario, including its impact on carbon sequestration in the short and long term, and other potential effects on the forest's carbon balance.

3.2 Climate mitigation scenarios for Swedish forestry

To support the discussions in the workshops, we used three hypothetical, yet plausible, scenarios: *the Landowner*, *State*, and *Market scenarios* – as alternatives to the fourth scenario, BAU – based on who should be the key actor in changing forest management on the route to Paris (Fig. 1). Each scenario represents an important stakeholder involved in the forest sector, which is why we argue that these scenarios, and combinations of them, reflect the current forest policy debate in the EU and Sweden (Sandström et al., 2020; Holmgren et al., 2022). However, in the workshops, we stressed that the levels of change in our scenarios were set as *hypothetical examples* to provide a basis for the discussions, and to test if different actors could envision or support a different path to Paris than BAU. Thus, the participants were encouraged to also suggest other pathways than the ones we presented.

Using a forest decision support system called Heureka RegWise (Lämås et al., 2023), we projected the development of Swedish forests according to the different management regimes described in the scenarios. Heureka RegWise simulates growth, mortality, and ingrowth of individual trees, input and decay of dead wood, and soil carbon content. This gave us results in terms of carbon sequestration, harvest potential, and structures essential for biodiversity, such as old forests. As initial state of the forest, we used data from the National Forest Inventory (NFI) for the period 2016–2020, which consists of about 55,000 circular plots systematically distributed all over Sweden (Fridman et al., 2014). The combination of NFI data and the Heureka RegWise simulator is well established and ensures robust predictions of future forest development, and is commonly used by Swedish public

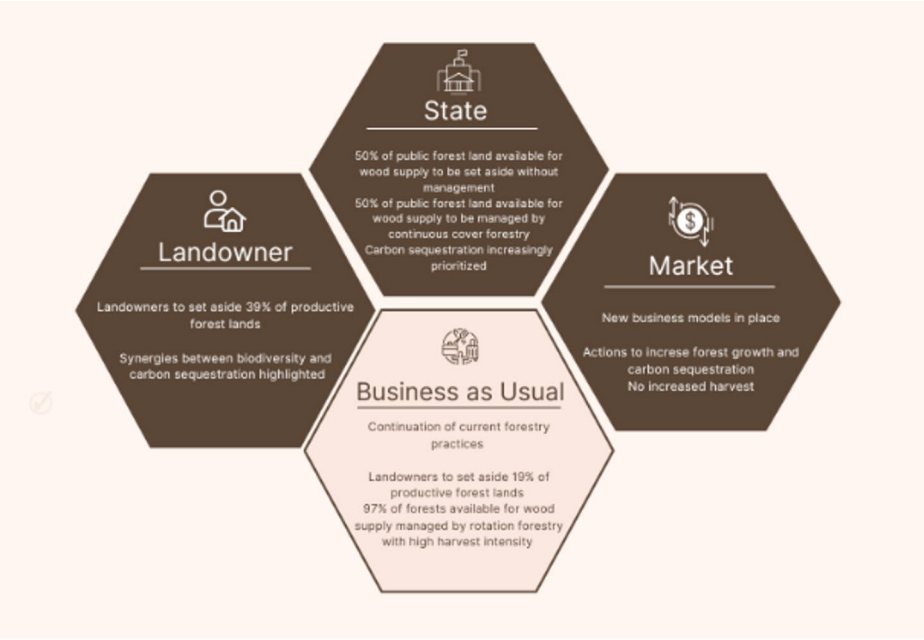

Fig. 1 Illustration of the scenarios, their main goals, and most important differences in forest management compared to BAU

agencies in large-scale scenario analysis (Swedish Forest Agency, 2022). The main models in Heureka RegWise were built on empirical data, mainly from the NFI.

In the BAU scenario, set-aside productive forest areas consisting of formally protected areas, voluntary protected areas, and retention patches (groups of trees spared for nature conservation in harvest operations) added up to 4.5 million hectares. The remaining 19 million hectares were available for wood supply, with management aimed at mimicking current landowner behaviour and a total harvest level set at 100% of net growth. However, extracting the entire net increment is not representative of historical practice (except in isolated years), so this should not be read as literal "business-as-usual" (Swedish University of Agricultural Sciences, 2022). About 0.6 million hectares were managed by continuous cover forestry. In the following, we describe the differences in settings between BAU and the three other scenarios.

In the Landowner scenario, the forest owners were assumed to ensure increased carbon sequestration by doubling the set-aside forest areas from 4.5 million hectares to 9 million.

In the State scenario, the state and other public landowners were assumed to take responsibility. Half of the publicly owned forest available for wood supply (2 million hectares) was set aside from forestry, while the other half (2 million hectares) was managed with continuous-cover forestry. This resulted in a total of 6.5 million hectares being set aside from forestry and 2.6 million hectares being managed with continuous-cover forestry. Harvest intensity in both the Landowner and State scenarios was set to 100% of the net growth on land available for wood supply.

In the Market scenario, we assumed that measures aiming to increase growth were applied to a larger extent than in BAU. For instance, the area on which fertilization was

applied was about 150,000 hectares/yr at the start of the forecast, and up to 300,000 hectares at the end (including traditional fertilization of elder stands and intensive fertilization over the whole rotation period), compared to about 33,000 hectares/yr in the BAU scenario. The harvested volume was equal to BAU, meaning that the increased growth resulted in increased carbon sequestration (Fig. 1).

A positive effect on growth due to climate change was assumed, according to the climate scenario RCP 4.5. No negative effects from a changing climate, such as increased frequency of various disturbances, were assumed. The primary reason for this limitation is that the Heureka system cannot simulate increased disturbances beyond storm frequency. Incorporating a higher storm frequency would likely produce similar outcomes across all scenarios, at least in the short term. Numerous assumptions – varying in plausibility – can be made regarding factors that may influence forests in the future. In this context, the objective was to present alternative scenarios for stakeholders to evaluate.

The only carbon pool considered was living biomass, in all scenarios. Thus, the transition of carbon transferred from living trees to other carbon pools such as dead wood, stumps, products (harvested wood products, or HWP), and litter was not considered, although these carbon pools are also included in the LULUCF accounting. Including these other carbon pools would, in the short term, have resulted in smaller differences in carbon sequestration between the scenarios. Decreases in living biomass due to higher harvest levels can be offset by additions to non-living biomass pools such as HWP and soil. Focusing only on living biomass is a simplification but does not change the main differences in carbon sequestration between the scenarios. Nor was the substitution effect considered, i.e., the avoidance of fossil emissions by using forest products and energy. The target emissions set by the EU considering the LULUCF include forest and HWP carbon pools while the avoidance of fossil emissions affects other sectors, such as the energy sector. This means that the results do not reflect the total climate effect. The purpose of the scenarios was to present examples of different pathways to reach the LULUCF target set by the EU, rather than to produce figures for the total climate effect including carbon sequestration and avoidance of fossil emissions. As shown in Fig. 2, all scenarios result in increased carbon sequestration (in living biomass only) compared to BAU. Depending on the time frame, being short- or long-term, there is a difference in which scenarios produce the highest carbon sequestration (+30 years/+100 years). In the Landowner and State scenarios, the annual harvest is reduced and the area of old forest is increased (>140 years in the boreal region and >120 years in the hemi boreal and temperate regions). The Market scenario upholds the harvest volume (additional data are provided in the supplementary material), as it was set at the same level as in the BAU scenario.

4 The routes to Paris

4.1 Who should take responsibility on the route to Paris?

In the questionnaire, when asked about who should take responsibility when using forests to reach the Agreement goals, participants from workshop 1 were mostly in favour of the Market and State scenarios. Five participants ranked the Market scenario as their highest preference and none of the participants placed it as their lowest. As for the State scenario,

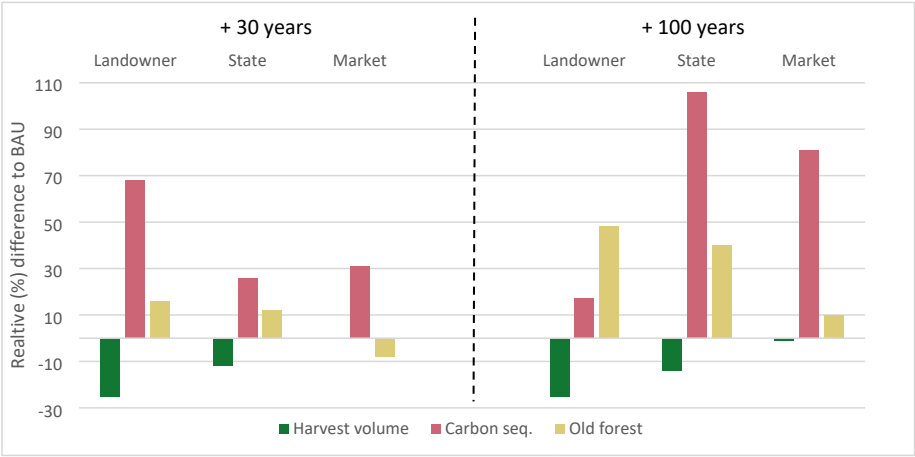

Fig. 2 Simulated results on harvest volume, carbon sequestration and area of old forest for the scenarios Landowner, State and Market. Relative differences compared to BAU in short term (+30 years) and long term (+100 years)

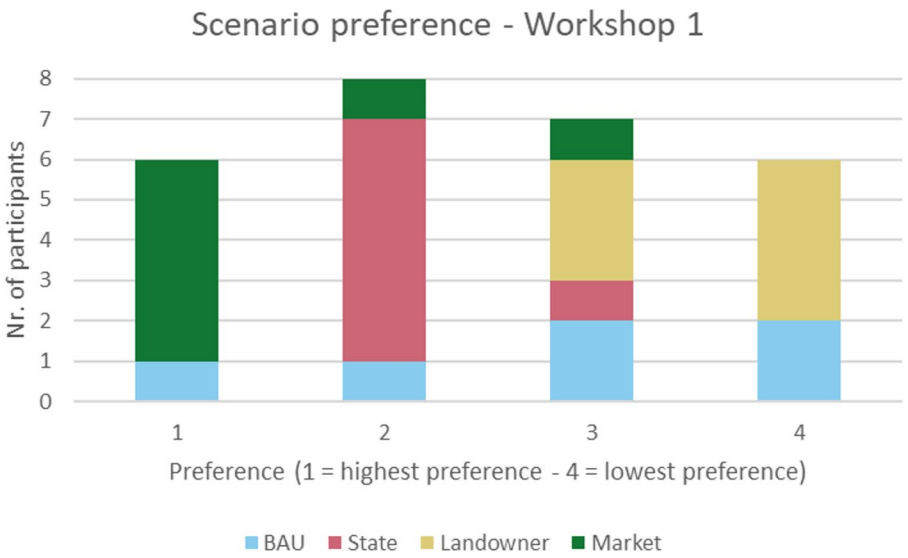

Fig. 3 Individual questionnaire reflection results on scenario preferences by participants in workshop 1

none of the participants gave it highest preference, but six participants, that is, more than half of the group, gave it second highest preference. No-one ranked it as the lowest. The BAU scenario and Landowner scenario were least favoured: only one participant gave the BAU scenario highest preference, and none prioritized the Landowner scenario (Fig. 3).

However, in the workshop 1 discussions, it was evident that the participants preferred a combination of scenarios – distributing responsibilities across multiple actors to locate the most realistic route to Paris. For example, joint responsibility between the state and

the market was seen as a way to stimulate effects beyond cleansing the air from carbon dioxide, such as protecting biological diversity. It was also highlighted that the state could facilitate and support the development of new business models. Many argued that the state as a landowner ought to somehow lead the way in mixed-responsibility scenarios and that an overarching state responsibility on public-owned land would absorb the pressure from other forestry sector groups. Not mixing the scenarios and distributing responsibilities was seen as unrealistic, as the participants perceived the road ahead to be much less straightforward than the individual scenarios indicated. This reflected the fact that the presented scenarios did not consider, for example, patterns of consumption, substitution of fossil products, international policy, and other societal sectors as variables. In addition, participants in workshop 1 deliberated on the local ramifications of new regulations, especially for rural areas reliant on the forest sector for their economies. Many highlighted that meeting the goals of the Paris Agreement often clashed with other prioritized objectives at the national, regional, or municipal levels, such as national biodiversity targets, forest owners' economic interests, and the preservation of reindeer herding land.

Furthermore, in parallel with the answers provided in the questionnaire, during the workshop 1 discussions, the BAU scenario in particular had low credibility among all participants, despite differences in interest and background. Many argued that BAU would lead to dissatisfaction for all forest interests (economic as well as social and environmental), although for different reasons, and several participants perceived it as an unrealistic option in the long run. Similarly, the Landowner scenario was perceived to be a risky route, since the general societal effects of this arrangement were perceived to be unclear. Some participants were also skeptical about the possibility of tackling climate change through this scenario. The Market scenario was criticized for needing more concretization and increased acknowledgement of the vital interests of the politics behind it, and for lacking integration of national economic factors such as taxes, workforce, and industry, alongside issues such as reindeer husbandry and the increase of old-growth forests.

Some of these views were also evident during workshop 2. In the questionnaire, the Market and State scenarios received the highest level of support, with four and three participants selecting them as their preferred scenarios, respectively. However, the Landowner and BAU scenarios were also identified as the most preferred option by two participants each. In contrast to the overall rejection of the BAU scenario in workshop 1, the workshop 2 participants' views on this scenario were more split (Fig. 4).

During the discussions in workshop 2, however, rather than focusing on participant preferences on responsibility distribution, the participants sought to explore the role of forests in reaching the Agreement more broadly. They expressed frustration with the idea that forests and forest owners should be responsible for compensating CO2 emissions resulting from non-forest related activities, such as individual long-distance travel. Workshop 2 underscored that forthcoming EU regulations were a central concern for private landowners, who struggled to navigate the intricate network of EU institutions, negotiations, and policy proposals. This related also to the goals that these participants prioritized in their forests, as stated in the questionnaire responses from workshop 2. It was evident that nature conservation and climate benefits were not given highest priority, apart from one participant who prioritized climate benefits the highest. Instead, most of the participants prioritized economic goals, as shown in Fig. 5. They were split in terms of their general preferred climate measure, with half of the participants preferring a focus on reduced harvesting through

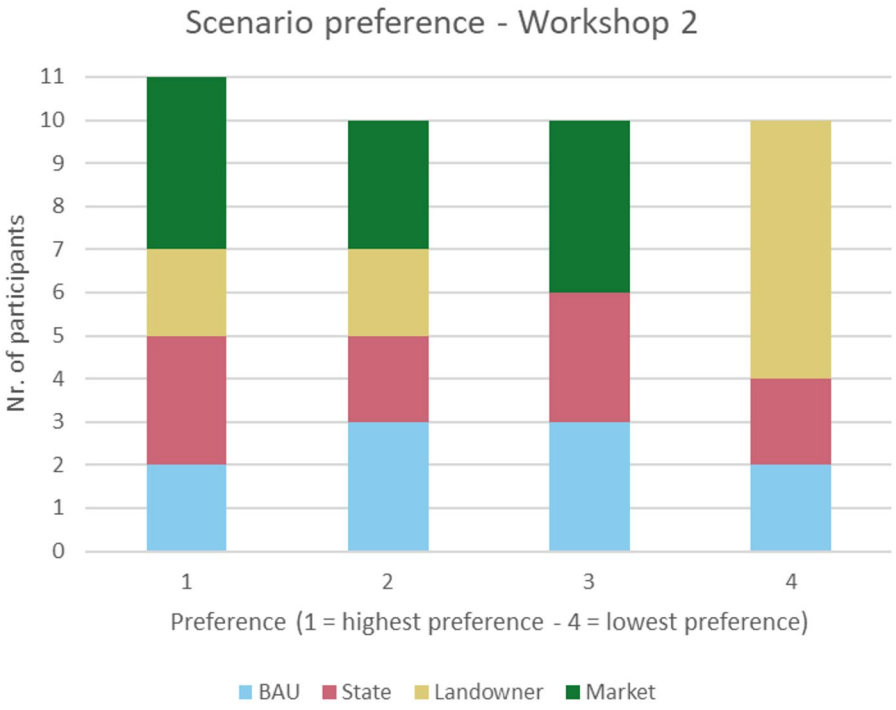

Fig. 4 Individual questionnaire reflection results on scenario preferences by participants in workshop 2

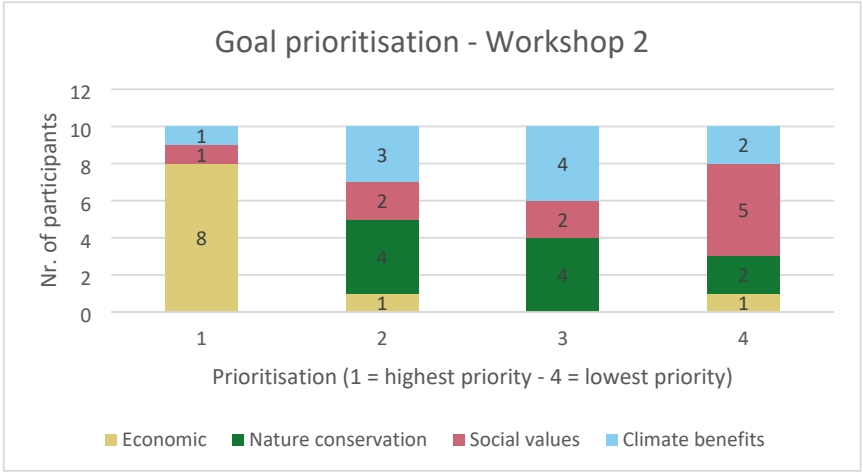

Fig. 5 Goal prioritisation of workshop 2 participants

set-asides or extended rotation periods, whilst the other half favoured a focus on increasing growth through fertilization, the use of new tree species, or other measures.

4.2 What policy instruments are needed along the route to Paris?

Regarding the question of what policy instruments would be helpful or required to reach the Agreement goals, none of the workshop 1 participants stated negative views on any of the policy instrument types regardless of which responsibility distribution scenario was followed (see also Fig. 6). Six participants expressed positive views in relation to social and information-based instruments, whilst the other participants did not make any comment. Several participants stated that these kinds of instruments are credible and that they could

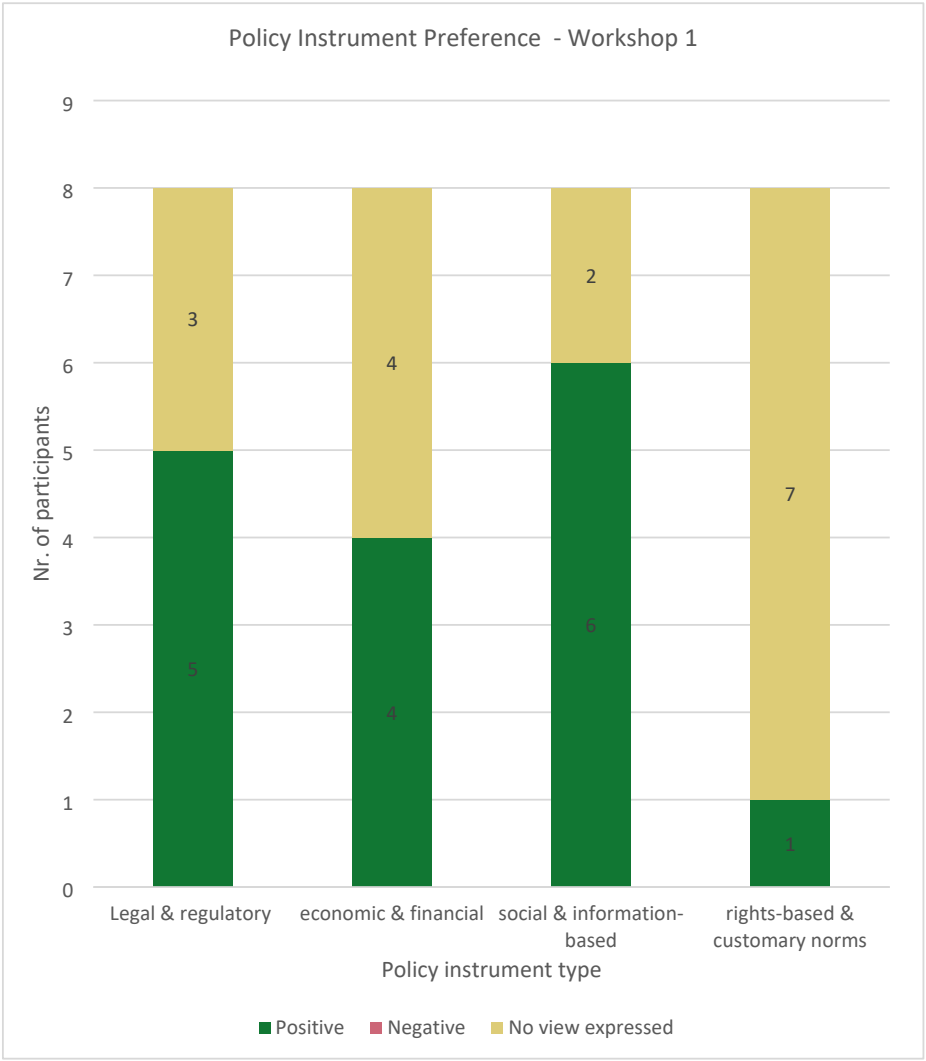

Fig. 6 Individual questionnaire reflection results on policy instruments workshop 1

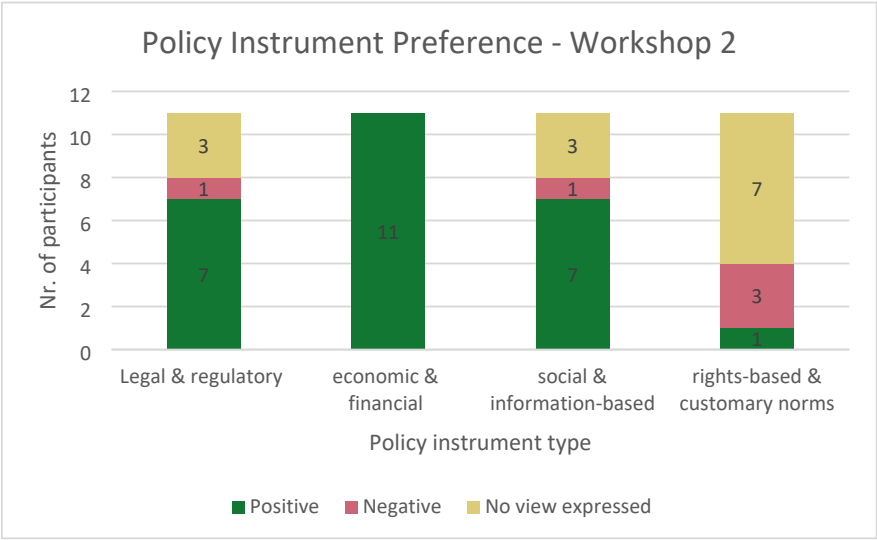

Fig. 7 Individual questionnaire reflection results on policy instruments workshop 2

help, for instance, to create clear shared models and increase the quality of nature conservation. Examples of specific instruments that were mentioned included certification, learning processes for new business models, dialogue processes, and carbon credit standards. Moreover, five workshop 1 participants expressed positive views in relation to legal and regulatory instruments, highlighting that these could ensure that landowners would take responsibility for climate mitigation. Specific instruments that were mentioned included long-term agreements linked to land, quality requirements legislation that supports measures for carbon sequestration, and a framework for a market for ecosystem services. Four participants had positive views of economic and financial instruments, perceiving these as an incentive for landowners to take responsibility. One example that was mentioned was a government grant as a complement to private financing. Also among the comments were positive views in relation to rights-based and customary norms instruments as a cornerstone of a sustainable society. However, as in the discussions around the responsibility scenarios, it was highlighted that a mix of the different instrument types would be needed.

The workshop 2 participants started the discussion on policy instruments by expressing the opinion that there are currently no policy instruments in place to guide forest owners in addressing climate goals and challenges. Participants did report having encountered more general instruments such as the Forestry Act, the Environmental Code, certification schemes, and advice and guidance. In relation to the question of which policy instruments the participants would prefer to guide them along the route to Paris, the questionnaire results showed that all workshop 2 participants had a positive view of economic and financial instruments (Fig. 7). These types of instruments were regarded as providing incentives to forest owners to manage their forests in a climate-smart way whilst simultaneously ensuring that the market would pay for the public goods that the forests provide.

This aligned clearly with participants' prioritization of economic goals in their forests. Examples of economic and financial instruments that were mentioned both in the question-

naire and in the discussion during workshop 2 included combinations of taxes and compensations, subsidies for fertilization and for the planting of the tree species lodgepole pine and larch, and carbon and bio credits. Instruments targeted at consumers, such as taxes on fossil-based products and services and leisure-intensive activities, were also mentioned. Legal and regulatory-based instruments and social and information-based instruments were regarded positively by seven participants and negatively by one participant, while three participants did not make any explicit comment. In relation to legal and regulatory instruments, positive views were expressed related to the importance of developing long-term policy and governance, whilst simultaneously maintaining Sweden's approach of "freedom with responsibility" and the ability to compel companies, society, and consumers to reduce their CO2 emissions. Specific examples of legal and regulatory-based instruments that were mentioned included rules around felling and a set percentage of productively used forests that would need to be older than 100 years. One of the participants pointed out that if there were to be rules and regulations on climate benefits, these would need to be clearer. Regarding social and information-based instruments, examples included dialogue processes, information campaigns and education on environmental goals, the benefits of forests, and their role in society, and certification schemes. One concern raised in relation to social and information-based instruments was that it is possible to "cheat" with these kinds of instruments since there is a lack of surveillance. Rights-based and customary norms instruments were least frequently mentioned by the participants, with seven participants not expressing any view, three participants expressing a negative view, and one participant expressing a positive view. The latter highlighted Agenda 2030 as an example, whilst the three participants who expressed a negative view all pointed to the Swedish Right of Public Access (*allemansrätten*) vis-à-vis the Rights of Landowners (*äganderätten*).

4.3 Which policy instruments are best suited to realize a preferred scenario?

In both workshops, participants discussed together, and described individually in the questionnaires, what policy instruments would be needed if a specific scenario was followed. The BAU scenario did not figure in these discussions in workshop 1, as the participants viewed this scenario as unrealistic. In workshop 2, only one participant commented on policy instruments for this scenario, highlighting the economic and financial instruments of taxes and compensations as desired options.

In relation to the Landowner scenario, participants from both workshops also focused on economic and financial instruments but wanted to combine these with legal and regulatory instruments and with social and information-based instruments. For example, participants in workshop 1 suggested support to landowners through contributions or tax reliefs backed by legislative changes and stimulating forest owners to cooperate and learn from each other. Economic and financial instruments could be used to create incentives for forest owners to cooperate across boundaries and contribute mutually to the environment. Several discussions during workshop 1 stressed the need for anchoring the hypothetical reform of responsibility in dialogue processes, while maintaining a humble and open-minded perspective. The question of customary law in relation to reindeer husbandry, but also in relation to ownership, was also raised. In workshop 2, rights-based instruments were not mentioned in relation to this scenario in either the discussion or questionnaire responses. Both economic and financial instruments and social and information-based instruments were mentioned as

a way to reward forest owners for their contributions and increase understanding and acceptance. Legal and regulatory instruments were also highlighted as potentially useful, on the condition that they were made clearer than those that exist today.

In relation to the State scenario, the workshop 1 participants again placed the most emphasis on economic and financial instruments, whilst workshop 2 participants found that a combination of all instrument types was most needed. Participants in workshop 1 highlighted several economic and financial instruments that could support the reform. These included applying new business models to state-owned forests, enabling the sale of surplus carbon credits on international and EU carbon markets, revising the ownership directive of the largest state-owned forest company to prioritize increased carbon sequestration, and providing compensation to the reindeer husbandry sector. Other instrument types that were briefly discussed in workshop 1 included social and information-based instruments in the form of connections and transparency with local communities, and rights-based and customary norms instruments in the form of ownership rights. The participants in workshop 2 gave examples such as dialogue processes, education around environmental goals, long-term regulations to guide forest owners to use their forests in specific ways, compensation for offsetting carbon, and reconsidering the right of public access versus landowners' interests.

Regarding the Market scenario, participants from both workshops focused on a combination of legal and regulatory, economic and financial, and social and information-based instruments. In terms of legal and regulatory instruments, workshop 1 participants suggested during the discussion that the state ought to provide clarity and predictability through legal frameworks. While some participants saw this as a guarantee for sustaining economic drivers, others saw it as a guarantee for safeguarding other forest interests. Workshop 2 participants saw laws and regulations in relation to this market scenario primarily as creating long-term clarity for forest owners and ensuring reduced CO2 emissions from society and consumers. Specific economic and financial instruments that were mentioned in both workshops included carbon and bio credits and various forms of financial support. The social and information-based instruments that were discussed in relation to this scenario differed between the two workshops. In workshop 1, participants discussed the role that contracts and certifications could play in this scenario. For example, one participant argued that a certification system could provide clear definitions of what investors value. In workshop 2, on the other hand, participants focused on aspects such as information campaigns to create awareness of the role of forests in society.

5 Discussion and conclusions

The aim of this paper was to enhance ongoing policy discussions on how Swedish forests can support climate mitigation goals by identifying which policy instruments, incentives, and climate strategies forest stakeholders prioritize, while advancing social science understandings of governance, stakeholder participation, and the socio-political conditions shaping forest management. Using Sweden as a case study, we distinguished several areas of contention: defining responsibility and power dynamics, the necessity of aligning policies across different sectors and administrative levels, and crafting suitable policy instruments to incentivize landowners to contribute to the goals outlined in the Agreement. Nonetheless, these findings may not directly translate to case studies outside the specific context of

our research in Sweden. Yet areas of debate between various stakeholders hold potential implications for pushing Sweden's climate transition forward and introducing new policy instruments that support forest- and climate-related objectives, which are also pertinent to the climate goals of the European Union.

Firstly, we demonstrate the prevalence of anticipated yet concerning disparities between various governance levels within the forestry sector and across different climate mitigation institutions. During the workshops, discussions centred on the forestry sector's role in mitigating climate change and the allocation of responsibilities among different categories of landowners and societal actors. In workshop 1, several participants advocated state leadership, such as through carbon credit pricing or taking the lead in testing new forestry practices, to mitigate potential financial risks for rural areas. Conversely, participants in workshop 2 did not express similar sentiments. Additionally, while BAU practices received scant attention in workshop 1, it became evident that many private landowners in workshop 2 still regarded BAU as a viable option for future forest management, despite its inadequacy in meeting the goals of the Agreement. As a result, we observed disparities among national representatives of organizations and companies versus local forest owners in their reasoning regarding the scenarios. One plausible explanation could be the homogeneous nature of the group of landowners in workshop 2, who were predominantly active forest owners residing near their forested properties (see also Danley, 2019). It is worth noting that many participants advocated for a blend of different scenarios and the development of a mix of instruments to support climate objectives.

Second, the workshop sessions highlighted tensions between international and national levels, primarily exemplified in the relationship between the EU and Sweden. At the international level, there is a tendency toward ambiguity regarding how goals should be achieved at the local level. Additionally, several forest owners objected to the idea that their land should be used to offset the effects of others' behavior. While acknowledging the necessity of climate action across Europe, many private forest owners questioned the notion of Nordic forests as a panacea for Europe's excessive fossil fuel consumption. Moreover, climate transition policies were perceived as too abstract and difficult to implement practically in forests – a sentiment less prevalent among participants in the more top-down oriented workshop 1. Drawing on these findings and concerns, we emphasize the importance of tailoring climate targets and actions to local forest conditions in order to contribute meaningfully to policy discussions and implementation (Mårald et al., 2017; Priebe et al., 2022). There is a clear need for policies that more effectively balance the global climate benefits of forests – such as carbon sequestration and bioenergy production – with the needs of local communities, including biodiversity, recreation, and livelihoods. Moreover, forest owners require stable, long-term incentives, as short-term policy frameworks often conflict with the long-term perspective necessary for achieving sustainability.

Third, based on the responses and inputs gathered during the workshop sessions, we contend that there is a need to address how forest and climate policies can be developed to be perceived as legitimate and equitable by various forest stakeholders and rightsholders. It is noteworthy that all three of the most common types of policy instruments – the stick, the carrot, and the sermon – were generally regarded positively by participants in both workshops. However, some expressed concerns about excessive regulation, while several forest owners, as previously mentioned, leaned toward voluntary commitments (see also Danley, 2019; Eriksson & Sandström, 2022). This tendency was somewhat anticipated, as a signifi-

cant portion of Swedish forest land is family owned (around 50%). Still, many participants identified a need for new economic and financial instruments (such as economic support for landowners or carbon credit markets) and social and information-based tools (like collaboration, dialogue, and certification schemes) supported by regulatory changes. It was also evident that there was a lack of guidance and trade-offs concerning rights-based instruments, making it challenging for both national and local participants to translate these into specific policy measures. What was particularly noteworthy about the workshop outcomes was the recognition of an absence of support or targeted instruments for climate mitigation in forestry. This could be attributed to a lack of integration between the climate policy framework, which heavily relies on financial mechanisms like the carbon tax, and the current forest policy, which primarily hinges on voluntary commitments and recommendations. The Swedish Government argues that current EU LULUCF commitments place an unfair burden on Sweden and maintains that active, high-growth forestry and using renewable materials offers the greatest long-term climate benefits (Ministry of Climate and Enterprise, 2024). Trade-offs between forest growth and management for substitution and conservation for carbon sinks, as well as the notion of a just transition, depend on democratic decision making. Policy makers must now reassess forest policy, develop climate-focused instruments, and support landowners in aligning with the Agreement.

Fourth, by reflecting on these issues, future research stands to gain from more systematic coordination across the various levels and scales of climate policy, recognizing intentions and agendas at the "top" while addressing action and implementation at the "bottom" (Priebe et al., 2022). To tackle this, along with the other challenges we have highlighted, we argue that research can benefit from employing participatory research methods and establishing living labs to collaboratively generate new knowledge and identify viable policy pathways to address current challenges in policy development and implementation (see also Arnould et al., 2022). Yet measures and policy instruments for climate action must tap into local knowledge and perspectives for sustainable management. Finally, understanding consumers' awareness of the various forestry actors and their roles in the transition to the Agreement is crucial to consider. Addressing such questions, we believe, is likely to bring us closer to the goals laid out in the Agreement.

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Data availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests One of the authors declare the following personal relationship, which may be considered as potential competing interests: Prof. Tomas Lundmark is the founder of *Silva Borealis konsulterna i Vindeln AB* who performs carbon balance calculations for forest owners, reviews forestry data and informs about climate-smart forestry. All other authors have no competing interests to declare that are relevant to the content of this article.

Compliance with ethical standards The research team obtained written/and or oral informed consent from each participant, which meant that that they were informed about (1) the research focus and aims of the *Route to Paris* project and the workshop, (2) storage of personal data (their name and e-mail address), (3) that participation in the workshop was entirely voluntary and that they could withdraw consent at any time, without stating a reason, and (4) how the research group would proceed with the results of the workshop and its role in the future work of the project.

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