iForest
Biogeosciences and Forestry

Commentaries and Perspectives
doi: 10.3832/ifor4457-016
vol. 16, pp. 325-333

Key information for forest policy decision-making - Does current reporting on forests and forestry reflect forest discourses?

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Forest discourses help identify forest-related issues. They aim to aid policy and decision-makers in understanding forest-related challenges and opportunities better so that they may initiate possible strategies and tactics to tackle them. Ideally, information requirements for the forest discourses would be translated into measurable variables, being the basis for collecting, analysing, and reporting data and information. Our study examined the connection between major international forest reporting processes and forest discourses. We analysed summaries and key findings for policy makers of five recent major forest reports. We compared their focus with forest discourses on climate change, forest conservation, deforestation, forest decline, illegal logging, industrial forestry/bioeconomy, traditional knowledge, woody biomass production, and innovative wood-based biofuels. The paper explores how the forest discourses are reflected in the surveyed documents and closely examines the specific focus areas in the summaries for policy makers. The results show that most forest discourses are generally well-represented, albeit with different foci. The discourse on illegal logging could not be identified in any investigated documents, even though it remains a significant concern for international forest policy. Keywords related to traditional knowledge and woody biomass production could not be found in two of the analysed findings. All analysed summaries and key findings mention issues related to the climate change discourse topic. However, they lack information on emissions from deforestation, carbon dioxide emissions and carbon budgets, which are high in political discussions. The paper highlights how discourse issues have gained in complexity both topic-wise and regarding the reporting obligations, as policy and decision-makers require more timely and comprehensive information about the status' and trends of forests.

Keywords: Forest Data, Forest Information, Forest Reporting, Forest Discourse, Forest Policy

Introduction

The contribution of forest ecosystems to human well-being and societal demands and needs are increasingly recognised. Awareness has been raised of their contribution to solving many of the current and future challenges currently experienced in our societies. It regards the loss of biodiversity, climate change impacts on forest ecosystems, and the supply of benefits from forests to society. Forests are the most critical terrestrial biological element to sustain life on Earth and are, as such, key to a sustainable future anchored in a circular bioeconomy (Giurca et al. 2022). Many ongoing policies have expressed the need for more detailed, up-to-date, and harmonised forest data and information for evidence-based policymaking to understand, quantify and qualify the contribution of forests to current and future challenges (Gluckman & Wilsdon 2016, Hetemäki 2019). The interest of society in forest information is also increasing mainly due to the above-mentioned rising concerns, also realising the high potential of forests to help mitigate human-caused climate change, host biodiversity, and provide society with a multitude of co-benefits. (Näyhä 2018, Anderegg et al. 2020, Hernández-Morcillo et al. 2022).

Forest discourses help identify forest-related issues. The forest discourses were elaborated by scientists some decades ago, based on literature reviews which are, according to Arts et al. (2000), interpretative approaches which identify forest-related issues over time. They may help policy makers, stakeholders, and decision-makers understand the forest-related challenges and opportunities better to initiate possible strategies and tactics to tackle them. What data and information would be required to update policy and decision-makers on issues raised by the discourses? Ideally, the information requirements for the forest discourses would be translated into measurable variables, being the basis for data and information collected, analysed, and reported.

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Received: Aug 24, 2023 - Accepted: Nov 08, 2023

Citation: Linser S, Lier M, Bastrup-Birk A (2023). Key information for forest policy decision-making - Does current reporting on forests and forestry reflect forest discourses? iForest 16: 325-333. – doi: 10.3832/ifor4457-016 [online 2023-11-15]

Communicated by: Marco Borghetti

Forest-related data and information have been collected periodically through national forest inventories, surveys, and monitoring systems to enable regular assessment and reporting on the status and trends of forest resources. First, the reporting serves national needs by supporting policies and forest management decisions. In addition, they also support regional (*e.g.*, EU policies) and international forest reporting obligations. Assessment of forest areas and the sustainable management of timber resources has occurred for more than three hundred years (Von Carlowitz 1713). Some European countries have assessed forests for over 100 years, like Finland, Norway, and Sweden (Breidenbach et al. 2021, Maltamo 2021) in their respective National Forest Inventories. Reporting on forests and forestry got a global angle in 1922 (FAO 1948). The Food and Agriculture Organization of the United Nations (FAO) has since 1948 produced the World Forest Resources Reports (GFRA) systematically at intervals of five to ten years (MacDicken 2015). Forest assessments have expanded to many world countries in the past five decades (McRoberts et al. 2012, FAO 2020, Forest Europe 2020). At the beginning of this millennium, the main forest reporting organisations FAO Forestry Division, the Central African Forests Commission, Forest Europe, the International Tropical Timber Organization, the Montréal Process and the United Nations Economic Commission for Europe have initiated a joint forest reporting mechanism, the Collaborative Forest Resources Questionnaire (CFRQ – FAO 2023). The CFRQ is the result of the joint commitment of these organisations to simplify and harmonise forest-related data collection while also reducing the reporting burden of some hundred participating countries with 88 per cent of the world's forest area. The main source of forest data and information is, for most countries, the national forest inventory (Chirici et al. 2012, Gschwantner et al. 2016) and other forest monitoring systems (*e.g.*, the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests, or monitoring systems based on Earth Observation, *e.g.*, Copernicus). After harmonisation and standardisation, the national data and information are also used for forest-related reporting obligations to different international and EU institutions and their forest-focused policies.

Our paper looks at the key findings or summaries for policy makers of the main recent forest reports to investigate whether the forest discourses of Arts et al. (2010) are reflected in the debate around the role of forests and forestry and what the focus of governing and managing the status of forests and the forest sector should be. Key findings or summaries of five recent renowned reports on forestry and sustainable forest management (EEA 2019, Eurostat 2019, FAO 2020, Forest Europe 2020, UNECE 2020) with a different regional focus (global, UNECE region, pan-Europe, EEA 38 and EU 28) are the basis of our analysis.

As we are interested in how discourse issues have gained in complexity both topic-wise and regarding the reporting obligations, as policy makers require more timely and comprehensive information about the status and trends of forests, we focus on the following three research questions: (i) Which issues of the forest discourses appear in the key findings or summaries of the various forest reports? (ii) What are the main issues of the key findings or summaries of the forest reports in relation to the discourse topics? (iii) For which issues of the discourse topics could the key findings or summaries for policy makers of the forest reports not provide any information and, *vice versa*, which issues of the key findings or summaries of the forest reports cannot be assigned to any discourse topic?

We identified which forest discourses were touched upon in the key findings or summaries of the forest reports. We investigated how the discourses were reflected in the key findings and summaries.

Material and methods

In our analyses, we applied a text analysis to compare the five leading international and intergovernmental key findings or summaries of forest reports with the forest discourses of Arts et al. (2010). Other forest discourses are described in the literature, *e.g.*, recently by Edwards et al. (2022). Here, we focus on the relevance of forest discourses of Arts et al. (2010) related to the reporting on forest state and trends at the global and European levels.

The concept of discourse entered forestry social science in the 1990s (Humphreys 1996, De Jong et al. 2017) to help understand forest policy and governance developments. Discourses change over time, reflecting evolving societal demands on forests and forest landscapes, the multiple uses and demands for forest ecosystem benefits, and how these changes influence forest governance and policies at various geographic and stakeholder levels (McGinley et al. 2023, Prins et al. 2023). Discourses impact forest management and protection (De Jong et al. 2017). The documents chosen for our analysis are the key findings or summaries for policy makers of the most recent forest reports of the FAO Global Forest Resources Assessment 2020 (FAO 2020), the State of Europe's Forests 2020 report (Forest Europe 2020), the United Nations Economic Commission for Europe (UNECE) Forest Resources Assessment 2020 (UNECE 2020), the European Environment State and Outlook 2020 of the European Environment Agency (EEA 2019) and Eurostat's Agriculture, Forestry and Fishery Statistics 2019 (Eurostat 2019) which were all published in close temporal proximity. The geographical scope of the studied documents varies. The FAO report has a global focus, the UNECE report includes 56 Member States in Europe, North America, and Asia, the Forest Europe report focuses on 45 pan-European countries, the EEA report addresses 38 European countries, and the Eurostat report refers to the EU Member States (28 at that time).

Based on the publication of Arts et al. (2010), Box 1 provides a pruned overview of nine discourses shaped by global forest issues at the time of their writing. They were, however, not the subject of a broader consensus process but a scientific paper finding. Arts et al. (2010) also describe a tenth forest discourse on "Sustainable Forest Management", which was, however, not considered in our analysis, as we assume that the nine discourses reported in Box 1 are sub-aspects of sustainable forest management.

The text analysis was done according to Bauer (2000) and in line with Flick's reliability and validity criteria for qualitative research (Flick 2010). We conducted quantitative and qualitative content analysis to examine the key findings and summary reports. We screened the texts for specific keywords and synonyms (available upon request) taken from the forest discourses of Arts et al. (2010). We used all terms of the forest discourses to query the five key findings or summaries of the different forest reports with an automatic text search (https://atlasti.com/) for a match. Each summary report's discourse-related thematic issues could be identified. At the same time, we could also determine those discourses-related thematic issues which were not addressed in the key information or summary report documents.

We did not conduct a statistical analysis to analyse the frequencies of keywords in the key findings and summary reports due to the varying length and level of detail of the reports. However, our results are based on a semantic analysis that allowed us to identify general and common keyword patterns. We then supplemented this with a qualitative content analysis to investigate the main issues behind the keywords under each discourse topic. Using this approach, we could evaluate whether a particular issue was addressed in the reports with confidence. We also did not intend nor did a critical discourse analysis. We used the discourses only as a tool to analyse the summary reports and key findings.

Results

Which discourses are served by the key findings and summary reports?

In all five investigated documents, we searched for keywords for issues assigned to the nine forest discourses (shortened titles – Tab. 1). Six of the nine forest discourses were well-identified. In contrast, three discourses were partly covered (one missing). Keywords related to "Illegal logging" could not be identified in any investigated documents. Keywords related to

"Traditional knowledge" could not be found in the Forest Europe summary for policy makers and the Eurostat key findings. Keywords related to "Woody biomass production" could not be found in the key findings of FAO and UNECE. The EEA key findings on forestry are the document which is serving most of the forest discourses (8 out of 9).

What are the main issues of the key findings and summary reports related to the discourse topics?

Most discourses are represented in the respective key summaries and findings, however, to different extents and, in some cases, only indirectly. For instance, our analysis shows (Tab. 2) that the closely interlinked discourse topics of "Forest Biodiversity" and "Conservation" are covered by all five key findings/summary reports, but there are variances. The Eurostat key findings only mention that forests are a significant source of biodiversity. The EEA key findings and the Forest Europe summary report focus on forest biodiversity topics, like deadwood, invasive species or introduced species, genetic diversity, undisturbed or virgin or primary forests, and common forest birds. The EEA key findings also mention biodiversity loss. All key findings or summary reports touch on "Conservation" and aspects related to protected forests.

Likewise, for the discourse topic "Forest decline", agents of human-induced or natural forest disturbances and damages are presented in all key findings and summary reports, *e.g.*, air pollution, deposition, diseases, storms, pests, insects, fungi, and fire. The EEA, Forest Europe and Eurostat key findings and summary reports highlight the significance of forests in climate change mitigation and adaptation in sequestering and storing carbon in forests. The EEA and Eurostat key findings present the cause-effect relationships of climate change and forest disturbances resulting in deteriorating forest condition and, therefore, in forest decline, loss of biodiversity and decreasing forest ecosystem productivity.

We identified issues related to the discourse topic "Industrial Forestry/Bioeconomy" in all investigated documents. They are generally associated with the socio-economic dimension of forests, *e.g.*, wood production, ecosystem services, employment, and income.

Concerning the discourse topic "Deforestation", we found three key findings (EEA 2019, FAO 2020, UNECE 2020) directly addressing deforestation. In the FAO and UNECE, key findings and underlying data are presented. The Forest Europe summary for policy makers and the Eurostat key findings do not touch on deforestation directly. However, the reports mention deforestation as related to land competition, land use change and conversion of forests. Likewise, in the EEA key findings, deforestation is related to its impacts on climate change mitigation and forest degradation, mainly in a global context.

On the other side, some discourses are

Box 1 - Summary of the forest discourses according to Arts et al. (2010).

1. The discourse on forests in the context of climate change focuses on economically efficient solutions for several problems: deforestation, forest degradation, livelihoods, and climate change. The discourse refers to biodiversity and livelihoods needing to be addressed to maximise carbon budgets and the incentives to change consumption patterns in developed countries to reduce carbon dioxide emissions.
2. The discourse on forest conservation focuses on the adequate protection of biodiversity and the related role of the broad public in decision-making processes, management responsibilities, and the wise use of natural resources in protected areas by residents.
3. The deforestation discourse focuses on the disappearance of tropical forests, particularly the loss of virgin, undisturbed, old-growth forests, and poverty reduction.
4. The biodiversity discourse addresses forest biodiversity, access to forest resources, technology, forest-related benefit-sharing, and tradable biological and genetic resources.
5. The discourse on forest decline refers to forest dieback and environmental issues such as acid rain affecting forest health.
6. The illegal logging discourse has a focus on international forest governance, forest law enforcement and governance (FLEG) in tropical countries to eliminate illegal timber from the domestic markets of importing countries and on the European Union's Forest Law Enforcement, Governance and Trade (FLEGT) action plan.
7. The discourse on industrial forestry or forest-related bioeconomy prioritises the contribution of forests and forestry to economic development and profit based on the sustainable production of wood products and maximising long-term economic return.
8. The discourse on forest-related traditional knowledge focuses on developing countries, indigenous people, and local communities living in forests, stressing the protection of intellectual property rights as well as biopiracy, bioprospecting, sustainable use, indigenous peoples as conservationists, the symbolic meaning of forests - such as forests as "cultured spaces" or "wilderness" that remains beyond human control.
9. The discourse on woody biomass production focuses on innovative wood-based biofuels, climate change mitigation and renewable energy.

Tab. 1 - Overview of the key findings and summaries from recent reports on forests.

Discourse topic	FAO (2020) Key Findings Scope: Global	UNECE (2020) Key Findings Scope: 56 countries	Forest Europe (2020) Summary for Policy Makers Scope: 45 countries	EEA (2019) Key Findings on Forestry Scope: 38 countries	Eurostat (2019) Key Findings on Forestry Scope: EU 28 countries
Climate change	x	x	x	x	x
Conservation	x	x	x	x	x
Deforestation	x	x	x	x	x
Forest biodiversity	x	x	x	x	x
Forest decline	x	x	x	x	x
Illegal logging	-	-	-	-	-
Industrial Forestry/ Bioeconomy	x	x	x	x	x
Traditional knowledge	x	x	-	x	-
Woody biomass production	-	-	x	x	x

Tab. 2 - Keywords identified in the key findings or summary for policy makers. The key findings and summary for policy makers are organised into thematic topics. (*): keywords appearing in all five documents. If a keyword was not identified in the summary, we reviewed the report to see if the issue was discussed.

Thematic topic of the discourses in alphabetical order	FAO (2020) Key Findings Scope: Global	UNECE (2020) Key Findings Scope: 56 countries	Forest Europe (2020) Summary for Policy Makers Scope: 45 countries	EEA (2019) Key Findings on Forestry Scope: 38 countries	Eurostat (2019) Key Findings on Forestry Scope: EU 28 countries
Climate change	carbon stock, carbon pool, litter, soil carbon	carbon stock, carbon pool, litter, soil carbon	adaptation, carbon stock, carbon sink, climate change, greenhouse gas, sequestration	adaptation/mitigation, air pollution, carbon sequestration, carbon sources, carbon storage, climate change, soil organic matter	carbon stock, climate change
Conservation	conservation, designated, protected forests	conservation, designated, protected forests	conservation, forest available for wood supply, landscape, conservation, protected areas, protected forests, protective areas, protective functions	forest not available for wood supply, Natura 2000, protected forests	forest protection
Deforestation	conversion, deforestation, forest area change, forest loss	conversion, deforestation, forest area change, forest loss	land competition	deforestation	conversion, land-use change
Forest biodiversity	biodiversity*, dead wood, introduced species, native species, natural regeneration, planted forests, plantation primary, forests	biodiversity*, deadwood, introduced species, native species, natural regeneration, plantation, primary forests	biodiversity*, deadwood, forest bird species, genetic diversity, introduced tree species, invasive species, natural expansion, natural regeneration, plantations, semi-natural tree species, composition undisturbed by man	biodiversity*, birds, deadwood, genetic diversity, invasive species, primary forests, undisturbed by man, virgin forests	afforestation, biodiversity*, invasive species, planting
Forest decline	disease, disturbance, forest fire*, insects	disease, disturbance, forest fire*, insects	air pollution, damages, defoliation, disturbances, drought, forest fire*, insects, nitrogen deposition, soil degradation, wind	air pollution, damages, deposition, diseases, disturbance, forest fire*, fungi pests, storm	drought, forest fires, storm
Illegal logging	predefined keywords could not be identified in the key findings, but the main report addresses the following issues: illegal activities, forest law	predefined keywords could not be identified either in the key findings or the main report	predefined keywords could not be identified in the summary for policy makers, but the main report addresses the following issues: illegal logging, forest law enforcement, governance and trade	predefined keywords could not be identified either in the key findings or the main report	predefined keywords could not be identified in the key findings or the main report
Industrial forestry/ Bioeconomy	ecosystem services*, growing stock, production, wood products*, multi-use forest	ecosystem services*, growing stock, production, wood products*, multi-use forest	accidents, employment, ecosystem services*, forest sector, forest ownership, GDP, growing stock, investments, net revenue, roundwood, wood products*	bioeconomy, ecosystem services*, employment, forest-based sector, forest ownership, GDP growing stock, income, multiple-use, novel products, roundwood, wood products*	employment, environmental services*, forest sector, GVA, harvesting/logging, SMEs, wood products*
Traditional knowledge	cultural sites, spiritual sites	cultural sites, spiritual sites	predefined keywords could not be identified in the summary for policy makers, but the main report addresses the following: cultural heritage, cultural purposes, cultural services, cultural ties, spiritual functions	cultural heritage, cultural services	predefined keywords could not be identified in the key findings or the main report
Wood fuel/ Innovative wood-based biofuels	predefined keywords could not be identified in the key findings, but the main report addresses the following: energy wood fuel	predefined keywords could not be identified either in the key findings or in the main report	energy renewables	energy fuel, wood renewable	wood fuel, fuel wood renewables

not well or indirectly addressed. For instance, "Traditional Knowledge" related issues focus on cultural and spiritual sites in the FAO and UNECE key findings and the role of cultural services and cultural heritage for providing forest ecosystem services in the EEA key findings. "Woody biomass production" in the context of wood energy and renewables is mentioned by the EEA and Eurostat key findings and in the Forest Europe summary report. "Illegal Logging" was not addressed in any of the investigated documents but was addressed in the main reports of FAO and Forest Europe.

The discourse topic "Climate Change" is an example of a discourse that, although included in all findings, is presented in the summary reports from different angles and in some findings only indirectly. Two key findings (FAO 2020, UNECE 2020) do not show the issue but mention keywords related to the topic, *e.g.*, forest carbon stock pools for living biomass, deadwood, litter, and soil organic matter. The significance of forests in climate change mitigation and adaptation in sequestering and storing carbon in forests is highlighted in three key findings/summary reports (EEA 2019, Eurostat 2019, Forest Europe 2020). Cause-effect relationships between climate change and forest disturbances resulting in deteriorating forest condition and, therefore, in forest decline, loss of biodiversity and decreasing forest ecosystem productivity are presented in two key findings (EEA 2019, Eurostat 2019).

Which issues of the discourse topics could the forest summary reports not provide any information and, vice versa, which issues of the summary reports cannot be assigned to a discourse topic?

Our analysis revealed which issues in the discourse topics, the key findings and summary for policy makers could not provide information, and vice versa discovered subjects not covered by the discourses (see Tab. S1 in Supplementary material for the outcomes of this analysis).

Although all studied key findings and summaries mention issues related to the "Climate Change" discourse topic, none provides information on emissions from deforestation, carbon dioxide emissions and carbon budgets, which are high in the political discussion (Köhl et al. 2021). The following issues are mentioned in the five investigated documents but not in the "Climate Change" discourse even though they are closely interlinked: forest carbon stock pools for living biomass, deadwood, litter and soil organic matter, and the role of forest in climate change mitigation and adaptation in sequestering and storing carbon in forest and in harvested wood products.

Concerning the discourse topic "Conservation", the five key findings and summary reports do not provide information on means of forest protection (*e.g.*, fences), public participation in decision-making processes when deciding on forest protection areas, and possible restrictions to human access. However, four key findings and summary reports (EEA 2019, FAO 2020, Forest Europe 2020, UNECE 2020) provide information on different protection classes in protected forest areas, an important issue (Leberger et al. 2019) not touched on in the "Conservation" discourse.

Concerning the discourse topic "Deforestation", the causes and drivers of tropical deforestation and the relation between deforestation and poverty reduction are not mentioned in the five analysed documents. The "Deforestation" discourse highlights that deforestation also occurs in northern temperate and boreal forests, but none of the key findings or summary reports provide such information. However, the changes in forest area, like net decrease and net gain, which are closely interlinked to the "Deforestation" discourse, are mentioned in three key findings (EEA 2019, FAO 2020, UNECE 2020).

Concerning the keywords of the "Forest Biodiversity" discourse, none of the analysed documents provides information on tradable biological and genetic resources, nevertheless an important aspect of forest biodiversity maintenance. However, the key findings and summary reports contain multiple other forest biodiversity relevant information on the following issues which are not mentioned in the "Forest Biodiversity" discourse instance, deadwood, native species, introduced species, invasive species, primary forests, forests undisturbed by man, planted forests, natural regeneration and common forest birds which are identified as key parameters for forest biodiversity in recent literature (Oettel & Lapin 2020, Pötzelsberger et al. 2021, Harrison et al. 2022, Muys et al. 2022).

Concerning the keywords of the "Forest Decline" discourse, none of the five investigated documents provide information on acid-rain deposition or on forest death, which in 2020 did not get much attention on the political agenda compared to decades ago (Krause et al. 1986, Bussotti & Ferretti 1998) and in the latest years (Forzieri et al. 2022, George et al. 2022). However, the key findings and summary reports provide various information on drivers of forest disturbance and damage leading to loss of vitality, forest decline or forest degradation (for instance, air pollution, deposition, diseases, storms, pests, insects, invasive species, fungi, and fires). They also refer to the cause-effect relationships of climate change and forest disturbances, resulting in deteriorating forest conditions, biodiversity loss, and decreasing productivity, all drivers of forest decline.

None of the five key information and summary reports provides information on fast-growing tree species, timber concessions and biotechnology, all issues of the discourse topic "Industrial Forestry/Bioeconomy". Also, the issue of innovation in the forest sector is mentioned only by the EEA's key findings (EEA 2019). Issues like GDP, wood industry, and increment and felling are mentioned in the key findings and summary reports of the EEA (2019), Forest Europe (2020) and Eurostat (2019). Issues not covered by the "Industrial Forestry/Forest-related Bioeconomy" discourse but mentioned by several key findings and summary reports are forests available for wood supply, workforce, occupational safety and health, wood consumption, trade in wood, non-wood forest products and ecosystem benefits.

On the issues of the discourse topic "Traditional Knowledge", none of the five key findings and summary reports provide knowledge on indigenous people and local communities living in forests or on traditional knowledge itself. However, the role issue of cultural services and cultural heritage in the provision of forest ecosystem benefits is mentioned in the EEA key findings (EEA 2019). Even if rooted in the past, traditional knowledge is critical to the future subsistence and well-being of rural communities and developed societies to maintain their livelihoods and the integrity of the forest ecosystems on which they depend (Parotta & Agnoletti 2007).

Concerning the discourse topic "Woody Biomass Production", two key findings (FAO 2020, UNECE 2020) do not mention any discourse issues like biofuel, wood fuel or energy. In three key findings and summary reports, innovative wood-based biofuels are not covered (EEA 2019, Eurostat 2019, Forest Europe 2020).

Discussion

Our study examined the connection between five major international and intergovernmental forest reporting processes and forest discourses, as outlined by Arts et al. (2010). Even after more than a decade, we find these forest discourses to be the most comprehensive in covering various aspects of forests (Edwards et al. 2022) and framing analyses of recent forest-related information. The key findings and summaries studied provided national or regionally aggregated information on forests, forest resources and their status and developments, and related issues, although varying in detail and report length. We identified keywords related to forest discourses in all the documents examined. However, only some reports reflected on forests' transdisciplinary and multifunctional aspects, as do the discourses.

Our analysis aimed to determine if the key findings and summaries reflect the forest discourses, well-knowing that they have different objectives, such as Eurostat's key findings focusing on forest socioeconomics and EEA's on forests and environment, reflecting various sources and scales (national, regional, or global) to achieve different objectives.

The focus of the discourse on "Climate Change" has gained in complexity topic-wise and regarding the reporting obliga-

tions. The "Climate Change" discourse is strongly and usually negatively linked to all other forest discourses, particularly the "Forest Decline" and "Forest Biodiversity" discourses. However, none of the analysed key findings and summary reports highlight such relationships. Nevertheless, the relationship between the total greenhouse gas emissions and the net carbon sink of forest and harvested wood products is essential for compliance with the Intergovernmental Panel on Climate Change (IPCC 2022). The EU Land Use, Land Use Change and Forestry (LULUCF) Regulation (EC 2018) are highlighted in all summary reports and key findings. Recently, forest reporting and assessments covered both natural and human-induced disturbances and how forests and forestry can adapt and mitigate the impacts of climate change.

"Deforestation" is reported and discussed in the key findings and summaries referring to the deforestation of tropical forests or indirectly mentioning deforestation in other regions such as the pan-European region through forest land use loss or net forest loss, *e.g.*, to agricultural or urban land use. This discourse is topical because deforestation has been regulated since May 2023 by the EU Deforestation and Degradation Regulation (EC 2023a), which focuses on commodities and products associated with deforestation and forest degradation and affects how forest resources are managed and used worldwide. The new Regulation acknowledges the complex factors that drive deforestation and degradation, which can originate inside and outside the forest.

Topics of the "Forest Biodiversity" discourse are covered in all key findings and summaries, referring to many indicators related to forest biodiversity. Recently, a growing focus has been on maintaining and improving biodiversity, reflected in various recent EU policy instruments (EC 2019, 2020, 2023a, 2023b, 2023c, 2023d), due to the irreversible global forest biodiversity loss caused by human activities and climate change. However, the available data and information should but can not provide a complete overview of the state and trends of forest biodiversity (Lier et al. 2021, 2022, Muys et al. 2022). There needs to be a better understanding of the links between biodiversity and climate change and the trade-offs and synergies between biodiversity, carbon stocks and carbon sinks.

The concept of "Conservation" is prominently featured in the reports and summaries discussing protected forest areas and is closely tied to "Forest Biodiversity". The Global Biodiversity Framework follows the EU Green Deal (EC 2019) and its policies for biodiversity and restoration, which call for the protection of 30% of the land area, an increase in the number of forests, and improving their health and resilience by 2030. The importance of "Conservation" has grown globally and in Europe due to new environmental policies that increasingly include forests in their goals, such as some of the 23 targets for 2030 of the Kunming-Montreal Global Biodiversity Framework (CBD 2022).

The findings and summaries also touch on the "Forest Decline" topic, but the focus is on forest disturbances and damages rather than on forest decline itself. The causes of forest disturbance and damage were presented. However, forest death caused by air pollution and acid rain has faded as an issue of the political agenda in the last two decades, although acidification and eutrophication still affect the condition of forest ecosystems in Europe (Michel et al. 2022). More recently, forest ecosystems have been threatened by biodiversity loss and climate change impacts, including droughts, insect outbreaks, pests, fires, and storms (Forest Europe 2020, FAO 2020, UNECE 2020). Other monitoring systems collect forest disturbance and damage-related data (JRC 2020), but the challenge is ensuring the information is timely and valuable for political decision-making. Forest decline is increasingly related to forest degradation, a term used in global and EU reporting on deforestation and the degradation of free value chains (EC 2023a). However, there is no global agreement on the definition of forest degradation, leading to different methods of measuring and assessing associated variables, highlighting the importance of harmonised and evidence-based information as a basis for decision-making. Forest restoration is another topic related to forest decline and forest biodiversity, requiring additional forest data and information (EC 2022).

All key findings and summaries mention issues of the discourse on "Industrial Forestry and Bioeconomy" with a focus on the socio-economic aspects of the forest sector, including wood supply, workforce, occupational safety and health, wood production, trade, increment and felling, and non-wood forest products. Recently, there has been a shift towards recognising forests' various benefits and uses beyond just wood production (Grönlund 2020). If paid for, forest ecosystem services could contribute more to rural development and society's welfare than they currently do (Muys 2020, Winkel et al. 2022). Sustainable use of forest resources can also help substitute fossil-based resources with wood alternatives, contributing to the bioeconomy (Palahí et al. 2021).

The key findings of FAO, UNECE, and EEA have identified concerns regarding "Traditional Knowledge". Specifically, there are issues related to using cultural and spiritual sites and cultural heritage for providing forest ecosystem services. This collective knowledge, firmly rooted in the past, is critical to the survival and future well-being of local communities, particularly indigenous peoples, who seek to maintain their distinctive cultural identity and livelihoods and the integrity and health of the forest ecosystems on which they depend. In many developed societies, the conservation of traditional knowledge and the landscapes where it is applied supports the economic development of rural areas, tourism, the promotion of local products, the conservation of biodiversity which was generated through human impact on the landscape, and the quality of life of local people (Parotta & Agnoletti 2007).

The discussion surrounding using "Woody Biomass for Energy Production" is only briefly mentioned in three key findings and summaries. Nonetheless, the issue is critical as there is an urgent need to secure energy provision due to ongoing global conflicts (Prins 2022). The potential of wood biomass and innovative wood-based products as renewable energy sources is gaining substantial interest (Paravantis & Kontoulis 2020). However, this discourse is closely linked to the discourses on "Industrial Forestry/Bioeconomy" and "Climate Change" related to mitigation. The "Woody Biomass for Energy Production " discourse is an example of how the respective individual discourses are closely interlinked and are difficult to separate in assessing the state of forests at the global and regional levels. On the other hand, trade-offs are appearing regarding the links to the discourses on "Biodiversity", "Conservation" and "Climate Change" related to adaptation, all highlighting the need to maintain diverse and carbon-rich forest ecosystems, including wetlands and peatlands (EC 2022).

While no specific keywords related to "Illegal Logging" were mentioned in the summaries or key findings, the issue was addressed in the main text of several forest reports, which may indicate a need for more available information on the topic. Nevertheless, illegal logging remains a significant concern (UNEP/UNICRI 2018, World Bank 2019, Iordachescu & Vasile 2023). The recently adopted European Union deforestation and degradation regulation (EC 2023a) may positively impact reducing the incentives for illegal logging in Europe and globally.

Conclusions

The policymaking needs for action have evolved in the past decades from forest decline issues in the 1990s to climate change, forest biodiversity loss, deforestation in the 2000s, and bioeconomy in 2010. Recently, with the European Green Deal in 2019, forests have become, for the first time, a high priority in the European Union policy agenda despite the absence of a dedicated forest policy in the European Union. Several EU flagship strategies and regulations have picked up almost all forest discourse topics, recognising the multiple benefits and solutions that forests and forestry can provide to the environment, economy, and social well-being and mentioning the transversal aspects of forests and forestry. Awareness of the possible contribution and role of forests as natural

resources, carbon sinks, and biodiversity pools, delivering manifold benefits to society and human well-being, has significantly increased (Bastrup-Birk 2021, Linser 2021).

A complete understanding of the issues related to forests and forestry requires a systemic and integrated assessment that interconnects the discourses rather than analysing them individually. Meeting the current and increasing demands for evidence-based forest policymaking that can have a targeted impact relies on regular, comparable, temporally, and spatially representative information from National Forest Inventories. Other monitoring systems are presently based on national and pan-European indicators that monitor the state and trends of sustainable management (Forest Europe 2020, Linser & Wolfslehner 2022).

Connecting forest information to international forest-related reporting requests, *e.g.*, European Union Regulations or Directives and the Global Core Set of forest-related indicators (FAO/CPF 2022a, FAO/CPF 2022b, FAO 2023, UNFF 2018), is crucial for informed policymaking.

Future forest summary reports or key findings for policy and decision-makers should embrace and reflect the topics of forest discourses. This is vital to quantify how and to what extent forests and forestry contribute to mitigating climate change impacts, securing renewable resources, protecting biodiversity, and promoting rural development and bioeconomy, identifying potential trade-offs and synergies between the different contributions from forests and across other sectors. Furthermore, policy makers require more timely and comprehensive information about the status and trends of forests. Thus, future forest reporting needs to rely on regular and frequent forest monitoring cycles and real-time data collection to react to urgent issues such as calamities, storms or forest fires (Talarczyk 2021) and to support evidence-based policy discussions regarding climate change, biodiversity crisis, socio-economic impacts of the forest-based sector and countermeasures. The crucial question of how much policy and decision-makers rely on the available data warrants dedicated exploration in a separate survey, as it holds the key to bridging the gap between scientific findings and meaningful policy implementation.

Acknowledgements

We want to thank K. Prins, M. Koehl, A. Talarczyk, and the colleagues of the Forest Policy Research Network at the University of Natural Resources and Life Sciences in Vienna for their constructive suggestions in developing this manuscript.

Annemarie Bastrup-Birk (ABB), Markus Lier (ML) and Stefanie Linser (SL) conceived the study together. ML and SL analysed the data. The manuscript was drafted, reviewed, and edited by SL, ABB, and ML.

Conflicts of 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. This research received no external funding or specific grants from public, commercial, or not-for-profit funding agencies.

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Supplementary Material

Tab. S1 - List of main issues regarding the forest discourse topics in alphabetical order.

Link: Linser_4457@suppl001.pdf