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IMPACT ASSESSMENT REPORT

Accompanying the proposal for a

Regulation of the European Parliament and of the Council

on a monitoring framework for resilient European forests

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Glossary

ALS	Air-borne Laser Scanning
BDS	Biodiversity Strategy
EFFIS	European Forest Fire Information System
ENFIN	European National Forest Inventory Network
EO	Earth-Observation
EUFS	European Forest Strategy
FAO	Food and Agriculture Organisation
FAO-Global FRA	FAO's Global Forest Resource Assessment
FISE	Forest Information System for Europe
ICP Forests	International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests
IPCC	Intergovernmental Panel on Climate Change
LIDAR	Laser-imaging, Detection and Ranging
LUCAS	Land Use and Land Use Survey
LULUCF	Land-Use, Land-Use Change and Forestry
NFI	National Forest Inventory
NRL	Nature Restoration Law
OPC	Open Public Consultation
RED	Renewable Energy Directive

SoEF	State of Europe's Forests
SHL	Soil Health Law
UN CBD	United Nation Convention on Biological Diversity
UN FCCC	United Nations Framework Convention on Climate Change

1 INTRODUCTION

Forests and other wooded land cover close to half of the EU's land surface and play a key role in mitigating and adapting to climate change, preserving and restoring biodiversity and ensuring the supply of woody and non-woody biomass to enable the transition towards a sustainable and circular bioeconomy . Forested land is, by far, the main contributor to the EU carbon sink and will play an essential role in meeting the EU's ambitious objective of climate neutrality by 2050. At the same time, forests also provide the raw material (wood and non-wood such as food and medical plants) for growing bioeconomy value chains substituting fossil-based or otherwise harmful products. The extended forest-based value chains currently support 4.5 million jobs in the EU[1].

Forests provide crucial ecosystem services (such as carbon sequestration, oxygen release and air filtering, water regulation and purification, flood and erosion control, habitats for numerous species, urban cooling and opportunities for recreation). The importance of forest multifunctionality is set to increase in the future, with higher demands to serve as provider of raw material for the bio-based industries in support of a sustainable and circular bioeconomy, as stronger and more resilient sustainable carbon sink as agreed by the EU in the Climate law, as biodiversity hotspot and as recreational space.

But Europe's forests are increasingly stressed by climate change and direct or indirect human use, activity and related land use changes. These pressures pose a threat to the capacity of forests to deliver on their different environmental and socio-economic functions.

In order to address these threats and ensure that forests are able to fulfil the wide variety of demands, it is crucial to have high quality and comparable data on EU forests, making the best use of the twin digital transition and remote sensing capabilities, as well as long-term integrated planning at the level of Member States for the use of their forests, which depends heavily on the availability of data on forests.

However, currently, monitoring and planning tools in the EU are not fit for purpose to ensure evidence-based sector-specific policy-decisions and measures that consider the bigger picture of forest multifunctionality in a changing climate with increasing risks and uncertainties. Certain data on forest have been collected so far through scattered approaches and tools. The fast developments in monitoring tools and technologies, in particular in earth observation (EO) through satellite or aerial means (including drones), provide a unique opportunity to modernise, digitalise and harmonise the monitoring of forests, as a service to all, forest users and authorities notably to effectively tackle tangible risks to forests, while stimulating the EU market growth on those technologies and related new skills, including for SMEs.

As figure 27 in Annex 5 illustrates, there are several EU policy instruments that directly or indirectly affect forests in the fields of environment and biodiversity, climate, energy and the bioeconomy. The successful implementation and evaluation of these policies and the development of sustainable business models depend on or significantly benefit from high quality forest monitoring. A coherent information infrastructure can support evidence-based policy and decision making by land managers and public authorities, research and innovation. Moreover, a forest information system consisting of strengthened ground-based observations complemented by data from EO allows tracking progress towards policy objectives, compliance monitoring and law enforcement.

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[1] Robert et al. 2020

The need for enhancing forest monitoring has since several years been repeatedly and clearly mentioned by the EU institutions[2]. The New EU Forest Strategy for 2030, consequently, announced a dedicated legislative proposal on EU Forest Observation, Reporting and Data Collection which should also include Strategic Plans for Forests and the forest-based sector prepared by the competent national authorities.

2 PROBLEM DEFINITION

Europe's forests need to be in a good, healthy condition in order to continue, or increase, the delivery of crucial ecosystem services. This is reflected in important pieces of EU legislation and policy, which recognize the multi-functionality of forests in the EU[3]. A comprehensive, high-quality EU-level monitoring system is needed to understand and show how well these objectives are achieved and where gaps remain.

Such a monitoring system does not currently exist in the EU. Instead, current forest monitoring in the EU consists of national systems that measure different forest parameters and indicators in different ways (Annex 5.2 informs in details about today's forest monitoring systems in the Member States).

With a few notable exceptions such as the Copernicus-driven European Forest Fire Information Service (EFFIS) and the Forest High Resolution Layer of the Copernicus Land Monitoring Service, and harmonisation efforts on a few core variables related to forest resources, the available data are not directly comparable. As described in Section 2.1.1, available data on forests are often outdated or have important gaps, hampering effective response by land managers and policy makers. Overall, information about the status of forests in the EU, their social, ecological and economic value, the pressures they face and ecosystem services they provide, is fragmented and patchy, largely heterogeneous, inconsistent, with data gaps and overlaps, and data is provided with significant delay and often only on a voluntary basis. In other words, the EU lacks a common system to collect long-term, consistent, and comparable forest data.

Insufficient information on the condition and evolution of forests and in particular forest disturbances dynamics impede the continuous provisioning of socio-economic functions and ecosystem services to society, including their climate change mitigation potential. The lack of timely and accurate information in combination with the absence of long-term planning integrating the impacts of climate change hinders the development of adaptive management strategies to increases forest resilience, disaster preparedness and response. This problem does not only affect EU-level decision-makers, with the risk of misinformed or failing EU policies in the climate, environmental, social and economic domains, but also forest planners and managers in many Member States, and players in the private, financial and insurance sectors, who risk taking poor decisions (e.g. on logging or on species to plant) based on incomplete information. This is likely to affect not only the distribution, shape and composition of future forests but also the associated industries and employed workforce.

These problems would already be significant under current conditions. However, the onset of climate change has made comprehensive forest monitoring more urgent and demanding. Dramatic disasters and growing levels of stress-induced loss of forest health show how climate change has started to transform today's forests. Shifts in forest disturbance regimes are compromising all forest functions and causing significant costs. For instance, the European heatwave and drought event in 2003 resulted

2 For instance COM(2013)659 final, Council Conclusions 12695/1/20, European Parliament Resolution 2019/2157(INI), COM/2021/572 final.

3 For instance COM(2021) 572, Regulation (EU) 2018/1999.

in a strong net release of CO_2, reversing the effects of four years of net carbon sequestration, and reduced forests' gross primary productivity by 30%[4]. The drought starting in 2018 caused a forest canopy loss of around 5% and financial losses forests damage of about EUR 18 billion in Germany alone[5]. As climate change progresses, scientists expect further increases in tree mortality, and they estimate more than 60% of the biomass in European forests to be exposed to climate risks[6]. In the light of increased forest disturbances, biodiversity loss and growing demand from the society on forest functions – including biomass[7] and non–timber related resources, the lack of a consistent and comprehensive forest monitoring framework, together with the current absence of harmonised planning instruments that include a long-term perspective and consistently address forest multifunctionality via an integrated approach, hampers the assessment of policy coherence and appropriate policy making.

This situation also makes the prevention and response to illegal logging and biodiversity loss difficult. There are several open infringement procedures against Member States[8] for logging activities in breach of EU legislation, in particular EU nature protection legislation, and the collection of data and evidence, though essential and decisive, has proven challenging and costly.

In conclusion, the absence of complete, harmonised, comparable, and timely data hampers cost-efficient implementation of EU and national/regional policies and targets and increases the risk of drawing wrong conclusions, which could lead to poor decision making from local to EU scale. An increasing number of objectives and targets for urgently needed actions on forest resilience and protection of their essential functions for climate, biodiversity and the bioeconomy will make the lack of knowledge even more apparent.

2.1 What are the problems

This impact assessment addresses two specific but interrelated problems:

- lack of data comparability and quality
- lack of integrated long-term forest planning,

which underpin the general problem of not having adequate and timely information on forests to make effective policy and ensure that forests contribute to multiple EU policy objectives.

2.1.1 Lack of data comparability and quality

Forest data and information gathered in the EU varies significantly and is not comparable between Member States. The spatially incomplete and temporarily inconsistent information[9] limits policy and decision making at all levels, making it very difficult to base decisions on evidence and face the growing pressures on forests.

As an illustration, Maes et al (2020) specified current key data gaps in the areas of forest pressures (e.g. drought, storm damage, over-harvesting) and forest conditions (e.g. defoliation, data on other forest species or structural diversity of forest stands). Avitabile *et al.* (2023) highlight that information on forest resources such as forest biomass, annual increment or fellings in the EU are

[4] Ciais. et al. 2005
[5] Thonfeld et al. 2022
[6] Allen et al. 2015; Forzieri et al. 2021 ; Lloret and Batllori 2021
[7] Ceccherini et al. 2020
[8] Notably against Poland, Romania, Slovakia and Estonia.
[9] Diabolo project 2016; Gschwantner et al. 2022; Linser and Wolfslehner 2022

currently patchy, imprecise, and updated too slowly. They are derived by a range of methodologies for parameters with different definitions across Member States. The Science for policy report by the abovementioned collective on *Biomass production, supply, uses and flows in the European Union* provides a comprehensive discussion of the needs for harmonisation of forest data and the inherent uncertainty of the harmonised estimates, e.g., due to the incomplete time series, low temporal frequency and lack of common reporting.

To exemplify the problem with lack of reliable data on a key variable with policy relevance, there were some 98 million cubic metres of fuelwood with a source that was 'missing' from reported data in EU-28 in 2013 – something likely attributable to under-reported felling and wood removal[10]. A more recent report found that, despite the abundance of available datasets, there are still large data gaps on the sources and uses of woody biomass for energy, and that most datasets are incomplete or provide insufficient detail[11].

A generally perceived need for comparable forest information at EU level and for more harmonized information collection methodologies has been highlighted by the Standing Forestry Committee already in 2012[12].

The replies to the open public consultation (OPC), further elaborated in Annex 2, reveal that 84% of the respondents consider consistent and comparable forest information across borders as an important or very important improvement of forest monitoring in the EU with no significant differences between stakeholder groups. They highlighted the need for harmonized and timely information on a number of variables, particularly on forest health, disturbances, and climate change impacts and projections (more than 88% of respondents). Likewise, responses to the call for evidence showed high support for consistent and comparable definitions, indicators, and measures of forest status across all Member States. At a Member State and stakeholders workshop hosted by the Czech Council Presidency (second semester 2022), participants stressed the importance of harmonised or standardised information on the state and development of EU forests (Annex 2). Standardisation of core parts of forest inventories between Member States was also mentioned as a possibility in the long-term perspective as one of the conclusions of a subsequent workshop with Member States and stakeholders organised by the Swedish Council Presidency[13].

Most national forest inventories (NFIs) are geared towards planning wood resources management with a focus only on economic, production-related variables such as volume of growing stock[14]. The current monitoring systems therefore tend to provide insufficient and patchy data on indicators related to biodiversity, forest health and resilience, and non-wood resources, which are priority areas identified in the New EU Forest Strategy for 2030. This is important also because the sustainability and long-term provision of wood resources fully depends on forest biodiversity, health and resilience.

The lack of comparability of the status and trends of forest ecosystems in the EU makes it difficult to track progress towards EU policy objectives and goals. A special report of the European Court of Auditors concluded in 2021 that the current monitoring system for the impacts of Common

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[10] Avitabile & Camia *et al.* 2018

[11] Camia et al. 2021

[12] Standing Forestry Committee 2012

[13] Swedish Presidency of the Council of the European Union 2023.

[14] Diabolo project 2017

Agricultural Policy's (CAP) forestry measures for rural development is lacking, especially in the areas of biodiversity and climate change effects[15].

Annex 5.2 provides further information on the current situation - Tables 21 and 22 provide a comprehensive overview of forest indicator coverage in Member States' monitoring and reporting and show that, on average, forest information is insufficient especially in the areas of forest biodiversity and resilience.

NFIs have evolved in distinct ways in EU Member States with country-specific methodologies, partially serving different purposes and policies (Annex 5.2, Table 20). Even basic concepts and definitions of key forest variables are not consistent between Member States[16] (Annex 5.2, table 18). Many EU countries use different definitions for forest, forest types, and forest available for wood supply[17], and some EU regulatory frameworks allow Member State-specific forest definitions[18]. Regarding data collection, some Member States (e.g. France and Sweden) sample between 10 and 20% of their observation plots each year, while others such as Germany or Austria sample all plots at once after 5 to 10 years. A few Member States have not conducted ground sampling campaigns for NFIs over the last two decades or more (Table 20 in Annex 5.2). -In several cases national datasets are not compatible with international definitions[19], available only in local languages[20], or employ a methodology that is not commonly agreed or transparently documented[21].

The quality of data sets and indicators varies among the EU Member States[22]. In several cases, more attention is given to socioeconomic quantitative information (e.g., growing stock, increment) over environmental qualitative (health, biodiversity, resilience), which limits the accuracy of certain indicators, notably for biodiversity. Too much reliance on proxy indicators can increase accuracy problems[23].

Annex 5.2 informs also about specificities of inventory-based *in-situ* monitoring approaches and the pros and cons compared to forest monitoring by EO. In-situ based inventory systems lack spatial continuity, granularity, timeliness and frequency compared to EO-based approaches. EO may result in ambiguity of automated data interpretation or differences in definitions[24]. An EU-wide platform for the integration of in-situ and remote sensing information is currently lacking, which would allow to create precise, statistically-sound estimates of target variables that correlate well with the remote sensing information using models.

Furthermore, there is a trade-off between continuation and innovation, which affects both in-situ and remote sensing-based monitoring. Emerging techniques may improve the quality of products related to accuracy, certainty, granularity, timeliness and frequency but introduce inconsistency in the time

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[15] European Court of Auditors 2021
[16] Baycheva-Merger and Wolfslehner 2016
[17] Baycheva-Merger et al. 2018; Xinqi et al. 2019
[18] E.g. Regulation (EU) 2018/841
[19] Avitabile and Camia 2018; Diabolo project 2017; Tomppo et al. 2010
[20] Schueler et al. 2020
[21] Baycheva-Merger and Wolfslehner 2016; Diabolo project 2017
[22] European Environment Agency 2015; Nilsson 2022
[23] Linser and Wolfslehner 2022
[24] European Commission, Directorate-General for Environment et al. 2020; van Brusselen et al. 2021; EEA 2015; Avitabile and Camia 2018;

series with regards to data collected in the past[25]. In many cases, techniques can be developed that cater for or prevent such biases and inconsistencies, hence allowing for comparability between historic and new measurements.

The absence of comparable data prevents transparent and integrated monitoring of forests in the EU, for instance, on wood harvesting for different purposes, growing stock, forest management practices, ecosystem health, resilience and related biodiversity[26]. The current forest monitoring landscape in the EU provides a rather 'static', patchy picture which fails to provide coherent and up-to-date information on EU forests[27]. This not only leads to inadequate data for informed development and implementation of forest-related legislation and policies on the EU level (see links to EU legislation and strategies in Table 21, Annex 5.2), but is also not cost-efficient and prevents acquiring a holistic view on the state of forest resources in the EU and potentials for their future development. Moreover, Vidal *et al.* (2016) argue that national differences in definitions, methods and scope of forest monitoring might make EU reporting under international processes such as FAO FRA or UNFCCC inconsistent.

At the level of the forest manager, making data more comparable between Member States, by following common definitions or standards, has the potential to decrease the costs for forest owners deciding to participate in voluntary carbon farming schemes, such as the EU Carbon Removal Certification Framework and would also allow for more informed management decisions and effective communication thereof, with corresponding reputational benefits, to the advantage in particular of SMEs and small forest owners.

Accuracy, timeliness, continuity and transparency of information are key issues for the quality and trustworthiness of forest monitoring, which is crucial for foresters to benefit from emerging payment for ecosystem services schemes. The granularity of data and information is essential to ensure their policy relevance and uptake by all user communities. More accurate and trustworthy forest information was identified as a key need of stakeholders in the OPC. This is valid across all stakeholder groups - although business associations showed the lowest values with only 36 % of respondents considering accuracy and trustworthiness as very important or important, 46% responded with 'somewhat important'.

Transparent data means access to data and information for all stakeholders (see Annex 3 for details on affected groups). Today, access to official forest data is limited and unequal between the user groups[28]. Even though aggregate data from NFIs is generally publicly accessible, the basic plot level measurements and in particular the geographic location of measurement plots are not disclosed or are blurred, which limits the possibility for comparison. Administrations and organizations responsible for plot-level data collection justify the limited access by highlighting bias in the management of forest where permanent plots are located, compliance with personal data protection and privacy policies, and inter organizational agreements[29], intellectual property rights, the potential for misuse and misinterpretation, or deliberate interferences on the forest plots[30]. The limited access to basic forest data makes it hard to assess whether these restrictions are fully justified in light of public

[25] Diabolo project 2017; Tomppo et al. 2010
[26] Diabolo project 2016, 2017 and 2019; Linser and Wolfslehner 2022; Schueler et al. 2020
[27] Avitabile *et al*. 2023
[28] Baycheva-Merger et al. 2018; Nabuurs et al. 2022
[29] Baycheva-Merger et al. 2018;
[30] Avitabile and Camia 2018; Baycheva-Merger et al. 2018;

interest to environmental information and complicates a critical assessment for non-state stakeholders, such as private organizations and NGOs[31]. Among public consultation respondents representing environmental organisations, academic institutions and EU citizens, between 81% and 100% agreed with the need for better open access to forest information.

Efficient and effective data dissemination is important to serve and build trust in different user communities. Forest data is inherently complex with differing definitions and interpretations in various user communities.

Current data interfaces and voluntary tools such as Forest Europe and the Forest Information System for Europe (FISE) only provide basic indicators aggregated at Member State level, such as forest area, growing stock or annual roundwood removals. There is a lack of user-friendly query tools for detailed data and data at the level of parcels or lower administrative units that is required by land managers, particularly smallholders, and researchers.

Consequently, usefulness of the information and the form how information is delivered does not meet the needs of the potential users including civil society, the private sector and academia[32]. Today's rigid frameworks may also constrain the exchange and acquisition of scientific forest information and cross-sectorial connection, which in consequence slows down the development of NFIs and of EO-based monitoring systems[33].

2.1.2 Lack of integrated long-term forest planning

In order to ensure that forests can deliver on their multiple functions, including those that have been agreed on in EU legislation, long-term planning of forest management is required. Planning horizons in forestry usually stretch over many decades – the time it takes between planting and felling, and for the forest to deliver its full range of bioeconomy functions including vital ecosystem services..

Likewise, several forest-related EU policies take a long-term view. For instance, the core goals of making the EU climate-neutral (EU Climate Law and Land-Use, Land-Use Change and Forests - LULUCF) and climate-resilient (EU Adaptation Strategy), or to maintain and restore European ecosystems (proposed EU Nature Restoration Law -NRL) are to be reached by 2050. Many climate change projections cover the period until the end of this century, including many studies on how forests will react to, and will be impacted by, accelerating climate change.

In sharp contrast to this, the following gaps could be identified:

- most national planning instruments in the EU do not go beyond a 10-year forest planning cycle. Only a few Member States developed a long-term vision for their forests, typically for 2050 (Table 23 in Annex 5);
- several planning instruments only address forests from specific policy perspectives: by way of example, National Energy and Climate Plans and Long-Term Strategies[34] cover carbon sequestration, renewable energy and energy efficiency; national and regional climate adaptation strategies cover climate adaptation needs etc. An overview of existing planning

[31] Diabolo project 2017
[32] Baycheva-Merger et al. 2018; Baycheva-Merger and Wolfslehner 2016; Diabolo project 2017; Requardt 2007
[33] Nabuurs et al. 2022; Janse 2006, 2007 and 2008; Wulder and Coops 2014;
[34] Regulation (EU) 2018/1999

tools, their relevance for sectoral forest policies and their different cycles for reporting and review is included in Table 24 of Annex 5;
- there is a lack of a holistic analysis and integration of policies and societal demands related to forests, which are often not prioritised, also in terms of funding;
- missing coordination and communication, often happening if there is a split in national competences and if there is no cross-sectoral exchange between forest stakeholders and others[35];
- the heterogeneity of information covered by the current planning instruments affect their comparability or possible exchange with other Member States, which is key to prepare a rapid and efficient response, particularly for threats with a cross-border dimension such as plant pests or wildfires[36];
- planning instruments are furthermore not always fit for purpose to reflect recent policy developments for forests and forestry at EU and national level due to economic and capacity constraints that would require a structured response at strategic and prospective level, also as regards funding opportunities (currently scattered in different instruments);
- presently there is no governance framework nor coordination at EU level to ensure harmonisation of the plans in order to address the abovementioned gaps.

With regard specifically to policy fragmentation in terms of planning, an assessment performed on Member States' tools along five key thematic areas relating to forestry (forest resource status and trends, biodiversity, forest based economy, ecosystem services and climate change) has identified the following gaps in Member States' coverage of certain areas:

- The consideration of the bioeconomy (see Table 25 in Annex V) was the most frequently lacking policy area in the EU27. A number of Member States have limited reference to the bioeconomy sector, some of those within other forest-related policies or strategies (BE, EL, LU, SK), or having a bioeconomy policy in place at regional level only (BG).

- Biodiversity and climate change were the two thematic areas where all Member States have either specific strategies in place or have substantially integrated them into their national forest policies or related policies.

- The status and trends of forest resources is generally well reported and considered in national strategies or plans, particularly due to the NFI network and the availability of national forest strategies for most countries.

- Cyprus is the only Member State without strong evidence of planning or consideration for forest ecosystem services. However, for other several Member States it emerged that ecosystem services have a small role within a larger related area and are not specifically

[35] An indicator is the presence/absence of an overarching forum for discussing forest strategic planning issues beyond forestry boundaries. There are good examples acting for bringing different sectoral aspects, stakeholders and responsible bodies together (e.g. AT, FI, SE, DE), while in other countries there are similar, but not formal processes (e.g. ITA, DE, ES, PL), or none (e.g. EST, NL). The Mutual Learning Exercise carried out in the preparation of the report *Deploying the bioeconomy in the EU* (2021) highlighted the gaps and needs relating to strengthening inter-ministerial dialogue in preparing holistic policies and strategies.

[36] Many response cooperations - especially bilaterally - exist (e.g. CZ-SVK, AT-ITA). Despite that, an overarching concept for a Europe-wide cooperation is still lacking. The development of a Forest Risk knowledge mechanism in FOREST EUROPE is a strong indication by countries that they need better cooperation with an additional focus on prevention and coordination of prepared action.

provisioned for. Ecosystem services are often nestled into wider biodiversity or climate change plans as they can be secondarily affected by the outcomes of these broader thematic areas.

Policy fragmentation and the lack of a harmonised set of information across the current planning instruments in Member States leads to a risk of setting policy targets or objectives that are mutually exclusive, creating mutual unintended trade-offs and inconsistent policy-making and implementation on the national and consequently EU level. Instead, an integrated, balanced assessment of needs across different sectors is needed to evaluate the overall ambitions and potentials with regard to the provision of various forest ecosystem services. Integrated forest planning based on clearly defined long-term strategic policy needs and forecasting is key to inform the structure of monitoring which in turn will allow to assess planning performance and adapt it if need be. Addressing the lack of a long-term integrated approach in terms of planning, including forecasting, would therefore contribute to further developing forest monitoring. Annex 5.3 includes an EU-wide SWOT analysis synthesising the main existing, missing or contradicting elements of forest planning and strategic documents and an EU-wide gap analysis.

In the OPC, respondents were asked to select among different options of what could be the benefits of strategic forest planning. Respondents most frequently pointed to providing a holistic view on forest status and trends as well as allowing for overall coordination of long-term forest planning (Figure 19 in Annex 2). The issue of policy fragmentation raised above is reflected in the OPC results, as when asked about their level of awareness of the various existing planning instruments, 69% of respondents, with the majority belonging to the stakeholder groups of EU citizens and NGOs, indicated that they know or use national or regional forest strategies, but much less sectoral forest-related instruments (with National Bioeconomy Action Plans ranking the lowest with 27%. .

2.2 What are the problem drivers?

Table 1: Specific problems, drivers and objectives to be addressed by the legislative initiative

(Interlinked) Problems	Problem drivers	Specific objectives
Data quality and comparability: Data is incomplete, inconsistent and not comparable across the EU	**Regulatory failure:** Existing rules relating to forests at EU level do not provide for a comprehensive monitoring of biodiversity, carbon storage, health and resilience and accessibility to collected data. **Market failure:** Prices of forestry products do not necessarily reflect the impact of forestry on biodiversity and climate; indicators are historically biased towards timber production. Insufficient exchange of information amongst actors involved in forestry undermines the quality and coherence of forest planning.	Ensure common digitalised, consistent, comparable, timely and accessible data on the state of EU forests.

Quality of planning: Lack of policy coherence and integrated planning with a long-term vision.	**Regulatory failure** due to scattered responsibilities between public authorities with different objectives. **Regulatory failure** due to lack of cross-sectoral coordination leading to scarce prioritisation of non-timber forest uses.	Give the possibility to all Member States to deliver integrated long-term forest plans based on high-quality monitoring information related to relevant EU policy objectives.

2.2.1 Drivers behind the lack of data comparability and quality

In the absence of a market incentive, there has been no general interest to monitor the environmental impacts of forestry, nor of non-timber-related forest bioeconomy (e.g. hunting licenses, eco-tourism). As a matter of fact, the price of timber resources, just as it is the case for natural resources in general, reflects historically a market where the impact of forestry on biodiversity and climate is generally not taken into account (externalities).

Only recently have data on environmental aspects, such as benefits of forests for climate change mitigation and adaptation and (mostly limited to protected forests) for biodiversity, started to gain attention, though still in a patchy manner. Such data is, however, increasingly important, given the EU's agreed climate policy and scientific evidence, which demonstrates that the forest resilience, adaptive capacity and capability to provide multiple products and services is dependent on forest ecosystem health and biodiversity.

Member States have developed different approaches for data collection, measurement systems, definitions, statistical processing, and different time frames for collection and dissemination of forest information because many Member States have developed their monitoring frameworks long before joining the EU and EU has not had a regulatory framework for forest monitoring (see Figure 28 in Annex 5.2). The lack of a regulatory framework at EU level has also contributed to the largely uncoordinated developments between Member States. The main argument against applying common standards to NFIs is the potential disruption of the measurement time series, control over measurement plots, the long experience gained with the existing systems[37].

Some international efforts for harmonization and standardization of NFIs, such as collaboration under the European National Forest Inventory Network (ENFIN) program, including framework contracts with the Joint Research Centre (JRC), have been made over many years with progress on harmonization limited to a few indicators, mainly limited to the areas where cooperation was agreed under international conventions, such as the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests[38]).

[37] Ståhl et al. 2012

[38] International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests), launched in 1985 under the Convention on Long-range Transboundary Air Pollution (Air Convention, formerly CLRTAP) of the United Nations Economic Commission for Europe (UNECE).

Existing national forest monitoring systems are expensive[39]. Several Member States operate forest-monitoring systems over many decades with data collection ongoing over many years to produce consistent time series[40] (see Figure 28). A change in the data collection, including the inclusion of data from EO to improve spatial granularity or frequency, could imply a temporary extra cost and at least a partial disruption of the time series. Furthermore, not all ecosystem services provided by the forests have been considered important, since the market rewards mainly the selling of timber.

Market and regulatory failures are also behind limited information or restricted access to data. Recent studies also concluded that a major reason for constraining the exchange of forest information is the lack of motivation and unwillingness due to lack of political, social, and/or economic incentives for data collection, processing, provision, and dissemination[41]. In the absence of a regulated monitoring framework, there is an overall concern on the unintentional misuse of data or false interpretation due to the lack of detailed on-site knowledge. In limited form, Member States share some information in the voluntary collaboration under ENFIN and other international projects, which seek improving the forest monitoring and information, however, after years of cooperation, limits of such voluntary efforts in terms of data accuracy and timeliness have been repeatedly reached[42]. The recent EU proposal for certification of carbon removals will provide financial incentives for increasing carbon storage in forests. This will lead to higher needs for information (on carbon removals and related co-benefits, such as higher biodiversity), by stakeholders motivated to obtain these financial incentives, especially SMEs active in the sector.

2.2.2 Drivers behind the lack of integrated long-term forest planning

Existing planning instruments in Member States often lack the analysis of forest policy coherence today and for the future with increasing demands and threats. Medium- and long-term forest strategies (e.g. DE, AT) tend to be broader in their scope and have to take more aspects into consideration (climate change, biodiversity, social development etc.) than very short-term demand-driven strategies. Planning often reflects sectoral policies, approaches and priorities, mirroring scattered responsibility among different departments/ministries or administrative levels, particularly in the systems where planning is taking place also at regional level, resulting in difficult coordination and communication among these levels. The existence of EU sectoral but uncoordinated legislation is also a reason behind this situation.

Existing planning documents such as national Forest Strategies and Programmes typically have a 10-year cycle and address primarily the economic value of wood-based bioeconomy, which is the only one reflected in the market price of timber. The lack of market incentives to address climate and biodiversity and non-timber forest bioeconomy results in scarce considerations of these dimensions in planning. Better plans need better data as outlined in the section above. Even if climate mitigation and adaptation or biodiversity are covered to some extent by existing EU and national planning instruments, this is not yet prioritised at sufficient scale neither it is done in an integrated manner. This is for example demonstrated by the fact that spending on forestry measures amounts to only 3% of all rural development spending under the CAP. Moreover, overall funding for forested areas from

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[39] For instance, in metropolitan France, the national forest inventory directly mobilizes about 91 full-time jobs and represents an estimated budget between EUR 8.2 and 10.4 million (2020 campaign). Source: Commission Territories of the National Council for Statistical Information 2021

[40] Gschwantner et al. 2022

[41] Baycheva-Merger et al. 2018

[42] Avitabile et al. 2023

the EU budget is much lower than for agriculture, representing less that the 1% of the CAP budget[43]. Long term-planning for environmental reasons is often absent (see SWOT and gap analysis in Annex 5.3). Lack of planning for climate and biodiversity threatens the forest-based bioeconomy and ecosystem functions of forests, given the interdependencies. Lack of attention to non-wood forest bioeconomy disregards the importance of sectors, which bring income and jobs to local communities and have often co-benefits with climate and biodiversity objectives.

2.3 How likely is the problem to persist?

While forest-related data needs are increasing in several EU policy fields and indicators are defined for monitoring, the state of forests and the demands on forests, the challenges related to consistent and improved information systems including common indicator development and to coherent and streamlined forest planning across policy domains are likely to persist. Details are provided in section 5.1.

3 WHY SHOULD THE EU ACT?

3.1 Legal basis

The proposal is based on Article 192(1) of the Treaty on the Functioning of the European Union (TFEU), which gives the Union the right to act in order to achieve objectives of its policy on the environment. The Court of Justice of the European Union has confirmed in Joint Cases C-164 and C-165 that measures, such as those aimed at protecting forest from wildfires and air pollution, inherently form part of the environmental action that the EU competence is founded on, in Article 191(1) TFEU. The objectives of the Union policy on the environment as defined in Article 191(1) of the TFEU include, inter alia, preserving, protecting and improving the quality of the environment; a prudent and rational utilisation of natural resources; and promoting measures at international level to deal with regional or worldwide environmental problems, in particular combating climate change. The Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay. Pursuant to Article 4 TFEU, in the field of environment, the EU shares competence with its Member States.

The same legal basis underpins Union measures aimed at protecting forest ecosystems from disturbances[44]. A monitoring framework for resilient European forests will provide the data which will enable monitoring the European Green Deal targets related to forests and develop policies to protect forest ecosystems. Given that environment is an area of shared competence between the EU and the Member States, EU action must respect the subsidiarity principle.

3.2 Subsidiarity: practical need for EU action

Necessity of EU action

Forest monitoring is currently patchy and fragmented, which prevents the Union from acting in a timely manner against stressors and threats (with a cross-border dimension), as advocated by the new

[43] European Court of Auditors 2021
[44] C-164/97 and C-195/97, in particular points 13 and 16.

EU forest strategy and from making the most out of cost-effective technological developments and digital innovation, particularly in the area of EO. The situation has arisen by the Member States developing their national forest monitoring systems in an uncoordinated manner over many years (see Figure 28 in Annex 5.2). While forest ecosystems often stretch across borders, forests are often seen as sovereign entities and no consistent, transnational data gathering approach has been fully developed so far (UWE Bristol, 2021, p. 82). Member States are unlikely to resolve this fragmented situation without EU intervention. The OPC results indicate that respondents expect that EU intervention will result in better scientific knowledge about forests, improve the prevention and response to natural forest disturbances and benefit forest management and planning.

The risks posed to forests by the climate emergency demonstrate the need for a coherent system to monitor and plan for transformations in forests and the forest-based sector as a result of climate change. In addition, the climate and biodiversity crisis require a re-consideration of the role of forests with greater focus on their multifunctionality. In this context adequate and comparable data on forests and is a prerequisite to achieving the climate, biodiversity and sustainable and circular bioeconomy policy objectives stemming directly from the European Green Deal. Providing Member States with instruments to develop long-term planning and make the most of the data at their disposal would also support this goal.

EO is a game changer in monitoring but requires a coordinated approach both at the level of technology development and use (especially satellites) and at the level of the necessary ground-truthing activities, which must be sufficiently harmonized. There is in addition a need to monitor the effects of other policy actions comprehensively and cost-efficiently.

Consequently, intervention at EU level is needed in view of:

(i) the scale and crossborder nature of the problem,
(ii) the impacts on citizens across the Union as well as the risks to its economy from growing disturbances, and
(iii) the need to monitor the effects of EU policies and legislation and to anticipate the need for policy changes with a view to achieve targets.

Added value of EU action

Taking action at EU level, within the limits of the objectives that cannot be achieved sufficiently or most effectively by the Member States in the absence of an EU framework, would provide a clear added value in terms of consistency and economic efficiency.

Although, together EU Member States spend 50 million EUR annually on their national forest inventories (Maes et al., 2020), often the information is unusable transnationally because countries cannot agree on definitions of parameters, the data are outdated or are too coarse (Nabuurs et al., 2019). Nabuurs et al (2019) also argued that basing forest policies on very little or outdated information might lead to undesirable trade-offs. Maes et al. (2020) make clear that systematically collecting harmonised, spatio-temporal data from across the EU will be an important step towards tracking and preventing pressures at a pan-European level, such as forest pests, droughts or invasive species.

Action in this sense is also supported by respondents to the open public consultation. Across stakeholder groups, more than 60%of respondents agree that data from Member States' monitoring systems should be better integrated. Split by stakeholder groups, 73% of all respondents from

academia and 75% from public authorities agree or somewhat agree. However, this percentage is smaller for business associations (36%). Additionally more than half of respondents think that the EU should operate a single monitoring system. The highest support for a single monitoring system is shown by EU Citizens and Environmental Organisations, with 69% and 67% respectively agreeing or somewhat agreeing, whereas 56% of all responses from the stakeholder group 'company' disagree or somewhat disagree. Only 40% of respondents agree that Member States should continue current monitoring systems (business-as-usual). Among the different stakeholder groups, 70% of the environmental and non-governmental organisations and 49% of business associations, company/business organisations and public authorities together support a common approach to monitoring which should build on existing data collection and reporting processes. Key business players expressed clear support for the legislative proposal underlining for example reliable, comparable and science-based data as the foundation for ambitious policy-making and sustainable forest management as well as encouraging National Strategy Plans by all Member States as a useful tool to implement the EU Forest Strategy 2030. Half of those EU Member States that expressed their views on the repartition of competences between the EU and the Member States, during a public debate in the Council on 22 October 2022), also supported a common approach to monitoring, building on existing data collection and reporting processes. A general support was expressed by the Member States experts participating in the technical workshop organised by the Czech Presidency in September 2022 (see section 6.1 or Annex 2 for the full report) to the importance of reliable, verified harmonized or standardized and up-to-date information and communication on the state and development of EU forests, inter-alia for informed both policy- and decision-making at the EU level.

Standardised, comparable information would allow to check the viability, consistency and sustainability of the many and various forest-related policies at EU level (or to identify trade-offs) in a cost-effective manner. Table 21 contains information on how the forest data considered for the monitoring framework link to specific legislation and policy objectives. Data harmonisation or, where appropriate, applying a standardised approach – particularly by taking advantage of the innovative solutions in the EO field – has the potential to lead to significant cost savings. Freely available satellite data can additionally facilitate compliance verification for national competent authorities and reduce reporting burden for stakeholders with obligations relating to forest land use. Moreover, the development of a more standardised approach to EO-based data collection acts as a strong facilitator for European SMEs related to the digital transition. As seen in the development of similar monitoring technologies for agricultural policy, by applying common approaches for data collection, companies executing this work will enter a developing market and thereby provide better value services (for data collection and processing), which in turn will stimulate more expansive, more regular data collection in a virtuous cycle.

Such a monitoring scheme would also allow identifying the relationship between the condition of forests and anthropogenic stress factors, including climate change, and potential future risks of forest disturbances at a reduced cost compared to a scenario in which each Member State operates its own monitoring scheme. It would also allow to support Member States which would encounter significant needs to improve their forest monitoring (see Table 20 for an overview of Member States' monitoring).

Increasing disturbance frequency and intensity, for example by bark beetle outbreaks, wildfires or wind storms, result in greenhouse gas emissions, biodiversity loss and market distortions that have a significant crossborder dimension. They may also cause abrupt increases of salvage logging with a direct impact on the market across countries. As an example, the early detection of bark beetle hotspots (to which EO can effectively and efficiently contribute) is essential for reducing the extent

of salvage logging, which is liable – when occurring in large scale – to disrupt the timber market, with particularly negative effect on SMEs which are heavily dependent on timber price. In the absence of a clear framework, punctual or sporadic exchange of information between administrations or stakeholders at national level is not sufficient to provide for a systematic coordinated response to these disturbances. Moreover, there is a crossborder long-term dimension due to the fact that the already observed northward migration of agro-climate zones is expected to accelerate significantly in the coming decades[45], making comparability of long-term datasets across borders a growing asset for forest owners and managers.

Finally, a level playing field for forest products from sustainably produced biomass would reward foresters and land managers who implement land management schemes with co-benefits for the climate, biodiversity and the bioeconomy. The EU is the appropriate actor in this case, as it has a long standing experience in working for the convergence of forest indicators and on data collection methods to obtain comparable and EU-wide data. This is not something that can be tackled at the level of individual Member States. Drawing on existing monitoring systems and emerging science, promotion of EU-wide methodological standards and knowledge sharing will also enable more cost-efficient reporting and monitoring.

With regard to cost effectiveness, a very important aspect in relation to EO is economies of scale. This is self-evident in the case of developing satellite technology, but also in the area of Laser-imaging, Detection and Ranging (LIDAR) monitoring, where the cost per hectare can be considerably reduced, the larger the surface to monitor. Moreover, past frontload investments into Copernicus monitoring services means that these systems are already in place and putting them into practice will contribute to cost-efficient use of this EU investment.

As regards planning, several Member States have planning instruments in place but the information covered is not harmonised at the EU level, affecting comparability and policy-making as aggregated information on national forest-related policies form the knowledge basis for the design of EU policies and strategies. Moreover, having an integrated and long-term approach to planning allows Member State to implement various EU policies relating to forests (LULUCF, Nature Directives, Renewable Energy Directive etc.) and their respective targets and objectives in a coherent manner, addressing potential trade-offs. Member States that have established and well-working planning frameworks would be able to continue their instruments. They would nonetheless have the possibility of entering a coordinated governance system to ensure temporal homogeneity and provision of common information . The added value of EU coordination and governance would be to ensure that plans across the EU have a similar structure for better delivery on forest-related policies at the EU level such us those delivering on forest bioeconomy or climate adaptation.

Comparability and exchange with other Member States was also selected as added value of strategic plans by 52% of all the respondents to the open public consultation without a significant difference across stakeholder groups. Among the options given to choose from, it ranked the third highest shortly after providing a holistic view on forest status and trends (55%) and overall coordination of long-term forest planning (53%). Only 5% of the respondents did not see any added value in strategic plans mostly linked to the concern that the intention would be to establish strategic plans for forests at EU level.

[45] Ceglar et al. 2019; Gallardo et al. 2013

4 OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1 General objectives

The general objective of this initiative is to develop an EU-wide monitoring framework for resilient European forests, which will seek to, as a general objective related to the implementation of Article 191 TFEU, contribute to:

- the EU commitment to combat climate change and achieve sustainability goals; and
- improving the level of preservation, protection and quality of the environment

This will be achieved by ensuring more data-driven decision and policy-making on forests, which is expected to increase public trust in forest management, reduce illegal logging, incentivise and reward more sustainable forest management, and support the adaptation of forests to climate change, therefore contributing to the Commission policy priorities outlined in strategic policy documents such as the EU Biodiversity Strategy, the Adaptation Strategy and the New Forest Strategy for 2030.

It is important to highlight that this initiative is about better data, knowledge and planning but does not impose on forest management policy choices and objectives of the Member States.

4.2 Specific objectives

Based on the problem definition and the problem drivers described regarding forest monitoring and integrated forest planning in the EU, the specific objectives of the initiative are described below. It is important to note that the objectives are intrinsically linked to each other since efficient monitoring requires clearly defined strategic policy needs and monitoring provides the evidence base needed for long-term planning that integrates different forest-related policy objectives.

4.2.1 *Ensure availability of common consistent, comparable, timely and accessible data*

In light of the new policy mandates and strategic objectives under the European Green Deal, such as those identified in the Biodiversity Strategy, Adaptation Strategy or the New EU Forest Strategy for 2030, this initiative aims to lay down a set of common indicators and methodologies to ensure that data collected across Member States on forest conditions and management are consistent, comparable, timely, particularly by making the most out of the digitalisation potential, and that they cover the relevant policy data needs on forest. The priority topics are those of climate change mitigation and adaptation, forest health and resilience, biodiversity and ecosystem condition, forest management and forest bioeconomy.

As an example, the production and dissemination of timely data is needed for land managers and policy makers to swiftly assess the current situation, implement corresponding response measures or adjust related policies. The forest data need to be furthermore collected in a transparent way and disseminated so that they are accessible to all relevant stakeholders and data users. EO, including EO data provided by the Commission via the Copernicus programme, combined with ground-truthing provides a significant potential to this end.

4.2.2 Facilitate integrated long-term forest planning

The development of a strategic vision of the forests and the forestry sector by Member States will address the problem of insufficient and fragmented long-term planning for forests with limited consistency across policy objectives with relevance to forests and the forest-based sector. A

governance framework for integrated forest planning can help to minimise conflicting objectives and maximise synergies across forest policies.

5 WHAT ARE THE AVAILABLE POLICY OPTIONS?

5.1 What is the baseline from which options are assessed?

Under a baseline scenario forest monitoring and planning continues to be based partly on the legal frameworks at the EU level and partly organised separately by each Member State under voluntary international monitoring and reporting frameworks, e.g. Forest Europe's *State of Europe's Forests* (SoEF) and ICP Forests, or country reporting into international frameworks of obligatory nature such as FAO's Global Forest Resource Assessment (FAO FRA) und greenhouse gas reporting to the UNFCCC. Table 21 and 22 in Annex 5 illustrate the coverage and diversity of forest-related indicator collection in the EU-27.

Considering the latest reporting year in the SoEF 2020 under Forest Europe, forest data availability differs greatly across Europe. Even though certain international frameworks collect information on forest vitality (ICP Forest), fragmentation (CORINE dataset), forest management objectives (FAO FRA) and the occurrence of common forest birds (Pan-European Common Bird Monitoring – PECBMS), data availability for other forest indicators remains scarce. For example, only sixteen Member States provide data on forest disturbances to the SoEF and only nine Member States publish data on threatened forest species. Without a common framework for monitoring, the efforts are likely to remain scattered, incomplete, and insufficient for the purpose of EU-wide assessments (Table 22 in Annex 5). At the same time, pressures on forests will increase, making the lack of consistent, complete and comparable spatio-temporal data an even greater problem in time.

The necessity of addressing challenges related to the integration of EO and ground-based data is increasingly recognised in the EU Member States[46]. This requires interoperability, common definitions, no ambiguity in data interpretation and long and comparable very high-resolution time-series. Current forest products from Copernicus represent a progress but so far limited to the indicators on tree cover density and dominant leave type and with rather limited uptake by state-level stakeholders[47]. Without a common framework and the engagement of stakeholders for building trust and a common understanding, the gap between potential improvements through the uptake of new technologies and available data will inevitably grow, hampering the EU's ambitions for a digital Europe.

Similarly, without an EU framework for forest monitoring, it will remain challenging to demonstrate that the EU is on the right track in implementing its relevant policies and ambitions, and that the forests can actually deliver on their multiple demands and functions.

[46] Almost 60% of OPC respondents identify data integration with ground or in situ data as a major or minor technical challenge. Recommendations from CZ PRES workshop on Forest Monitoring highlights the need of combining remote sensing and field-collected data for improving information on forests, and the need for mutual and timely exchange of both kinds of data

[47] At the first meeting of the SFC sub-group on forest monitoring and integrated long-term planning 8 out of 9 MS that spoke on this point indicated they are not using Copernicus for National Forest Monitoring

The EU legal framework is set to evolve through several legislative proposals by the Commission with relevance to forest monitoring and integrated forest planning, namely on the NRL[48] and an amendment of the European environmental economic accounts Regulation[49] introducing a new forest accounts module. Where adopted, these legislative proposals will establish some mandatory indicators as well as lay down some reporting and monitoring requirements in support of their specific policy objectives (Table 21 in Annex 5). The NRL proposal furthermore provides for the establishment of restoration plans including forest ecosystems where relevant. However, the monitoring and reporting requirements of certain forest-related parameters included in the NRL proposal are designed for restoration purposes and only concern national average value, whereas a comprehensive forest monitoring framework would require broader indicator coverage and a more detailed level of granularity. The NRL proposal includes a certain level of harmonisation for the indicators, while some incentive for the use of EO is foreseen[50], e.g. for the monitoring of forest connectivity.

With the provisional agreement between Parliament and Council on a revised LULUCF Regulation, monitoring of annual carbon fluxes in forest land can be expected to improve. The LULUCF reporting approaches and methods, applied by Member States under the Governance Regulation, are proposed as the basis to certify carbon removals under the proposal for an EU-wide voluntary carbon removal certification framework recently adopted by the Commission. Nevertheless, the reporting requirements in the provisional agreement on a revised LULUCF Regulation build on the general reporting guidelines as set out by the Intergovernmental Panel on Climate Change (IPCC), and do not prescribe the exact tools with which data on greenhouse gas emissions and removals are to be collected, e.g. using EO. An EU-wide monitoring framework would therefore support the implementation of LULUCF and better work as enabler for carbon removal certification schemes.

Data collection and reporting at national (and where applicable regional) and EU and international levels would therefore continue to evolve with partial coordination and harmonisation that is mostly achieved at the level of definitions and with only limited success on the level of data collection design and methods[51]. Data quality and data continuity would remain for most indicators in the current state (with quality, continuity and transparency of data accuracy varying across Member States), with some limited exceptions, particularly related to monitoring of forest-based carbon and wood-based industry related indicators, which through the impetus of several large EU research projects[52] are edging closer to EU-wide and repeated data production.

Methods for biodiversity monitoring would mostly continue to rely largely on proxy indicators with the exception of the common forest bird index, with a likely addition of EO-based monitoring of forest structural diversity and tree species – but not as an operational EU-wide monitoring system.

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[48] COM(2022)304 final
[49] COM(2022)329 final
[50] The NRL proposal already contains a requirement that Member States should "maximise the access and use of data and services from remote sensing technologies, earth observation (Copernicus services)" and others.
[51] See Forest Europe 2020 (Annex I on limitations in harmonisation) and FAO 2020
[52] For instance Horizon 2020 project BioMonitor

Importantly, there would be no system or requirements for the EU-wide collection of comprehensive, near-time, comparable, high-quality data on the evolution of tree health and forest disturbances under climate change key to ensure forest resilience for example.

The harmonisation of NFI data collection and reporting systems would continue to benefit to a certain extent from EU funded activities such as COST actions[53], and Horizon Europe and other research and innovation projects that bring NFIs together[54] (via Commission's JRC, ENFIN or other cooperation modalities) as well as non-EU funded research into harmonisation of forest indicators in Europe[55]. However, actual engagement would differ across Member States and, together with the ad-hoc nature of respective EU funding, would limit longer-term strategic efficiency and progress.

Advances through research and innovation, notably in EO might reduce the existing gap between knowledge availability and needs for EU policy making and implementation. However, the lack of a common framework will likely lead to varying uptake by Member States and access to such information will remain fragmented.

A lack of oversight and consistency will continue to impede integrated forest planning across the various relevant policy domains. Benchmarking or setting of objectives would unlikely be achieved; and the incentive to streamline and improve EU-wide forest monitoring would depend on sectoral legislation addressing only interests in very specific indicators. Voluntary approaches to harmonise would continue for the majority of indicators. Coordination of forest-related policies would remain at the initiative of the coordinating authority in the Member States.

5.2 Description of the policy options

5.2.1 Option 1: Streamlined reporting for forest monitoring and integrated forest planning – fully voluntary option

This option aims to achieve a common approach to forest monitoring and integrated planning for coherent delivery of EU objectives and priorities pertaining to forests while leaving maximum flexibility to Member States as how to translate them into their national context.

Voluntary coordination through Commission guidelines and sharing of best practices would aim to harmonise national data collection and strengthen forest planning frameworks and mechanisms to address the problems identified in Section 2. Monitoring obligations under existing (or proposed) legal obligations (Table 21 in Annex 5) would form the starting point for setting priorities while enhanced harmonisation efforts could also concern key selected indicators currently included in existing international monitoring and reporting frameworks such as Forest Europe's SoEF reporting, forest condition parameters collected in the ICP Forests network or indicators reported under FAO-Global FRA.

The Commission, in the framework of the new Forest Governance being set up pursuant to the new EU Forest Strategy, would make use of dedicated expert groups in order to facilitate coordination and exchange on forest monitoring including harmonisation and integrated planning. Following

[53] For instance COST Action E43

[54] Examples of such projects are PathFinder or ForestNavigator, both having as one of their objectives the strengthening of forest monitoring and harmonised forest data in the EU.

[55] E.g. through ENFIN, or other research such as Gschwantner et al 2019, Gschwantner et al 2022 or Vauhkonen et al 2019

consultation with theses expert groups, the Commission would issue voluntary guidelines to strengthen consistency and comparability in data collection, promote EO and facilitate the drafting of evidence-based integrated forest planning for example by offering a common set of basic requirements and core elements for consideration by Member States.

The Commission would continue to provide existing EO services through the Copernicus Land Monitoring Service on selected forest data such as phenology and net primary productivity.

The Call for evidence showed wide agreement among stakeholders that an EU-wide forest monitoring network should be based on existing national forest inventory data, in order to reduce the risk of duplicating data. In the OPC, business associations and public authorities tended to be in favour of better integration of Member States' monitoring systems, but with little changes to monitoring methods. These views are in line with Option 1.

5.2.2 Option 2: Monitoring framework for resilient European forests –legislative option

This option would aim to set up an obligatory EU framework for data collection and reporting, advanced use of EO and integrated forest planning with two sub-options on the level of EU intervention.

In order to address the problem of varying level of indicator coverage across Member States, and following a step-wise approach (see Annex 5.2), a set of key mandatory indicators and parameters would be selected for their inclusion in this obligatory EU framework. Their selection would be linked to strategic objectives, such as those identified in the Biodiversity Strategy, Adaptation Strategy or the new EU Forest Strategy and supported by an expert group (see below). Stakeholders identified these indicators also as the most important ones to monitor in the OPC (Figure 22 in Annex 2). The methodology for the selection of the indicators is further described in Section 5.2.1 of Annex 5.

Common to both sub-options, definitions and methods for the mandatory indicators would be harmonised based either on existing definitions and methods or those developed with the support of an expert group (see further down). Standardisation would be suggested for core indicators where the uncertainty of harmonised estimates is too high or where no internationally agreed common definitions and methods currently exist. Common harmonised definitions will be established where currently missin . Sharing of relevant data by Member States will follow the approach to open public data and its re-use of Directive (EU) 2019/1024, mitigating reporting obligations on public administrations.

Further details on indicator harmonisation and standardisation are given in Box 1, Annex 5.

The Commission would ensure that data collected by Member States are regularly reported to and published on Forest Information System for Europe (FISE) as a common platform for forest information.

The use of Earth-Observation (EO), complemented by in-situ monitoring where necessary for data calibration and validation, would be mandatory for indicators and parameters for which the underlying policy needs necessitate data acquisition with higher frequency and spatial resolution, i.e. at a parcel level with roll out over large areas. The Commission would operate the EO-based forest

monitoring system, expanding and developing its service to provide data covering the EO mandatory indicators specified in Table 21 in Annex 5. This will lead to a consistent monitoring of such EO-based parameters (e.g. forest area) across the EU.

Member States would be required to develop context-specific long-term plans based on common elements, building on existing planning instruments. These plans should provide a holistic assessment, integrating forest-related policy objectives, targets and risks (related to biodiversity protection, forest ecosystem restoration, forest carbon sink, climate change projections, forest biomass demand for energy and material uses, non-timber uses of forests etc.), and include forecasting via available integrated modelling frameworks to be defined by the expert group. Based on these assessments, the Member States' plans would develop a vision for forests and the forest-based sector for the next 10, 30 and 50 years. This assessment would need to be underpinned by quantitative and qualitative analyses, forecasting and climate projections, and be developed in an inclusive process with stakeholders. Furthermore, to help ensure coherence between national and Union policies, a governance framework would enable an ongoing dialogue between the Commission and the Member States and, where appropriate, between the Member States. In this context, the Member States would be required review the plans every 10 years in order to ensure their viability, building on the average periodicities for data collection and monitoring in Member States.

Among the OPC responses, stakeholders identified a "holistic view on forest status and trends" and "overall coordination of long-term forest planning" as the most important added values of integrated forest planning. Generally, providers of forest data tended to be more positive towards a comprehensive coverage of issues in such plans, while forest owners tended to be less positive (see Annex 2).

Similar to option 1, a new expert group in the framework of the new Forest Governance would facilitate follow-up and implementation of the regulation. Where not yet available, the expert group would help the Commission developing proposals for common methods for indicator harmonisation and standardisation, dealing with data collection needs and proposing further indicators for policy implementation as relevant. It would further provide a forum for good practice exchange on long-term planning for forests.

Generally, business associations, companies, forest owners and public authorities tend to show a preference for Member States continuing current monitoring systems, while environmental organisations, forest data providers and EU citizens tend to favour better integration of monitoring systems, with standardisation of forest monitoring methods (see Annex 2). Option 2 and its two sub-options represents a balance between these two views.

- Sub-option 2.1– Medium level of intervention

Member States will be required to report on a targeted set of indicators and parameters related to EU legislation and policy objectives on forests (see Table 21 in Annex 5). The selection would be based on existing EU and relevant international monitoring and reporting systems, such as criteria and indicators used for Forest Europe's SoEF reporting, forest condition parameters collected in the ICP Forests network, indicators reported under FAO-Global FRA (see 5.2 of Annex 5). Basing the selection of indicators and parameters on those reported under existing frameworks aims to reduce costs related to data collection and harmonisation. The initiative would not introduce any additional reporting requirements for indicators relevant for EU forest policy objectives which are currently

collected under international monitoring and reporting schemes and which satisfy identified policy needs (e.g. reporting on forest management plans and management objectives under FAO).

The "opt-in approach" combines EO-based forest monitoring operated by the Commission with the possibility for Member States to enrich the data pool with their sources. Following a specific, clearly documented data management protocol, Member States could upload their measurements, or LIDAR coverages that are currently not available wall-to-wall across the European Union, in Member State specific containers including regionally or nationally available EO-data. Regarding data management, such a system could, for instance label the data as:

> "private": not geo-located (plot location) and not accessible (plot measurement) by other Member States or the public. Only the Member State who provided the data can use it for forest monitoring in their national domain and the Commission can access them for purposes of data quality assessment.
>
> "protected": not geo-located but accessible by other Member States and the public, i.e. they can benefit from the measurement information without knowing the measurement location.
>
> "public": geo-located and accessible by other Member States and the public.

This way, Member States' existing and more advanced monitoring systems could also benefit from an EU monitoring system as a complementary layer of information (and potentially decrease national costs for its operation) without compromising on the quality compared to their current national systems.

Member States will be required to prepare, report and review integrated long-term plans, but the Commission will not make recommendations on these plans.

- Sub-option 2.2 – High level of intervention

Member States will be required to report on a more comprehensive set of indicators and parameters related to EU legislation and policy objectives extending beyond existing EU and relevant international monitoring and reporting systems. The additional indicators compared to sub-option 2.1 would however still be limited to a small number of indicators essential to underpin the main policy objectives related to forests (see Table 21 in Annex 5).

These new indicators would notably include more detailed information on tree mortality, storm damage, drought damage, or pest outbreaks which - although crucial for making appropriate decisions for adapting forests to climate change and for assessing the related progress under Articles 5 and 6 of the European Climate Law - are currently not monitored under specific EU law or by the international forest monitoring systems mentioned above. Similarly, sub-option 2.2 would include in its scope monitoring of silvicultural regimes in EU forests, use of clear-cutting and the location and extent of primary and old-growth forest, all identified as policy-relevant information essential for the implementation of the new EU Forest and Biodiversity Strategies for 2030. In addition to data harmonisation for existing indicators, data collection will be standardised for the new indicators.

The Commission will develop and operate EO-based forest monitoring on a specific set of indicators (see Table 21), complementary to in-situ data collection carried out by MS, and provide these data for their publishing in FISE. There would be no opt-in possibility for the Member States. The OPC revealed a high level of support for a single monitoring system operated by the EU among

environmental organisations and EU citizens, while companies, business associations and public authorities tended to be less positive.

The Commission will review Member States' integrated plans and, where relevant, issue recommendations on their alignment with specific policy objectives and targets. Whereas recommendations have no binding force, Member States will nevertheless be invited to take account of such recommendations. Contrary to other governance frameworks (for example on National Energy and Climate Plans (NECPs[56]), Member States will not have to provide and make public the reasons for not addressing the recommendations.

5.2.3 Option 3: Obligatory monitoring and voluntary planning - the hybrid option

This option combines core elements described in option 1 and sub-option 2.2.

Monitoring elements would be mandatory to address the problem of varying level of indicator coverage and data collection approaches across Member States following the approach described in sub-option 2.2, while integrated forest planning would be optional for Member States. Reporting would be obligatory for a set of indicators and parameters related to EU legislation and policy objectives beyond existing EU/international requirements with data harmonisation for existing indicators and standardisation for the new indicators. The Commission will develop and operate EO-based forest monitoring, complementary to in-situ data collection, and publish this data into the monitoring system.

Like under Option 1, integrated long-term planning would be voluntary for Member States supported by an expert group for coordination and knowledge exchange for instance for sharing best national practices in drafting such plans. Following consultation with this expert group, the Commission would issue voluntary guidance to facilitate the drafting of evidence-based integrated forest planning for example by defining a common set of basic requirements and core elements for consideration by Member States.

5.3 Options discarded at an early stage

5.3.1 Option 4- Targeted EU funding for monitoring and integrated long-term planning

Option 4 would seek to address the problems identified by ring-fencing EU funding for forest monitoring and integrated long-term planning activities, either from existing funding programmes or through the creation of a new funding facility.

Common objectives for forest monitoring and integrated planning would be defined together with the requirement to prepare national programmes and a process to decide on what should be funded at EU level and a process for allocating and managing the funds.

A dedicated budget from the EU budget would be assumed based on current costs for in-situ observation in the EU [57] and costs of satellite and airborne measurements by the EU and MS.

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[56] See Article 9 of Regulation (EU) 2018/1999.

[57] This would include financial support for extending and strengthening the existing international monitoring and reporting frameworks (e.g. ICP Forests or LUCAS) or national forest inventory programmes.

A dedicated funding instrument for forest monitoring existed in the past with the Forest Focus Regulation that established an obligation for coordinated EU-level forest monitoring backed by extensive co-funding (EUR 65 Mio over a four-year period for the EU-15). This Regulation strengthened integrated forest monitoring, established a database with aggregated data and information on the state of EU forests, and broadened the scope of forest monitoring to soil and biodiversity. However, its cost-efficiency was limited by the absence of common definitions for indicators, data collection or monitoring protocols. In combination with the complex landscape of beneficiaries of these funds, significant differences of "value for money" among beneficiaries were the result. The assessment of the legal instrument concluded that despite strict control of financial management (external auditing) implementation of forest monitoring in Member States was insufficient[58]. In view of the objective to streamline and consolidate financial instruments, the Forest Focus Regulation was not renewed and was replaced at the end of 2006 by the LIFE+ Regulation. Voluntary in nature and without dedicated focus on forests, clear monitoring targets or obligations for consistency and harmonisation, uncoordinated activities and limited spatial and temporal coverage increased again in light of the high administrative and field costs for forest monitoring.

Given this experience, funding without specific objectives and targets or obligations would not achieve the objectives of this initiative as described above, i.e. Member States would not put in place coherent monitoring frameworks and long-term planning. Therefore, option 4 is not considered suitable as a stand-alone option, but funding is considered a useful add-on for the preferred option (Chapter 8).

5.3.2 Option 5: Strengthened international engagement

Option 5 will consider whether a common standard for forest monitoring and integrated long-term planning could be achieved through promoting the development of appropriate international standards and coordination of the delivery of existing international requirements for the EC and Member States.

There are several international or intergovernmental bodies and processes with relevance to forest monitoring and integrated long-term forest planning but none has an overall responsibility. United Nations' Framework Convention on Climate Change (FCCC) and Convention on Biological Diversity (CBD) specifically address forests and forested land, including in relevant international agreements[59]. Several UN subsidiary and implementing bodies such as the FAO, the UN Forum on Forests and the International Tropical Timber Organization support improving forest-related data, information, and capacities for conservation, sustainable management, and legal harvesting. The EU and its Member States have reporting obligations that require forest information systems towards international schemes such as ICP Forests, the FAO-Global FRA, the UNFCCC and the CBD and the recently adopted "Kunming-Montreal Global Biodiversity Framework" (GBF)[60]. In the framework of FOREST EUROPE (also known as the Ministerial Conference on the Protection of Forests in Europe), Member States report to varying degree on indicators for forests and the forest-based sector on a voluntary basis.

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[58] Freer-Smith et al. 2006

[59] Paris Agreement, Kyoto Protocol, Montreal Agreement.

[60] Target 21 aims to ensure that the best available data, information and knowledge, are accessible to decision makers, practitioners and the public to guide effective and equitable governance, integrated and participatory management of biodiversity, and to strengthen communication, awareness-raising, education, monitoring, research and knowledge management […].

However, none of these international commitments and fora includes an obligation for the EU or its Member States that establishes a common framework for forest monitoring or integrated long-term planning or provide a structured process for doing so. Neither is it likely that such commitments and obligations would emerge in the foreseeable future. Collaboration certainly exists but it is on a voluntary basis and split between many separate arrangements not achieving the required level of harmonisation or standardisation. For example, the experience in Forest Europe shows that the voluntary process on criteria and indicators serves as a structure and framework, but the actual take-up and application of the criteria and indicators varies widely between the various countries as the development and implementation process is complex and can be costly[61].

While not considered a viable stand-alone option, international engagement should continue and could be considered as part of the preferred option.

6 WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

This chapter identifies specific categories of economic, environmental and social impacts and provides a detailed assessment of those impacts for each of the policy options and sub-options that are still under consideration:

1. Option 1: Streamlined reporting for forest monitoring and integrated long-term forest planning – voluntary option
2. Option 2: EU framework for forest monitoring and integrated long-term forest planning – legislative option
   - 2.1. Medium level of intervention
   - 2.2. High level of intervention
3. Option 3: Obligatory monitoring and voluntary planning - the hybrid option

Table 2: Summary of the key components for each of the options

	Reporting obligation for indicators	Data harmonisation and standardisation	Role of Earth Observation (EO)	Dedicated Group for implementation support	Long-term plans obligations
Policy Option 1	No additional indicator obligations	Voluntary, based on Commission guidance	EC offers existing EO services to MS – i.e. baseline	Yes, focus on coordination, guidelines and knowledge exchange	No

[61] Linser and Wolfslehner 2022

Policy sub-Option 2.1	Yes, based on indicators gathered in existing EU and international frameworks Easy data access via FISE	Mandatory harmonisation, standardisation where statistical accuracy cannot be achieved	EO mandatory where pertinent; EU further developed EO services with MS 'opt-in' possibility	Yes, supporting development of common methods for monitoring	Yes, with mandatory common structure and elements
Policy sub-Option 2.2	Yes, also beyond existing monitoring EU and international frameworks Easy data access via FISE	Mandatory harmonisation and standardisation	EO mandatory where pertinent; EU operated	Yes, supporting development of common methods for monitoring and recommendations	Yes, with mandatory common structure and elements Commission issues non-binding recommendations
Policy Option 3	Yes, also beyond existing monitoring EU and international frameworks Easy data access via FISE	Mandatory harmonisation and standardisation	EO mandatory where pertinent; EU operated	Yes, focus on coordination, guidelines and knowledge exchange	No

The identified impacts have components that are unique, but also several components that are similar in nature for each of the assessed policy options and sub-options. To avoid unnecessary repetitions and keep the different sections balanced and of similar length, this chapter is structured by impact category rather than by policy option. In each section assessing a given impact category, all policy options and sub-options are considered, showcasing impacts that are common to all of them and those that are unique.

For the hybrid option (Option 3), provisions regarding monitoring are the same as for the existing policy option 2.2. and for long-term planning the same as for policy option 1. Socio-economic and environmental impacts of Option 3 are therefore not assessed individually but according to its two building blocks together with option 1 for the planning element and option 2.2 for the monitoring element. In light of the intrinsic links between the two elements, internal coherence is added as additional criterium for the comparison of the different options in the following chapter.

6.1 Identification of impacts and stakeholders

The following section describes impact categories that are being considered for each of the assessed policy options and sub-options.

Several relevant stakeholder groups have been identified. The table below summarises the main stakeholder groups which are used throughout this chapter, along with a brief description.

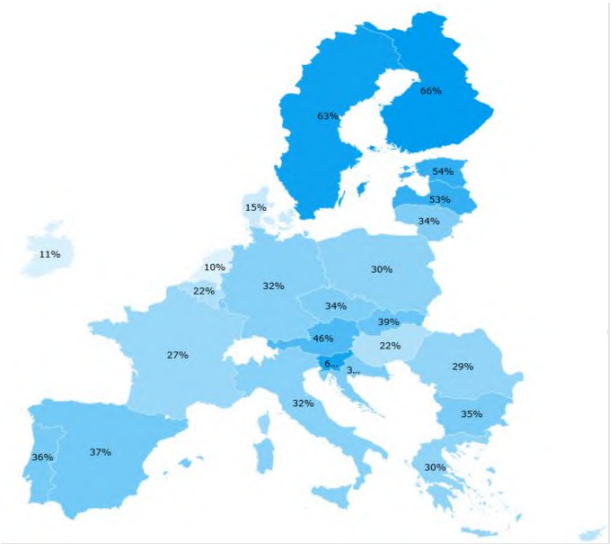
Table 3: Overview of most relevant stakeholder groups

Group	Description
EU institutions	• The EU level institutions develop and coordinate policy and oversee its implementation. They use data for policy monitoring and reviews.
MS public authorities	• Those include the relevant ministries, agencies, and other public institutions in the MS. They organise and implement (or procure) data collection activities and are in charge of integrated long-term planning. They use data and information to help the monitoring of policy implementation and policy making (including for forest management purposes) and to fulfil international reporting obligations. This may include disaster risk management agencies and services.
Data providers	• Those include organisations responsible for national forest inventories, organisations responsible for preparing and or collecting information on forest management planning, as well as organisations involved in the mid- to down-stream development of forest monitoring services in programmes such as Copernicus.
Other users of forest data	Those include a wide range of stakeholders which use forest data, for example: • Forest owners: Those who own forests and may or may not use them for economic purposes. • Forest industries: Forest industries can use information on forest resources to plan their resourcing strategies and to plan the feasibility of possible investments • Service providers: forest management services, carbon trade services, environment/green services; financial services/insurances; recreation and health, nature-based tourism, but also other types of service business - data applications on natural sites, non-wood products and services, and any other data-based business • Non-governmental organisations: Accurate and timely information will support transparency and participation of non-governmental organisation
Society	• Users of forest products, beneficiaries of healthy forests, general public

6.2 Description of the current situation

Costs for monitoring depend to some extent also on the area that needs to be monitored, i.e. the forest area in the respective Member State. The Figure below provides an overview of forest area per Member State.

Figure 1: Share of forest areas in the EU Member States **Figure 2: Share of gross value added of forestry and logging of national GDP**



Source: Eurostat. Own illustration. Detailed data in Annex 4

The Figure shows that there are large differences regarding the relative share of forest area to the overall area of the respective Member State. For example, around 2/3 of the areas of Finland and Sweden are covered by forests. On the other hand, only 1% of Malta and 11% in Ireland are covered in forests.

Consequently, the overall costs for monitoring are likely to be higher in Finland and Sweden. At the same time, the average cost per area can be expected to be lower in countries with large shares of forest areas since the cost for the overall structure of forest monitoring is distributed more widely. Vice versa, while the costs in countries with a small share of forest area will be lower overall, the overhead for governance, education, IT structure, and other enabling factors for forest monitoring, is comparably larger.

In addition to those benefits of scale, it should also be noted that the expected long-term benefits from better monitoring such as reduced biodiversity loss, enhanced resilience and others are higher in those countries than in the ones with little forest.

6.3 Economic impacts

6.3.1 Public budget

Data harmonization, improvement of existing as well as the set-up of new monitoring and integrated planning systems bear the following economic costs for equipment and personnel that would be borne by the public budget (EU, national, regional, or lower level):

- Monitoring systems: This includes costs related to one-off investments, scientific research and technical analysis, operational roll-out and maintenance.
- Harmonisation and standardisation of data collection and reporting: Data for a given indicator, collected through different methods or different sources, can have various formats. To be able to

compare data collected through different methods, the aggregated statistical estimates needs to be harmonized, which is linked to some costs. The development of the definition and methodology for standardization can also be linked to costs as well as its roll out.

- Integrated long-term planning: This includes administrative costs related to drafting of the plans, their review and monitoring of progress towards objectives set out in the plan.

6.3.1.1 Monitoring systems

It is planned that through the legislative initiative remote sensing will play a greater role in forest monitoring than is currently the case, with positive impacts on the productivity of the sector. Table 4 on the semi-quantitative review of forest monitoring methods provides a comparison of remote sensing as compared to ground-based monitoring or aerial monitoring. The selected attributes are rated in relative terms from + (worst, compared to other methods) to +++ (best, compared to other methods).

Table 4: Semi-quantitative review of forest monitoring methods

Method	Data timeliness	Resolution	Data accessibility	Costs*	Strengths	Weaknesses
Ground-based data collection	+	+	+	+	Direct observation in the field; source of official statistics; long tradition of methods; strong statistical soundness; possibility to collect detailed biodiversity and habitat related information on the plot level	Lack of harmonisation on definitions and methods; expensive; raw geodata not available; unable to detect quick changes in near real time; estimates only valid at national or macro-regional levels
Airborne data collection	++	+++	+ to ++ depending on the project	+ to ++ depending on the project	Airborne Laser Scanning and optical imagery can be used for precise structural and compositional mapping; good biomass/carbon stock monitoring;	Cost; geographical coverage
Satellite data collection	+++	++ to +++ based on the product used	+++	+++	Wall-to-wall information; capable of acquiring changes in near real time (e.g., forest disturbance); large public and open-access databases; pan-European monitoring process operational/demonstrated or developed for many forest indicators	Need for processing capacity; data quality related to climatic conditions; need of ground-based data for modelling, calibration and accuracy assessment

The selected attributes are rated in relative terms from + (worst, compared to other methods) to +++ (best, compared to other methods).

* Only considering the per hectare costs of EO image acquisition without the launch/take-off costs, they are lowest for satellite monitoring (0.09 EUR/ha) and higher for airborne technologies, with airplanes being less expensive (1.68 EUR/ha) than drones (43.36 EUR/ha)[62].

Source: Own compilation

As is shown, satellite data offers many benefits such as frequency, wall-to-wall coverage, transparency of data and many others. From an operational standpoint, remote sensing can provide

[62] Sozzi et al 2021

benefits when replacing ground-based data collection or complementing it when used for monitoring new indicators. The feasibility of satellite-based support systems for land management, including compliance assessment, is demonstrated by the CAP legislation, where its use is prescribed in the legal text[63]. It should be noted that satellites are to date already used for EU wide forest-related monitoring, for example through the EFFIS or high resolution layers on tree cover density and forest type under Copernicus[64].

A case study in Sweden assessed the benefits from a situation in which ground-based data collection for forest regeneration after clearcutting has been replaced by satellite-based monitoring[65]. It found that the use of satellite data collection allowed to save between EUR 16 and 21 million per year. Breaking savings further down, the study finds that approximately EUR 9 million of those annual benefits accrue for the public authorities (the Swedish Forest Agency), between EUR 6 and 11 million for private forests owners (from increased compliance with forest management obligations which in the long-term lead to higher return), and approximately EUR 1 million for citizens.

An ex-ante evaluation of Copernicus benefits[66] estimated that if 75% of data needed to produce clear-cut maps by public administrations for monitoring compliance will be produced using free of charge Copernicus data, replacing data currently purchased from commercial satellites, this can bring cumulative savings of anywhere between EUR 28.2 million to 37.6 million by 2035 (not discounted). At the same time, it should be emphasised that the figures only looked at one specific indicator, and that benefits from additional indicators will likely add up.

Looking at the overall benefits of the Copernicus system for forest monitoring, the ex-ante study estimated that the potential of those cumulative benefits[67] between 2017 and 2035 is between EUR 5 and 13 billion across the EU. However, it should be noted that those numbers are subject to major uncertainties and only partly applicable in this context: they are to a large extent based on extrapolating findings from the abovementioned case study across the whole EU; they assume that commercial data are replaced with free-of-charge Copernicus data at a certain rate; and the ecosystem benefits are based in the assumption that the access to Copernicus data will improve the implementation of the Habitats Directive.

Albeit major investments are needed for providing and maintaining the necessary infrastructure (by public as well as commercial providers), all assessed policy options build on already existing EO technologies, and thus no major costs would be linked to their set-up. Those systems are part of the baseline and do not increase through improved uptake of the forest related data products. It should however be highlighted that those initial investments are substantial; for example, the European EO Programme Copernicus alone had a budget of around EUR 4 billion for the period 2014 to 2020 and is planned to benefit from EUR 5.8 billion for the period 2021 to 2027[i], covering a wide range of domains and applications, with only a part of this budget being relevant for forest monitoring. Monitoring that would purely rely on data from these public satellites would imply that there are no costs for data acquisition. However, depending on which indicators are monitored, costs can occur

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[63] See Recitals 58 and 100, and Articles 7, 25, 65 and 83 of Regulation (EU) 2021/2116.

[64] https://effis.jrc.ec.europa.eu, https://land.copernicus.eu/pan-european/high-resolution-layers/forests

[65] Geoff et al. 2016

[66] PWC 2017

[67] Coming from a) cost reduction in monitoring compliance to forest management best practices; b) improved yields in forest industry thanks to sustainable management; c) improved and preserved forest ecosystems and green infrastructures

for the processing of the data and development of the relevant new data products, and those would be borne by the EU.

Table 5 below shows the potential savings by using public satellite data (Sentinel 2) whose data are free of charge. The minimum area price includes data processing costs of image rectification, masking, index calculation and producing output. It should be noted that resolution plays a crucial role in determining the price as well as the further processing that is needed in order to obtain data for a specific indicator.

Table 5: Estimation of costs for selected remote-sensing products

	Minimum order area *ha*	Price per unit *$ ha⁻¹*	Minimum area price* *$*	Computational demand *KB ha⁻¹*
Deimos-2	10 000	0.060	700	50
Dove	10 000	0.012	218	8
GeoEye-1	10 000	0.275	2850	100
Kompsat-2	2 500	0.055	237.5	20
Kompsat-3	2 500	0.110	375	50
Kompsat-3A	2 500	0.160	500	100
Landsat-7/8	3 700 000 (one scene)	0	100	0.5
Pleiades-1A/1B	10 000	0.213	2225	100
Rapideye	10 000	0.012	218	4
Sentinel-2	1 200 000 (one scene)	0	100	0.63
Spot-6/7	10 000	0.045	550	8
WorldView-2/3/4	10 000	0.275	2850	130

*minimum area price is obtained by minimum order area times price per unit plus data processing cost

Source: Sozzi et al. 2018

Option 1

Voluntary coordination through guidelines, recommendations, benchmarking and sharing of best practices will lead to low to moderate economic impacts for the public budget of Member States with respect to forest monitoring, which would have the choice on their level of engagement, varying anywhere between the baseline and the most ambitious option, and the related costs they would decide to bear.

It is assumed that Member States will show a slight increase in uptake of remote sensing for their national forest monitoring following the recommendations for the use of publicly available data or producing their own data sets using purchased services.

Common for Option 2

Under both sub-options, Member States will be obliged to report on a mandatory set of indicators and parameters linked to EU legislation and policy objectives on forests. Depending on the indicator, ground-based or EO-based data collection, or both, might be used (see table 21 in Annex 5).

Costs for Member States under this option will depend on whether their current ground-based data collection system (e.g. NFI) meets the minimum requirements defined – specifically the 5 year data collection frequency and the spatial resolution indicated in Table 21 for each indicator and parameter.

The analysis presented in Table 6 based on the current status of NFIs in Member Status shows that Member States can be divided in 3 groups in line with the degree of expected costs which would be required to adapt their current data collection framework to meet the required minimum quality standards, namely a 5-year data collection frequency, and data coverage. For more detailed discussion on the method and the results, see the relevant sections in Annex III.

The costs for those Member States with a current 10-year cycle would likely be considerably less than double of the current costs, since expertise, infrastructure, and equipment would be maintained and incremental cost would only arise from additional staff costs during data collection and analysis.

More significant costs would occur in cases where a new ground-based system with sufficient sampling plot density would need to be established by a Member State with no existing running NFI (Bulgaria, Greece) or those where only one assessment has been carried out (e.g. Croatia) – these costs would relate to investments into new infrastructure (e.g. designing the sampling grid and establishing plots), capacity building (training of personnel), and equipment. In these countries the running costs would decrease for the subsequent exercises.

Table 6: Categorisation on Member States according to potential costs under the preferred option

	MS	Forest area	Share of GVA of forestry sector overall GDP	Monitoring plots: Number of NFI forest monitoring plots	Monitoring plots: NFI monitoring plots per km2 of forest area	Monitoring plots: Current time interval between subsequent plot visits	Extent to which EO is currently integrated in forest monitoring programs	Overall number of indicators NOT monitored yet	Extent to which MS already have forest strategic planning in place
Group 1	Bulgaria	38,930 km2	0.40%	No NFI	n/a	n/a	No information	5	2
	Croatia	19,391 km2	0.40%	6,232	0.3	only 1 assessment	2	6	2
	Cyprus	1,725 km2	0.01%	320	0.2	only 1 assessment	No information	12	3
	Greece	39,018 km2	0.03%	2,744	0.1	only 1 assessment	3	9	2
	Malta	5 km2	0.00%	No NFI	n/a	n/a	No information	18	2
Group 2	Austria	38,992 km2	0.24%	11,000	0.3	3	3	5	2
	Belgium	6,893 km2	0.02%	11,000	1.6	5	4	4	2
	Czechia	26,771 km2	0.52%	19,727	0.7	5	3	5	3
	Denmark	6,284 km2	0.09%	9,558	1.5	5	2	6	3
	France	172,530 km2	0.14%	33,500	0.2	5	2	5	3
	Germany	114,190 km2	0.08%	78,000	0.7	10	2	5	2
	Hungary	20,530 km2	0.19%	7,425	0.4	5	2	6	2
	Ireland	7,820 km2	0.01%	1,932	0.2	5	2	6	2
	Italy	95,661 km2	0.11%	7,000	0.1	10	2	4	2
	Lithuania	22,010 km2	0.50%	5,737	0.3	5	3	4	2
	Luxembourg	887 km2	0.03%	1,200	1.4	10	No information	6	3
	Netherlands	3,695 km2	0.02%	3,190	0.9	4	4	7	2
	Poland	94,830 km2	0.36%	30,722	0.3	5	2	9	3
	Portugal	33,120 km2	0.44%	12,000	0.4	10	3	5	2
	Romania	69,291 km2	0.63%	24,000	0.3	5	No information	7	2
	Slovakia	19,259 km2	0.54%	1,486	0.1	10	3	6	3
	Slovenia	12,378 km2	0.60%	761	0.1	10	4	6	3
	Spain	185,722 km2	0.08%	95,327	0.5	10	3	4	2
Group 3	Estonia	24,384 km2	1.16%	27,500	1.1	5	2	6	2
	Finland	224,090 km2	1.70%	60,000	0.3	5	1	3	2
	Latvia	34,108 km2	1.70%	No information	n/a	5	3	5	3
	Sweden	279,800 km2	0.73%	No information	n/a	5	1	5	2

Legend: For columns showing the variables of forest area, number of NFI plots, NFI plot density and frequency and the number of indicators not monitored (compared to the indicators of Table 21 considered for their inclusion in the legislative proposal under the preferred option), the red colour coding denotes a high effect of this variable on costs under the preferred option, yellow a neutral effect, while green denotes a low effect. Frequency of plot visits is compared to a 5 year benchmark. For the column on the 'Share of Gross Value Added of Forestry Sector to overall GDP', green colour denotes higher overall benefit from acquiring additional information on forest to the forest sector. For the column on planning, the orange colouring code denotes moderate costs while yellow denotes limited costs.

Both sub-options come with additional effort needed for the mapping of forest habitats under Habitats Directive (2.1) and primary and old-growth forests (sub-option 2.2), for which field surveys additional to the sample-based forest inventory might be necessary, entailing some further costs to Member States, especially those with large forest areas. Tools such as EO data could be used in the first stage for pre-screening potential areas, in combination with in-situ data and modelling techniques, for improving the cost-efficiency of such an exercise.

While the impact assessment faced in most cases major challenges in identifying information on the costs and budgets of conducting NFI and other forest monitoring activities, such data could be identified in three Member States: Finland, France, and the Netherlands. While this sample is not representative for the whole EU, it nevertheless includes a spread of countries of different size and different share of forest areas. It needs to be noted that the costs include the use of EO for the support of the NFIs and that the NFI frequency ranges from 5 (France and Finland) to 7 years (the Netherlands). The average annual cost of forest monitoring through NFIs in those countries is 42 EUR/km^2 of forest area. Bearing in mind the caveats around the non-representativeness of the sample (e.g. France and Finland have above-average indicator coverage of their NFIs, see Table 22) and the assumption around the use of EO, this sum is a rough approximation that countries with no NFI would bear to set up a new system. Countries with lower NFI frequency could bear the additional cost equalling the difference between the abovementioned sum and their current annual costs per km^2 of forest area in order to reduce their NFI interval to 5 years.

Development costs for Copernicus would be limited compared to the significant frontload of past investments into the system and its forest-related elements, especially on tree cover density. Still, there would be additional costs for development and continuous updating of new forest data products. Based on the existing contracts by the EEA's Copernicus Land Monitoring Service[68], the estimated costs for producing an annual update of an EO-based forest data product is approximately EUR 500 000. Additional costs are expected in relation to acquiring ground data for the validation and calibration of these products, especially relating to forest disturbances or estimation of aboveground forest biomass. These will vary depending on accessibility of existing data collected by NFIs – higher costs are to be expected if the data are not accessible and an alternative ground data framework would need to be funded.

In both sub-options, benefits stemming from a greater role of remote sensing can be expected (see also 6.4).

Option 2 – Sub-option 2.1

Under sub-option 2.1, the Commission will further develop and operate satellite-based forest monitoring for the indicators with foreseen EO obligations, with the possibility for Member States to enrich the data pool via an 'opt-in' option. Additional cost would mainly relate to increasing the frequency and quality of existing products, relating to for example tree cover density changes or monitoring of crown condition.

For indicators with foreseen mandatory EO monitoring, the Member State could use data provided by the Commission, or use the 'opt-in' option, using either their own existing EO data sets and systems or acquiring new EO data and services. Most costs incurred by the public budget of Member States linked to this sub-option would therefore be linked to the purchase of selected products from existing remote sensing service providers where Member States choose to 'opt-in'. For satellite data,

[68] https://ted.europa.eu/udl?uri=TED:NOTICE:163863-2019:TEXT:EN:HTML

this would entail related data processing and acquisition costs of the order of magnitude similar to products showcased in table 5 above.

To ensure comparability of data from Member States choosing to 'opt-in', the EU institutions might bear the cost of defining minimum product requirements for remote sensing in terms of technical parameters of an indicator, minimum mapping unit, pixel resolution, periodicity between assessments and accuracy. Those could then be calibrated to national circumstances to ensure that the data would be comparable across the EU.

An advantage of a system that is developed centrally but that has the option to be implemented in a distributed manner through 'opting-in', is that Member States could realise potential synergies and meet requirements both at EU-level as well as at national, sub-national to local levels. Another advantage is that restrictions on the sharing or use of geo-referenced in-situ plot data – as is currently an issue in several Member States – may be circumvented (as explained in Chapter 5.2.2 for sub-option 2.1). Lastly, higher resolution data might be fed into the satellite-based EU system (e.g. from airborne monitoring), increasing the quality of data provided.

Option 2 – Sub-option 2.2 and Option 3

Under sub-option 2.2 and Option 3, the Commission would develop and operate EO-based forest monitoring complementary to in-situ data collection and report these data to FISE. [69]

In addition to impacts described for sub-option 2.1, additional processing costs would be incurred by the Commission by developing new forest data products for indicators and parameters that are not currently produced using Copernicus remote sensing data and the reporting on which would be mandatory (e.g. comprehensive EU forest disturbance monitoring). The costs would overall be comparable to those outlined under sub-option 2.1.

6.3.1.2 Harmonisation and standardisation of data collection and reporting

Common to all options

Some moderate costs are expected to occur when developing and applying reference definitions and harmonised methods for the different indicators. An indication of the order of magnitude of data harmonization costs can be found from looking at costs of ongoing initiatives with comparable objectives. The table below provides an overview of such initiatives and their costs.

Table 8: Overview of ongoing and past initiatives aiming at harmonising EU wide forest data

Name	Type	Overall budget	Estimated share of the overall budget for harmonisation
PathFinder Towards an Integrated Consistent European LULUCF Monitoring and Policy Pathway Assessment Framework	Horizon Europe research project	6.3m EUR	5-10 %
ForestPaths Co-designing Holistic Forest-based Policy Pathways for Climate Change Mitigation	Horizon Europe research project	6m EUR	14% (10 indicators – EUR 840.000 per indicator)
DIABOLO Distributed, Integrated and Harmonized Forest Information for Bioeconomy Outlooks[70]	Horizon 2020 research project	5m EUR	60 %

[69] See Recitals 58 and 100, and Articles 7, 25, 65 and 83 of Regulation (EU) 2021/2116.
[70] More details in these projects see https://cordis.europa.eu/

Name	Type	Overall budget	Estimated share of the overall budget for harmonisation
Harmonisation of National Inventories in Europe: Techniques for Common Reporting[71]	Cost action	570k EUR	100%

Source: Own compilation

In addition, several specific contracts have been tendered by the Commission's Joint Research Centre under the framework contract with ENFIN, focusing among other objectives on forest data harmonisation through developing and applying common definitions and conversion methods, for instance on aboveground biomass, area of forest available for wood supply and net annual increment (Specific contract 17, 19, 20 and 21 under the Framework contract 934340)[72]. The total cost for these and other forest data harmonisation exercises under three framework contracts as of 2008 is estimated to be around EUR 1.95 million.

The actual costs for harmonising the data, once the method is implemented, are not considered to be significant. As the necessary scientific and technical background analysis for harmonization is already undertaken, cost per Member State will be limited to operational roll out, which in most cases can be assumed to be an automatized statistical process following an established protocol from the background research. Our internal analysis of three JRC projects showed that the conversion of estimates by applying the harmonised definitions cost up to EUR 10 000 per variable per Member State.

It is expected that most of the process would be automatic, with manual quality assurance procedures in place. As for the QA/QC, the reporting frequency plays an important role for the costs (see Table 21 for data reporting per indicator).

The data will be reported through the existing FISE platform[73] and thus no major IT development costs would occur; those would relate mainly to operational and maintenance costs, which might be slightly higher due to the amount of data to be processed. Maintenance and further development of the platform are currently partly outsourced through a number of contracts with combined costs of around EUR 300 000 annually.

Additional costs would occur for the Commission for developing IT related specifications for data, metadata, data exchange and data sharing protocols. This would e.g. include the development of xml schemas and guidance documents[74] and thus not lead to major costs.

Increasing the efficient use of public resources, the Commission may save costs on accessing and assessing reporting done by Member State authorities where current reporting in formats which cannot easily be automated (e.g. reporting in pdf format) or accessed is replaced by common reporting of the base data to FISE.

Option 1

Voluntary harmonisation and standardisation will lead to low to moderate budgetary impacts for Member States, which would have the choice on their level of engagement, varying anywhere

[71] https://www.cost.eu/actions/E43/
[72] https://ted.europa.eu/udl?uri=TED:NOTICE:45302-2018:TEXT:EN:HTML
[73] Developed in a partnership between the Commission and the EEA, and set up under the 2013 EU Forest Strategy, FISE is an entry point for sharing information and data on Europe's forests.
[74] See e.g. this example of the respective files for reporting under the Drinking Water Directive

between the baseline and the sub-option 2.2 in terms of the extent of indicators harmonised/standardised, and the related costs they would decide to bear. The voluntary nature could mean that Member States choose to harmonise indicators in the most cost-efficient manner, i.e. choose to target such indicators where harmonisation costs borne by their public administration would be lowest in relation to the estimated utility value of the efforts on the national level.

The order of magnitude of those costs for option 1 should stay below the costs of initiatives listed in Table 6, as it is assumed that the Member State choosing to harmonise will select indicators for which the necessary harmonised definitions and methods have already been developed.

It can be assumed from previous experience that some Member States will "go the extra mile" and transform their locally collected data according to an established protocol into harmonized indicators for the EU in cases where the added value for Member States of such a harmonisation is immediate and demonstrated, in particular for forest risk assessments and collaboration in case of natural disasters. Other Member States could show more reluctance to carry out this additional step for indicators they deem less critical for their own benefit, in particular with regards to biodiversity and forest carbon estimates. Where standardisation is recommended, e.g. because the transformation process does not lead to a statically robust harmonized indicator or because the indicator is new, voluntary engagement by Member States is highly unlikely due to relatively higher costs, unless there is a clear and immediate benefit for them.

Option 2* and *monitoring element of Option 3

Obligatory standardization and harmonization of selected mandatory indicators would lead to moderate to significant economic impacts for the public budget of Member States, depending on the current situation in individual Member States.

Similarly as for Option 1, cost of harmonisation for public administrations will be mostly limited to operational roll out, and, where currently missing, building of new reference definitions and conversion methodologies (i.e. 'bridges'[75]).

In cases where harmonization of estimates is not possible due to a lack of common reference definition or harmonisation methods, or the high inherent uncertainty of the bridging functions leading to harmonised estimates of low quality and accuracy, there would be additional costs as data need to be collected according to a common standard instead. The bulk of costs would be borne by those Member State authorities who have to adapt their current monitoring to the new standards. This can lead to two different situations: on the one hand, MS could give up their current national system and only apply the standardised methodology. This could lead to the loss of national time series. On the other hand, MS could decide to implement two parallel systems (i.e., their national system and the established standard), which would result in increased costs for labour.

Specific costs for the MS for implementing the new standardised methodology depends on the indicator. The cost of standardisation may be close to zero for new easily visually detectable tree-related parameters which require only limited changes in time and skills to detect – this applies for example to standardisation of indicators related to basic tree variables (e.g. growing stock).

For both sub-options of Option 2 and the monitoring element of option 3, there are indicators which are not yet part of the data collection in all Member States (see Table 21 and 22 in Annex 5). In those cases, additional costs would accrue for rolling out the indicators in the country (including staff costs and potentially costs for new equipment). It is not possible to estimate the marginal cost of rolling

[75] Ståhl et al. 2012

out additional indicators in Member States where they are not yet measured, because detailed information on monitoring of particular indicators is very sparse and is not openly shared due to various data protection reasons.

In general, adding an indicator to a national monitoring system could come with almost no additional cost if it is calculated on the basis of existing data (e.g., Shannon index for tree species diversity could be calculated based on the already collected data on tree species). On the other hand, it could lead to increased costs if additional training of staff, purchase of equipment, or others are needed – if substantial measurements or additional staff are required (e.g., for non-tree plant diversity), this might increase cost per plot of 30 to 50%.[76].

For sub-option 2.2 and monitoring element of Option 3 costs will increase with the additional indicators. Most of these can be assumed not to be gathered by Member States at a significant scale and would thus require standardization. The costs of the obligation of monitoring an additional indicator in the existing NFI is in general limited, although in the case of primary and old-growth forest, it might entail costs related to ground-surveys for their identification and monitoring.

In contrast to option 1, the data to be reported is fully harmonised or standardised across Member States. Thus, the data could be presented in specific maps, graphs, charts or other means in FISE. Within the institutions, it is expected that the integration of additional forest data and indicators would entail further staff days as a one-off expense when extending the contracts, resulting in additional costs compared to the baseline (EUR 300 000 annually through external contracts plus internal resources at the EEA) estimated at max 30%.

6.3.1.3 Integrated long-term planning

Option 1 and Option 3

Under options 1 and 3, Member States would not have any obligations related to integrated planning other than those already in place. Limited additional costs specific to integrated planning would be incurred by Member States from the adoption of voluntary guidelines on integrated planning and by the Commission for producing the guidelines and providing means of policy coordination between Member States, such as costs for organising the workshops or costs for developing the guidance materials. Based on the voluntary guidelines, Member States could gradually improve and adapt their national strategy planning system ensuring better comparability at EU level. There is however large uncertainty on whether Member States would follow voluntary guidelines to the extent required to achieve the objectives of this initiative.

Option 2 – Sub-option 2.1

Under this option, Member States would be required to develop long-term plans aligning them to a common structure including forecasting, to report every five years towards the goals set out in the plans and review them every 10 years to ensure their viability. At an expert workshop on costs and benefits hosted by the Commission, most participants agreed that such timeframes were relevant due to the fast moving nature of pressures and policy frameworks, and to be able to adapt the plans in case of rapid changes in forests (see Annex 2).

The actual costs per Member State would to some extent depend on already existing information, structures and expertise in the Member States. Several Member States at least partly develop integrated planning instruments for forests. A mapping done as part of the impact assessment (Table 23, Annex 5) shows that 18 Member States already have or are developing a document which can be

[76] An estimate based on an assessment by NFI experts interviewed by a contractor

considered a national forest strategy fulfilling to some degree the objectives of long-term integrated planning. Requiring those plans to follow a common structure would require limited efforts and low additional costs.

For Member States that do not have partially integrated planning instruments in place or for underpinning existing plans moderate costs would occur, the main cost coming from the preparation of the reports. This would include the following items:

- One-off costs for developing new or adapting existing methodologies for forecasting,
- Recurring cost for conducting the forecasting exercise,
- Recurring cost for target setting (including internal coordination between authorities and conducting stakeholder consultations),
- Recurring cost for drafting the report.

The direct costs for Member States are very difficult to estimate in advance as these costs depend to a large extent on the national context, capacity, economic situation etc in the Member States and it is not possible to foresee how Member States would work to design their plans.

However, as a reference for the magnitude of the costs the example of Germany can be given which started developing their 2050 strategy in 2015 and spent approximately EUR 600 000 for the development (EUR 500 000 for the preparation of the strategy and EUR 100 000 for dissemination[77]).

Costs for analysis related to forest carbon can be considered low given previous experiences by Member States with National Forestry Accounting Plans, the National Energy and Climate Plans and the Long-term strategy and biannual reporting obligations on policies, measures and projections. Socio-economic indicators may also be readily available in several Member States. However, for Member States that do not yet include those, cost will occur for sections on climate adaptation, biodiversity and assessing the overall policy coherence. In particular costs for smaller Member States with less experience and Member States with low shares of forest land may be higher than Member States with more experience in forest planning and foresight.

Regarding the costs for drafting the progress reports, by way of example the Fitness check of the Reporting, Planning and Monitoring Obligations in the EU energy acquis[78] surveyed Member States about their costs for policy planning and reporting in relation to several obligations of the Renewable Energy Directive. The results presented in the study include median costs of EUR 4 407 per Member State and year. Those relatively low costs have been found to be largely driven by a standardised template provided by the Commission, which was also found to increase the compliance of Member States with the reporting obligations[79].

Option 2 – Sub-option 2.2

In addition to requirements described under sub-option 2.1, under sub-option 2.2, the Commission will review Member States' integrated planning instruments and issue recommendations on their alignment with specific policy goals.

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[77] Bundesfinanzministerium 2015
[78] Trinomics 2016
[79] SWD/2016/0416 final

Costs would be of the same order of magnitude as under Sub-option 2.1, but additional costs in Sub-Option 2.2 would arise for any follow up to the Commission's recommendations.

6.3.2 Regulatory burden for SMEs and other businesses

None of the policy options includes any regulatory obligations that would be directly applicable to businesses. Monitoring, reporting and integrated planning would, for all of the policy options, be the responsibility of public authorities.

Data collection for the large majority of indicators, namely those that will rely on satellite data or on a network of monitoring sites to produce statistically relevant information on the national level[80], would be directly undertaken by competent authorities, with no risk that the burden or costs would be passed down to businesses.

In the case of economic indicators under Options 2.1, 2.2 and in relation to Option 3's monitoring element related to the bioeconomy, namely on production and use of timber and non-wood forest products, some indirect basic reporting obligations might arise for the forest-based sector to fulfil data needs by competent authorities, but these statistical data are estimated to have negligible additional costs, as they would be collected and reported for industry statistics purposes or for existing international reporting, such as Joint Forest Sector Questionnaire, to which the vast majority of the MS already provide replies.

[80] See Table 21 for an overview of those already monitored by NFIs.

Box 1: SME Test

In the first step of the SME Test it has to be determined *'to what extent is the initiative relevant for SMEs (not relevant, relevant, highly relevant)?'* with the help of the following guiding questions:

- *Are SMEs within the scope of the legislative initiative? Does the initiative specifically target SMEs?*

The scope of the assessed initiative does not include any obligations towards the SMEs, neither in the forestry and logging sector, nor on the side of industry. Therefore it can be concluded that SMEs are not specifically targeted by the initiative.

- *Will the SMEs be significantly impacted directly or indirectly by the legislative initiative? Are SMEs impacts likely to be more substantial than on other companies, for example in terms of adverse effects?*

Based on the questions above, no direct impact on the SMEs is expected. On-the-ground data collection on forest resources and condition will not be done by individual forest owners, but through a sample-based approach by forest inventory networks funded by public authorities, as is the case in every MS with an established monitoring system.

Nevertheless, some indirect impacts on wood-based industries cannot be excluded if reporting on the production and use of timber products is passed onto the forest-based industries. However, additional costs are considered to be limited as such reporting already largely exists for other purposes (see below).

Based on the questions above, the first step of the SME Test can conclude that the initiative is ***not relevant for SMEs*** in terms of its potential negative impacts and therefore no further analysis is needed.

No major impacts on businesses related to regulatory burden were thus identified for any of the policy options under the 'SME Test'(see box 1 above).[81]

6.3.3 Opportunities for SMEs and other businesses

It is planned that thanks to the legislative initiative the EU will be a global leader for forest monitoring and implementation of sustainable forest management practices, offering numerous opportunities for growth and innovation of European businesses.

Remote sensing will play a greater role in forest monitoring than is currently the case, offering many possibilities to SMEs active in acquiring and processing the satellite imagery, data processing and providing services related to forests and forestry, including advisory services. Promoting EO-based based products under Option 1 or introducing a legal mandate for acquisition of specific forest data under Options 2 and 3 would increase the demand for EO based products in general, which would

[81] Based on tool 23 in European Commission 2021

encourage more companies to enter the market and create new products to meet the increased demand.

A survey[82] from 2020 among countries members of either the EU or ESA has found that for more than 9000 companies EO services are a minority part of their business, with 97% of them being classified as micro, small or medium companies. As it has been the case in agriculture with the revolution brought by remote sensing to precision agriculture, and that opened a new market, offering numerous opportunities for European SMEs and other businesses, it can be assumed that a similar success story could take place in forestry.

The global market for remote sensing products and related data processing and advisory services has been estimated at USD 16.5 billion[83] in 2020, out of which around 40% are held by European businesses[84]. The global market is estimated to grow and reach USD 55.5 billion in 2028. According to the World Economic Forum, the conservation, restoration, and sustainable management of forests could generate EUR 190 billion in business opportunities and 16 million jobs worldwide by 2030[85].

The greater role of remote sensing can also bring benefits for forest managers and the forest sector: the case study[86] mentioned in the previous section on monitoring systems estimated annual benefits ranging between EUR 6 and EUR 11 million annually for private forests owners in Sweden from increased compliance with forest management obligations leading to higher returns in the long-term. Building on this study, the ex-ante benefits assessment for Copernicus[87] also concludes on remote sensing and Copernicus' potential to improve yields thanks to sustainable management practices, increasing the volume and quality of timber in the long term.

Easy access to high quality data will also allow businesses linked to the forest sector to better understand the quality and quantity of ecosystem services forests provide and the costs of inaction. A study from 2021 provided an assessment of the economic costs of climate change in Europe and found that there was low coverage of the forest sector, and a particularly limited number of studies on the evaluation of losses from pests and diseases[88]. A case in point is Czechia, which suffered dramatic decreases in the market value of its wood products due to severe bark beetle attacks requiring salvage logging of large amounts of infected trees. Following a severe 2018 outbreak, timber prices decreased from EUR 56-64 per m3 (2011-2017), to EUR 14-16 per m3[89].

Understanding the quality and quantity of ecosystem services provided by forests is also a crucial step in view of a future implementation of payments for ecosystem that would compensate and reward forest managers, incentivizing them to enhance or maintain ecosystem services provided by forests. Indicators related to carbon capture and storage would be key to quantify possible payments for climate mitigation, for instance within the framework of the EU Certification of Carbon Removals[90],

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[82] EARSC 2020
[83] Statistics Market Research Consulting 2021
[84] European Union Agency for the Space Programme 2022
[85] World Economic Forum 2020
[86] Geoff at al. 2016
[87] PWC 2017
[88] COACCH 2018
[89] Hlásny et al. 2019
[90] https://climate.ec.europa.eu/eu-action/sustainable-carbon-cycles/carbon-removal-certification_en

while indicators related to biodiversity could allow to quantify possible payments for nature restoration or conservation.

This may also allow forest holdings and the downstream forest-based businesses to foresee changes (e.g. in species composition) and adapt their business practices. This may lead not only to additional jobs in information technology and communication as well as foresters working in the field but also more cost-efficient intervention when field units are guided to areas where the intervention is pertinent.

6.3.4 Digitalisation

There are strong synergies between the green and digital transition.[91] The greater role of advanced forest monitoring technologies and reporting systems, using advanced technology, is expected to bring high benefits in terms of digitalisation, in line with the objectives of the Digital Agenda for Europe[92]. This digitalization of forest information will require higher upfront investments followed by moderate costs for operation as discussed in the section on impacts on public budgets.

The benefits accrued in terms of digitalisation can be found mainly under Option 2 and Option 3, where more prominent role is envisioned for reporting of the data collected through a single portal – FISE. A future version of FISE enhanced with up to date in situ data and EO calculated indicators could take part in the Green Deal Data Space eco-system and contribute to a data market economy.

As elaborated in 6.4.1.1, the carbon offset market will most likely have a strong interest for certain Forest indicators made available from the forest monitoring program. Carbon market stakeholders like forest owners will make use of the data to carry out monitoring reporting and verification activities related to carbon capture by their forest projects.

In line with the first objective of the Digital Agenda for Europe, *providing better access for consumers and businesses to digital goods and services across Europe,* having easy access to the data will reduce the administrative burden for businesses, citizens, and administrations in search of forest-related information. Using FISE as the single portal for data reporting and publication will also be aligned with the 'once-only' principle for data use. This principle is also adhered to when Copernicus data are reused for production and monitoring of new indicators.As outlined in section 6.3.3 on Opportunities for SMEs and other businesses, the initiative will contribute to creating the right conditions for digital networks and services to flourish and contribute to maximising the growth potential of the digital economy, which are the second and the third objectives of the Digital Agenda for Europe.

6.4 Assessment of environmental and social impacts

The environmental and social impacts of the initiative are difficult to directly quantify as they are often 'knock-on', i.e. indirect benefits of the initiative. As an example, the framework aims to facilitate evidence-based decision-making at the EU level, which will support the implementation (and achievement) of EU policy objectives relating to forests, and more sustainable forest management and enhanced environmental protection of forests. Therefore, general estimations are

[91] COM(2022)289 final
[92] European Parliament 2022

given in quantitative terms where possible; otherwise qualitative statements based on existing literature are used to illustrate the impact.

6.4.1 Environmental impacts

Facilitation of evidence-based decision- and policy-making

Evidence-based decision-making is one of the pillars of EU policy[93].The availability of high-quality, accurate and continuous datasets that provide a holistic picture on the state of forests provides the evidence base for informed decisions and policies on forests by administrations and forest managers, and facilitates the monitoring of progress towards policy objectives and goals. This is needed for national or EU wide outlooks, scenario building and impact assessments. Moreover, long-term integrated plans that highlight trade-offs between different policy objectives at the national level can contribute to identifying inefficiencies, potential policy incoherencies and conflicting demands on forests that could necessitate a policy review.

The ability of the different policy options to deliver on this is highly dependent on the comprehensiveness of the long-term plans and the type of indicators that are selected and their adequacy to capture the broad range of policy goals and objectives. For policy option 1 and in relation to long-term planning for option 3, it is in general difficult to assess to what extent Member States would adopt monitoring of additional indicators and carry out integrated long-term planning on a voluntary basis. Even though this might bring certain economic benefits (see Section 6.3.1), it can be safely assumed that the indicator coverage and the uptake of long-term plans in Member States will bring about a comparatively lower environmental impact as opposed to the obligatory nature of indicators, EO-based monitoring and integrated planning instruments under Option 2 and Option 3. The means for the Commission to issue recommendations on integrated planning instruments will result in a moderately better environmental impact with regard to matching national projections with overall EU policy and balancing trade-offs between the demands and the potential of forests to supply different ecosystem services.

The following section therefore only addresses the difference between sub-options 2.1 versus 2.2 and Option 3 organized along the different environmental impact categories which would benefit indirectly from improved decision- and policy-making. The following section therefore only addresses the difference between the sub-option 2.1 vs 2.2 and Option 3 organized along the different environmental impact categories which would benefit indirectly from improved decision- and policy-making.

6.4.1.1 Climate mitigation

Land based carbon removals will play a key role in the achievement of carbon neutrality by 2050 in the EU, and they will be increasingly needed when negative emissions will be pursued to stabilise the world's temperature increase[94].

Forest land in the EU currently removes about 340 Mt CO2eq yr−1 of carbon from the atmosphere (excluding storage in harvested wood products), and research suggests it should increase to 450 Mt CO2eq yr−1 by 2050 in order to reach the EU target for climate neutrality by 2050[95]. There has been

[93] COM(2021)219 final
[94] COM(2021)800 final
[95] Pilli et al. 2022

a steady decline in the amount of carbon sequestered with levels of about 410 Mt CO2eq yr−1 in the 2010-2012 period, decreasing to 340 Mt CO2eq yr−1 in the 2016-2020 period[96]. Therefore, the current estimated economic value of the net carbon sink of EU forests is EUR 32.8 billion per year[97].

Improving the quality and extent of data on forest area, forest carbon stocks and fluxes through integration of remote sensing with ground data and better long-term planning integrating other policy goals with the one of enhancing forest sink can therefore bring additional positive impacts through improved decision- and policy-making. Monitoring is essential to understand where and how to act. Subsequently, more streamlined and efficient monitoring of forest carbon can reduce 'transaction' and 'design' costs involved in enhancing forest carbon sequestration[98].

At the EU and national level this concerns mainly improving the monitoring and reporting of emissions and removals of forest land under the LULUCF Regulation[99]. Information at parcel-level is needed for targeted cost-effective implementation of mitigation actions, tracking their progress, and assessing their impacts in different biogeographical settings and socio-economic contexts. Information by EO is a key asset, as such data are cheap, readily available and transparent. This improved knowledge-base of timely and more accurate information may lead to policies and decisions better suited for maintaining and enhancing forest sink, and therefore reaching the national and EU land sink targets of the Regulation.

Although both sub-options of Option 2 and Option 3 foresee mandatory use of EO for forest carbon indicators, sub-option 2.1 is likely to bring an additional level of accuracy and detail through the 'opt-in' option which would allow the EU wide monitoring to be enriched through incorporation of very high spatial resolution data from national monitoring systems such as those collected through LIDAR coverage campaigns, which contain critical information about forest structure. The expert workshop organised for the purposes of this IA[100] concluded that this feature of LIDAR monitoring is especially useful for high-accuracy and spatial resolution monitoring of above-ground biomass and potentially for cost-efficient deadwood volume estimates.

Regarding indicator coverage, Option 2.2 and Option 3 covers a few additional parameters and indicators which would be useful for the purposes of improving the implementation of the LULUCF Regulation and carbon sink management, namely on forest area and biomass volume affected by disturbances.

Concerning the use of the forest data by forest managers and land owners, the initiative has a high potential to benefit land users by providing freely available, reliable and timely data on changes in forest carbon, providing the basis for the quantification of baselines and carbon removals, which are necessary for the issuance of tradable certificates. The availability of this data could support the overall functioning of the EU-wide certification mechanism[101], and therefore stimulate the adoption

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[96] UNFCCC 2022

[97] Calculated based on the current figure of 360 Mt CO2eq referenced above and the EIB 2022 shadow cost of carbon. See Commission Notice — Technical guidance on the climate proofing of infrastructure in the period 2021-2027.

[98] OECD, 2021. A Global Analysis of the Cost-Efficiency of Forest Carbon Sequestration. Environment Working Paper No. 185.

[99] COM(2021)554 final

[100] The workshop took place online on 23 November 2022 with the participation of invited national forest inventory and EO experts.

[101] The Commission proposal for a first EU-wide voluntary framework to reliably certify high-quality carbon removals [COM(2022)672 final] specifies that "all land managers should have access to verified emission and removal data to

and large-scale deployment of sustainable carbon farming practices across the EU, including improved forest management, forest conservation and afforestation[102]. Both sub-options offer a similar level of necessary indicator coverage on forest carbon, although additional data on forest disturbances might improve knowledge on potential emissions that can inform the estimations on the parcel level.

6.4.1.2 Forest health and resilience

Forest disturbances disrupt the composition of forests and compromise the provision of ecosystem services. Disturbances are becoming more frequent and intense. It is important to improve and maintain forest health and vitality as a measure of protection against the pressures faced. Healthier forests exhibit high resilience against both abiotic and biotic stressors, and the need for strengthening forest resilience will increase.

While land-based insect trap networks and other ground-based monitoring and sampling can provide good information on the various pest species, more wide-spread use of EO-based monitoring could help fostering more rapid or preventive reaction to the disturbances across Member States, potentially resulting in reducing forest degradation. This data may also inform long-term planning of adaptive forest management practices in identified hotspots.

Regarding the role of EO, for certain types of disturbances such as pest attacks which manifest through defoliation or changes in crown condition, optical remote sensing with sufficiently high frequency (at least yearly, ideally monthly)[103] and spatial resolution is of great relevance, potentially allowing earlier detection of the "green" stage within the outbreak cycle which may lead to reduced time lag in appropriate management decisions in line with the Plant Health Legislation (Regulation (EU) 2016/2031), which contains provisions for obligatory surveillance and reporting of outbreaks of Union quarantine pests. Both sub-options' approaches to EO would therefore likely positively contribute to reducing disturbances caused by pests. However, for detection of smaller scale disturbances, distinguishing certain types of damages (e.g. pest vs drought), having more higher-resolution information from aerial mapping (e.g. aerial photography) is essential. For this, the more flexible 'opt-in' approach of sub-option 2.1 brings more benefits.

Concerning monitoring of forest fires and fire risks, compared to the baseline, the current EFFIS would under Options 2 and 3 gain a legal mandate and therefore higher certainty of its continuity. Even though it is hard to quantify the preventive value of the system, it is important to note that some estimates have valued economic damages from forest fires in Europe of approximately EUR 1.5 billion per year in the 1998-2009 period[104] - retaining and improving this information system is likely to have positive economic impacts in as far as it promotes disaster prevention and preparedness.

The enhanced use of LIDAR in EU forest monitoring that is foreseen to be fostered under Options 2 and 3 can contribute to visualise and quantify the impact of forest fires in order to plan for the

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measure carbon farming practices, and all CO2 captured, transported, used and stored through industrial activities should be reported and accounted".

[102] SWD/2021/450 final

[103] EO expert workshop, November 2022.

[104] European Environment Agency 2010

rehabilitation of the burnt area[105], and as a result reduce costs to Member States and forest owners through more efficient post-fire management. Land managers and forest owners can use LIDAR data to assess canopy gaps, the success of forest treatments on forest density, individual tree data, and other forest inventory metrics.

6.4.1.3 Biodiversity and ecosystem conditions

Preserving and restoring biodiversity is essential to ensuring healthy and resilient forests that can fully deliver on their socio-economic and environmental functions. There are clear gaps in the current knowledge of the state of biodiversity in the forests in the EU[106,107,108]. EU assessments of forest ecosystems typically include only a limited number of indicators to monitor biodiversity. If the EU is to fulfil the objectives of Biodiversity Strategy for 2030, data collection and monitoring of other important indicators for biodiversity within forests, for example on other plant and animal species, must be undertaken.

An improved EU-wide monitoring framework would allow for better understanding of the impact of forest management decisions on biodiversity and ecosystem service provision, and the detection of biodiversity hotspots. Protection could thus be more accurately and efficiently given to the forest ecosystems by policy- and decision-makers. Equally, better data would feed into long-term planning on national as well as local level by competent authorities, incorporating and tracking of biodiversity-related objectives (e.g. protection of high conservation value forest habitats and species). A significant impact on the potential of forests to foster biodiversity derives from the management practices carried out. More concrete links between management practices and biodiversity effects can be assessed once a clearer overview of forest biodiversity is accessible to different forest stakeholders, particularly forest managers.

In this area, sub-option 2.1 only relies on the limited indicator coverage of existing reporting frameworks such as State of Europe's Forests, which lacks some of the important indicators related to the implementation of EU strategic objectives on biodiversity. Instead, the additional indicators under Option 2.2 require, for instance, data on EU primary and old-growth forests[109], and accurate information on areas and impacts of silvicultural regimes and practices supporting biodiversity and resilience such as close-to-nature forestry, as well as those with high risk of negative impacts such as clearcutting. Data collected for these indicators can moreover feed into the integrated long-term plans to safeguard the integrity and health of these important ecosystems.

Regarding the EO element, high resolution data on forests and their structure using air-borne LIDAR could potentially allow monitoring of important biodiversity proxy indicators such as deadwood and habitat trees – as mentioned above, this is better facilitated with the use of 'opt-in' approach of sub-option 2.1.

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[105] Goetz, S.J., Sun, M., Baccini, A. and Beck, P.S., 2010. Synergistic use of spaceborne lidar and optical imagery for assessing forest disturbance: An Alaska case study. Journal of Geophysical Research: Biogeosciences, 115(G2).
[106] Maes et al. 2020
[107] Forest Europe 2020
[108] Table 21 and 22 in Annex 5.2.1
[109] Under the European Green Deal and the Biodiversity Strategy for 2030, old-growth and primary forests are recognised for their superior ability to store carbon, regulate the climate, and act as important habitats, and are to be protected.

Another important factor exerting negative influence on EU forests are invasive species. The uncontrolled spread of IAS is often a transboundary issue which requires cooperation across various levels and regions of governance. Especially invasive insect species have large damage potential for EU forests. A 2021 study estimated that the cumulative cost of the impact of biological invasions on the forest sector in Europe from 1960 to 2020 was EUR 20.9 billion[110].

The trends for the percentage of forest area under pressure from invasive alien species (IAS) are generally unknown due to a lack of information available to monitor these species[111].

The existence of an EU-wide framework for reporting and monitoring spatially explicit information on the species type, extent, and density, could greatly reduce this as a threat in the EU by allowing early detection, rapid eradication as well as preventive measures. Member States have an obligation of reporting on IAS of Union concern listed under the Regulation 1143/2014 on their spread and introduction. This is, however, not the case for certain invasive tree species which are cultivated for economic reasons, such as black locust, even though they have significant impact on biodiversity and other ecosystem services in native EU ecosystems[112].

Both sub-options under options 2 and option 3 consider the inclusion of invasive species, irrespective of the list of IAS of Union concern, as a mandatory monitoring element, as a potential indicator, which would ensure that adequate knowledge is available on their spread to take appropriate measures.

6.4.1.4 Countering deforestation and illegal logging

In order to combat deforestation and illegal logging, a proper monitoring system is essential for quantifying and evaluating the extent of the problem as a first step. The focus on the monitoring of illegal timber generally falls on timber imports from non-EU countries - The Thünen Institute estimate that 6% - 13% of timber imports to the EU in 2009 came from illegal sources[113]. The World bank has estimated the value of forgone tax revenue caused by illegal logging in Europe to be 190 million USD [114]. However, internal EU illegal logging is also economically detrimental to EU forest-based industries. Illegal timber can be sold for a significantly reduced price, unfairly undercutting the prices of legal timber and forcing legitimate producers to lower their prices to unsustainable and unprofitable levels.

The European Court of Auditors' report from 2021[115] found that remote sensing is a powerful cost-efficient tool that could strengthen the implementation and enforcement of the EU Timber Regulation[116] to monitor deforestation and illegal logging activities, and recommends to extend the Commission's use of, and promote Member States' use of, geospatial intelligence including remote sensing techniques to better assure compliance with EU requirements concerning forest management and illegal logging.

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[110] Haubrock et al. 2021
[111] Maes et al. 2020
[112] Sitzia et al. 2016
[113] Dieter M, Englert H, Weimar H, 2012. Holz aus illegalem Einschlag in Deutschland und der EU: Status-Quo-Bericht zum Inkrafttreten des Holzhandels-Sicherungs-Gesetz (Holz-SiG). Holz Zentralbl 137(10):257-259
[114] World Bank 2019
[115] European Court of Auditors 2021
[116] Regulation (EU) 995/2010

The creation of an EU-wide forest monitoring framework under option 2 and option 3 includes the EO-based monitoring of key variables such as tree cover, spatially explicit designation of areas by management objective or protection status. This will allow for better identification and prevention of deforestation and illegal logging, thus protecting the forest ecosystem services and allow Member States and forest managers to reduce revenues losses.

It is difficult to estimate the value of this loss prevention, as EU-level estimates on the value of illegal logging are not available. However, using national examples, illegal operations made up around a quarter of all logging in Bulgaria between 2006 and 2013, generating hidden revenue of over EUR 50 million per year117. According to a study of a limited set of illegal harvesting methods by the Romanian government an estimated volume of 80 million m3 of timber was cut illegally in Romania between 1990 and 2011. This represents 24% of the total volume of wood cut during this period, a similar share as in Bulgaria. Adequate monitoring and planning will help in reducing deforestation and illegal logging and related costs.

6.4.2 Assessment of social and socio-economic impacts

The social and socioeconomic impacts considered in this section are those of ecosystem services provided by forests and are not exhaustive or indicative of the full capabilities of the EU's forests, or the long-term impacts which improved sustainable forest management and enhanced environmental protection can have. However, these were prioritised and deemed to be the most prominent and important to highlight, based on the extent they are discussed in the literature and the importance given to them in the relevant forest assessment reports. Other impacts besides those discussed here include the support of pollination services for agriculture and otherwise, water purification, flood and soil erosion mitigation.

6.4.2.1 Greater trust in forest data from different stakeholders

More accurate and trustworthy forest information was identified as a key need of stakeholders in the public consultation (see Annex II). The adoption of modern technology, common definitions of indicators, harmonisation/standardisation of data collection methodologies, as well as increased transparency relating to data, could improve trust in forest data across the EU and provide reputational benefits to forest owners and managers. Accessible data collected in the context of the monitoring and planning framework can potentially stimulate the additional use of forest data by different stakeholders, beyond traditional users and industries e.g. scientific community, policymakers, certain actors within the forest industries, data-based services, forest owners (Table 3 for stakeholder overview).

More accessible forest data made available on FISE through a new framework can reduce costs for those SMEs in the forestry sector who may have paid for data from private data providers[118], where publicly available information was not available, or considered unreliable or untrustworthy. . SMEs who may have relied on publicly available data in the past would benefit for their decision-making from increased accuracy and trust in the data on forest resources - 66% of companies and businesses responding to the OPC agree that better access to forest data in general is needed .

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[117] WWF 2015

[118] 16% of companies and businesses responding to the OPC stated that they used private data providers as a source for forest information.

In this respect, sub-options under Option 2 and Option 3 bring a more significant positive impact in that they ensure a higher degree of data comparability and consistency, and they make it accessible to the stakeholders as well as wider public through a single portal (FISE).

6.4.2.2 Sustainable provision of forest resources and services

Timber provision as an ecosystem service is defined as the contribution of ecosystems to the growth of wood harvested as raw material for different purposes. For 2019, the value of timber provision as an ecosystem service in the EU was estimated at around EUR 16 billion in the INCA study[119], while the gross-added value of the forestry and logging industry was estimated at around EUR 23 billion by EUROSTAT[120]. To put those estimates in context: the reported value of marketed non-wood forest products in Europe was approximately EUR 4 billion in 2015[121], and the annual value of regulatory and cultural ecosystem services (i.e. flood control, water purification and recreation for which forests were the main contributor to the total value of nature-based recreation) for the year 2012 was estimated at about EUR 57 billion in the same study[122]. Moreover, forestry and logging employed almost 0.5 million people in the EU27[123] in 2020, with the wider forest-based employment of approximately 3.5 million people[124]. The pulp and paper industry alone provides 1.5 million jobs along the value chain, and bio-based products and biofuels involve 300,000 jobs[125]. The creation of a sound planning framework backed by reliable data can protect future forest resources and establish healthy, long-term forest yields to ensure that the forest-based industry has a viable future.

The added value of more harmonised, accurate, and timely forest data which this initiative would bring, will contribute to competitiveness and resilience of EU forest-based sector in multiple ways. For instance, timely information on forest risks such as droughts or wildfire risk under Option 2 and 3 can help forest owners, and forestry industries identify potential risks to their management objectives and operations, and take proactive measures to mitigate or adapt to them. Accurate data on tree species composition of EU forests and the distribution of impacts of stresses and disturbances according to the tree species can bring valuable insight into the evolution of timber resources for the timber industry. Moreover, integration of this data into long-term plans can inform more sustainably forest management which benefits both the ecosystem and the forest owners or forest-based industry. The combined effects can contribute to healthy, long-term forest yields to ensure sustainability of wood supply. Secondly, a more secure internal EU-timber yield will reduce the need to import non-EU timber and strengthen the competitiveness of EU timber for European use and for export.

The warming climate in Europe will shift the distribution of forest species and this will have economic consequences. A study on the impact of future temperature increases on 32 tree species in Europe by 2100 found that the expected value of European forest land will reduce due to a predicted decline in economically valuable species[126]. Depending on the scenario and discount rate, this

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[119] European Union 2021
[120] Eurostat 2022
[121] Forest Europe 2020
[122] European Union 2021
[123] European Union 2022
[124] Sincere Project 2022
[125] Mubareka, S., Jonsson, R., Rinaldi, F., Azevedo, J. C., de Rigo, D., Sikkema, R., 2016. Forest bio-based economy in Europe. In: San-Miguel-Ayanz, J., de Rigo, D., Caudullo, G., Houston Durrant, T., Mauri, A. (Eds.), European Atlas of Forest Tree Species. Publ. Off. EU, Luxembourg, pp. e01a52d+
[126] Hanewinkel et al. 2013

indicated a 28% reduction (with a range of 14% and 50%) in the present value of forest land in Europe, with a cost of several hundred billion Euros.

In order to protect valuable forest land in the EU, the mandatory set of indicators monitored under Option 2, specifically on the impact of forest disturbances on forest resources, and the harmonisation of the reporting system will facilitate relevant planning by the private and public sector towards mitigating these impacts and financial losses as best as possible. This data can inform specific forest management practices from forest owners and ensure the decisions made are timely and effective.

Where the monitoring and planning framework leads to the adoption of decisions that ensure a more sustainable and forward-looking management of forest resources, this could potentially ensure long-term provision of forest resources in the future, and the ability of forest resource to satisfying the many competing demands on both forest biomass (e.g. solid wood for construction, furniture and other wood and bio-based products, and for energy) and other ecosystem services (e.g. recreation), helping to safeguard existing and create new jobs, particularly in rural or remote areas. Thus, monitoring is needed to collect evidence on the adjusting policies and management decisions that support the sustainable provision of forest resources.

7 HOW DO THE OPTIONS COMPARE?

This chapter evaluates the policy options presented and analysed in Chapters 5 and 6 against a set of three key criteria: effectiveness, efficiency and coherence. Based on these criteria, the options are compared to the baseline scenario with "+++" meaning that objectives are fully met, "++" objectives are partly met and "+" slight improvement over baseline. For Option 3 rankings are expressed with two scores reflecting the different levels of intervention between the two main elements of the proposal (mandatory monitoring and voluntary planning).

7.1 Effectiveness

This criterion includes contributions to the specific objectives to ensure data comparability and indicator coverage of EU priority topics, quality and transparency of forest data and to establish a holistic forest governance planning framework.

	Option 1 Voluntary	**Sub-option 2.1 Legislative - Medium**	**Sub-option 2.2 Legislative- High**	**Option 3 Hybrid**
Effectiveness				
Data comparability and quality	+	+++	+++	+++
Holistic forest governance planning framework	+	++	+++	+

Option 1 would be less effective than sub-option 2.1 and sub-option 2.2 and Option 3 for reaching the objectives related to monitoring. Without a legal framework establishing coherent objectives and standards, data comparability and quality will only improve slightly over the baseline.

Considering the marked differences among monitoring and planning systems, as well as the drivers behind the problems identified (costs, historical preferences, scattered responsibilities), it can be expected that the timing and degree of using voluntary guidance to update or amend national systems for data collection, achieve harmonised international reporting or improve long-term planning would vary widely across Member States. Member States will to a certain extent continue to use a range of definitions, and different means to monitor, process and report on forest indicators, especially those not related to forest timber resources where some harmonisation efforts are expected to continue.

Likewise, existing differences in the definition and use of the term "forest strategies" and the varying degree of including forest information or measures under required planning instruments such as NECPs and adaptation strategies will only be addressed partly.

Data and information access continuing through various channels would continue to hamper transparency. The role of EO would not change significantly without any obligation to use it where pertinent due to path dependencies despite its benefits.

Sub-option 2.1 could score higher in terms of data quality than sub-option 2.2 or Option 3 in case Member States provide LIDAR data via the opt-in approach. These data have a higher spatial resolution than satellite-based data, which will be the basis for the EO-based products provided by the Commission. A similar level of data comparability as for sub-option 2.2 and Option 3 could be achieved for EO data in case of Member State's 'opt in' under sub-option 2.1 if a proper calibration exercise is carried out and quality of the provided data is assessed. However, data comparability overall will be slightly higher under sub-option 2.2 and Option 3 considering higher indicator coverage. Overall scoring is therefore equal for both sub-options under Option 2 and Option 3 (objective partly to fully met) in relation to the data criterion.

Option 1 and Option 3 score the lowest in ensuring a common standard for long-term planning bringing only slight improvements compared to the baseline. Under a voluntary approach, predominantly Member States with already high ambition in terms of strategic planning would join; thus, the overall ambition in the EU would not be raised and the objective of a coherent governance framework would not be achieved. Establishing an obligation for long-term planning with common key elements, Option 2 will ensure integrated planning coverage on a comparable standard across Member States. Among the two sub-option 2.2 will be more effective (fully meeting the objectives) than sub-option 2.1 (partly achieving the objectives) with non-binding recommendations by the Commission expected to support Member States in tackling possibly shortcomings in achieving an integrated approach in forest planning.

7.2 Efficiency

This criterion includes contributions to economic benefits, reducing administrative burden and improving regulatory compliance.

	Option 1 Voluntary	Sub-option 2.1 Legislative - Medium	Sub-option 2.2 Legislative- High	Option 3 Hybrid
Efficiency				
Economic cost and benefits	+	++	++	++
Reducing administrative burden	++	++	+	+
Improving regulatory compliance	+	+++	+++	++

Under option 1 and for integrated planning under option 3, cost efficiency will improve slightly or partly compared to the baseline. Economic cost and benefits will not change significantly and will depend on Member States' willingness to engage in voluntary coordination and align their systems to Commission guidelines on data standardisation and integrated planning. As a result, benefits derived by Member States might be slightly improved compared to the baseline from cost-efficient harmonisation of a limited number of indicators suited for national circumstances and policy needs, and from enhanced use of EO services offered by the Commission. Under sub-options 2.1 and 2.2, economic costs and benefits will be equally higher on average across their different elements – this means that with increasing costs associated with harmonisation and standardisation, their direct and indirect economic benefits are expected to rise proportionally too. This applies also to the monitoring part under option 3. Substantial one-off costs could occur under both sub-options and option 3 if a Member State had to set up a new data collection framework or adapt its current one significantly to meet common quality standards (e.g. in respect of frequency), but may be off-set through indirect benefits accrued on both the EU, national and forest level through improved policy- and decision-making based on the better quality data. Both sub-options under option 2 and option 3 will require some investment costs by public administrations for data harmonisation or standardisation (both their development and application), slightly higher under sub-option 2.2 and option 3 because of the higher number of indicators. Mandatory planning under Option 2 will imply administrative burden for those Member States not yet implementing strategic planning but this may be off-set in the longer-run by reducing the need for ad-hoc responses due to unforeseen events.

In addition to the indirect benefits for decision-making of acquiring more timely and geographically explicit data, EO related benefits relate to the cost reduction from reducing costs for ground-based data collection, mostly related to changes to tree cover extent and condition. These are slightly higher under sub-option 2.1 because the voluntary opt-in approach would allow Member States to choose the most cost-efficient link between their individual national system in place and the EU services while under sub-option 2.2 and option 3, Member States with an own EO system may risk some sunk costs through stranded investment, and therefore have lower overall benefits.

Cost efficiency for integrated long-term planning will be higher under sub-option 2.2 and 2.1 and party met, compared to option 1 and option 3 which will result only in a slight improvement compared to the baseline. Benefits under sub-option 2.2 will derive from an increase in planning over time if recommendations lead to a gradual improvement throughout the iterations, but at the expense of additional administrative burden on the side of the Commission (for review and issuing recommendations) and Member States (for revising the plans).

The Commission would incur limited additional running costs for FISE and more substantial running costs related to developing and continually updating additional EO-based forest data products as foreseen under option 2 and option 3, including a potential need for funding a sample plot network for collection of necessary ground data. On the other hand, the Commission would benefit also from cost savings on accessing and utilising higher quality forest data from common mandatory reporting done by Member States under Option 2 and Option 3, resulting, for instance, from reduced administrative costs on data gap filling exercises currently undertaken by the JRC. Research funding would have to be spent on developing harmonisation methodologies where currently missing or new standards, where deemed necessary. The two options will also entail administrative costs in relation to data quality assurance and control.

The expected benefit from reduced administrative burden by public authorities in Member States for option 1 and for planning under Option 3 will be inversely proportional to the level of engagement by Member States in voluntary coordination in a similar magnitude like either sub-option 2.1 or sub-option 2.2. The burden related to drafting of guidance on data harmonisation and integrated planning is expected to be slightly lower under Option 1 and regarding planning under Option 3 than Option 2, given the expected larger extent of indicators and planning elements covered under the legislative option.

Sub-options 2.1 and 2.2 and option 3 will generate administrative costs to public authorities for ensuring the monitoring systems meet minimum standards in terms of frequency of data collection. Sub-options 2.1 and 2.2 are also linked to costs associated with data harmonisation following a common definition, or data collection according to common standards, and preparation of integrated long-term plans. The actual magnitude will depend on the individual starting point of the Member State and partly incur a one-time investment and thereafter limited running costs where continuous harmonisation of new datasets is needed, thus decreasing on the long-term.

Facilitating a single-portal access to forest information both option 2.1 and option 2.2 and option 3 reduces administrative burden for National authorities, businesses, and citizens. Considering the lower number of indicators under sub-option 2.1 compared to 2.2., the latter scores somewhat higher in efficiency in relation to administrative burden (objectives partly met vs slight improvement compared to the baseline).

Improvement of regulatory compliance requires common progress across all Member States. This will likely not be achieved with option 1 resulting only in a slight improvement compared to the baseline. A voluntary set-up will trigger different responses across Member States. The mandatory set of indicators and the standardisation of data collection and reporting in combination with long-term planning under sub-option 2.1 and more so under sub-option 2.2 will strengthen evidence-based decision-making on forests status and uses and support better control of illegal activities. The objective will therefore be fully met. Under option 3 this will be achieved only partly due to the incoherence in the level of intervention between the monitoring and the planning part.

7.3 Coherence

This initiative relates to several EU policy objectives, initiatives, and instruments. The evaluation of coherence looks at how consistent each option is with these, and it identifies the extent to which it promotes horizontal objectives and facilitates the delivery of relevant key targets. Since the hybrid

option combines different levels of intervention (obligatory for monitoring and voluntary with planning), internal coherence is assessed in addition.

	Option 1 Voluntary	**Sub-option 2.1 Legislative - Medium**	**Sub-option 2.2 Legislative- High**	**Option 3 Hybrid-**
Coherence				
Existing and proposed EU legislation	+	+++	+++	++
Existing and proposed EU strategies and policies	+	++	+++	++
Internal coherence	++	+++	+++	+

7.3.1 Coherence with other policies

The coherence with other policies will be the highest with objectives fully met for sub-options 2.2 and the lowest for Option 1. Only slight improvements beyond baseline are expected since coherence will depend on Member States individual level of ambition. This will differ according to National priorities. For EU strategies and policies, it is expected that the coherence objective will be partly met with sub-option 2.1 and fully met with sub-option 2.2 with the wider indicator coverage beyond legal obligations. With option 3 coherence will be fully met for monitoring while only slight improvements can be expected for planning. Overall coherence objectives will therefore partly be met.

Regarding coherence and synergies with other international frameworks, all options aim to minimize reporting burden by aligning, wherever possible, with internationally agreed reference definitions, specifically FAO FRA, while options 2 and 3 aim to limit the introduction of double obligations where current international reporting is deemed sufficient (see Table 21). Harmonised EU reporting aligned with definitions and methods used for reporting to international frameworks like the FAO FRA or UNECE can ensure coherence of the internationally reported EU figures with the sum of national values[127].

A detailed evaluation is discussed according to individual legislation, strategies and policies in the following table.

[127] Vidal *et al.* 2016

EU initiative	Key considerations on policy coherence
New EU Forest Strategy for 2030 (EUFS)	The EUFS is based on enhanced ambition, in line with the EGD, particularly on climate and biodiversity. A comprehensive set of harmonized/standardized indicators as in sub-option 2.2, with a strong EO component as in sub-options 2.1 or 2.2 and option 3 maximises the coherence with these targets. Concerning integrated long-term planning, coherence with the EUFS is the highest where Member States provide integrated comparable plans (sub-option 2.2) and the lowest for option 1 and 3
Biodiversity Strategy for 2030 (BDS)	The BDS sets ambitious targets to halt biodiversity loss. It calls for strict protection of the remaining primary and old-growth forests, for which common indicators do not yet exist. Sub-option 2.2 and Option 3 on common indicators maximised the coherence with the policy objectives of the BDS. EO will be an important tool for biodiversity monitoring.
Air, Water and Nature Directives	Healthy forest, providing essential ecosystems, contribute to air and water quality and to nature protection. Sub-option 2.2 and Option 3 (for indicators) maximises the synergies with nature protection legislation and in particular the data provided by Member States under Article 17. The EU monitoring framework would allow to complement this information, for instance by making available spatially characterised data, allowing for the production of ecosystems maps. Concerning integrated long-term planning, coherence with the EUFS is the highest where Member States provide integrated comparable plans (sub-option 2.2). The voluntary approach under option 1 and Option 3 would not be coherent with the mandatory reporting requirements of the nature protection legislation.
Legislative initiative on Soil Health Law (SHL-adoption planned for July 2023)	The monitoring of forest soil will be dealt with by the SHL proposal. In this sense, there is no overlap between the two proposals. However, since the SHL proposes mandatory monitoring of forest soil parameters, the consistency would be maximised by sub-options 2.1 and especially 2.2. and Option 3
Proposal for Nature Restoration Law (NRL)	The NRL proposal refers to six forest-related indicators that need to be monitored at least every three years and possibly every year. The coherence with this initiative is maximised by sub-options 2.1 and especially 2.2 and Option 3 (higher number of biodiversity indicators). The voluntary approach under option 1 would not be coherent with the mandatory reporting requirements of the NRL

EU climate policy (European Climate Law, LULUCF Regulation, Carbon Removal Certification Framework, EU Adaptation Strategy, Governance Regulation)	As the voluntary approach under option 1 would not be coherent with the mandatory reporting requirements of the revised LULUCF and Governance Regulations, options 2 and 3 would ensure that such requirements are respected. However, both sub-options, 2.1 and 2.2 and option 3 would go beyond LULUCF requirements. By enabling the development of quality forest data, option 2 and option 3 would facilitate the achievement of the policy objectives underlying the proposal for the certification of carbon removals under the EU-wide voluntary framework, which would not be supported by the voluntary approach under option 1. Sub-option 2.2 and option 3 would also provide the greatest capacity to assess progress in climate adaptation at both Member State and EU level, as required under Article 6 of the European Climate Law. Option 2.1 would be less effective because it would omit some important indicators. Integrated planning with Commission recommendations as in sub-option 2.2 is particularly important in relation to LULUCF which requires long-term planning of forest resources and this would not be ensured under option 1, sub-option 2.1 and option 3.
Renewable Energy Directive (RED)	The RED II Directive sets criteria for ensuring the sustainability of sourcing for the purpose of biomass use for energy. A set of additional common indicators (as in sub-option 2.2 and option 3) specifically on biodiversity is fully coherent with the objectives of RED, specifically the sustainability criteria of its Article 29 (6). The integrated long-term planning of forest resources will aim to ensure coherence of national bioenergy policies under the RED with other forest-related policy objectives on the EU and national level.
Proposal on amending European Environmental Economic Accounts	The forest accounts module proposed by the Commission on 11.7.2022 to amend Reg. 691/2011 on European environmental economic accounts explicitly supports the EU forest strategy for 2030 and the future forest monitoring initiative and connects forest policies with policies on climate, energy and the bioeconomy. Coherence is maximised by sub-options 2.1 and 2.2 as well as option 3.
Copernicus Programme	Forest monitoring can capitalise on the infrastructure and services in place provided by Copernicus in other areas. A strong EO component of forest monitoring as in sub-options 2.1, 2.2 and option 3 can positively contribute by providing specific needs not addressed with today's Copernicus data, to be taken into account in Copernicus evolutions.
FISE	FISE is the one-stop shop for forest-related data. An enhanced monitoring framework channelling data through FISE is fully coherent with the objectives of FISE. The more the common/harmonized/standardized indicators, the better the coherence with FISE.
Deforestation Regulation proposal /EU Observatory	A coherent set of indicators on forest health and condition is in line with the objective of the new reg. of deforestation, in particular as regards the non-

on deforestation and forest degradation	degradation objective. Coherence is maximised by sub-options 2.1, 2.2 and option 3. The initiative will also be fully consistent with the EU observatory, whose findings as regards EU forests will also be channelled to FISE.
Plant Health Legislation	The Plant Health Legislation contains provisions for obligatory surveillance and reporting of outbreaks of Union quarantine pests. For certain types of pest attacks which manifest through defoliation or changes in crown condition, optical remote sensing with sufficiently high and spatial resolution would allow earlier detection within the outbreak cycle which may lead to reduced time lag in appropriate management decisions. Sub-options 2.1 and especially 2.2 as well as Option 3 would maximise coherence
Europe's Digital Agenda and drone strategy 2.0	The greater the use and uptake of digital services related to forest monitoring, the greater the synergy and coherence with the digitalisation agenda. The drone strategy 2.0 has as one of the objectives that by 2030 drones and their required eco-system will have become an accepted part of the life of EU citizens. Air-transported LIDAR offers significant opportunities for developing the market and become a leader on forest monitoring applications.
Union Civil Protection Mechanism (UCPM)	Under the UCPM, the Commission and the Member States are working towards achieving a higher level of protection against disasters, including wildfires. The EU response capacity to wildfires will continue to be strengthened. Prevention and preparedness efforts will be stepped up, and improved EU forest monitoring will greatly contribute to improved early warning tools for wildfires and other disasters, more accurate risk assessments, and overall improved preparedness capacity to deal with future disasters. Sub-options 2.1 and 2.2 as well as option 3 will contribute to achieving these objectives.

7.3.2 Coherence between the two main elements of the different options

Based on the assessment of the three previous criteria in sections 7.1-7.3 it can be assumed that the objective that this legislative initiative seeks to achieve, i.e. "A coherent governance framework for reporting and planning is established", would be partly achieved with option 1 and fully with option 2. The voluntary approach under option 1 risks that the level of ambition for monitoring and planning might not be equal in individual Member States generating mixed results regarding effectiveness and efficiency. This risk is much lower under option 2 setting a mandatory standard for both elements that Member States will have to comply with.

With option 3, the initiative's objective would most likely not be fully achieved resulting only in slight improvements above the baseline. The monitoring obligations would produce a wide range of high-quality datapoints regarding forests for all Member States. However, data collection is not an end goal in itself, but will be key to benefit other policies and their implementation, not least carbon capture which will be important for the competitiveness of the sector.

The long-term integrated planning would fall under those potential uses of the available data. Not using this data to the best extent possible would not reach the full potential of the legislative proposal.

In addition, it could undermine the assessed effectiveness of the monitoring, given that the actual use and benefit of the collected data would depend on individual Member State's ambition on planning.

Forest monitoring and integrated long-term planning are linked with monitoring crucial to ensure that forest planning is evidence-based and an integrated long-term planning in turn supports targeted and efficient monitoring. Forest monitoring and long-term planning therefore require the same level of a common approach.

PREFERRED OPTION

7.4 Choice of option

The analysis carried out in chapter 6 shows that, even within the constraints due to lack of quantitative criteria for comparing costs and benefits, the benefits of a full legislative approach clearly outweigh those stemming from the voluntary and hybrid options.

The preferred option would be a self-standing instrument that informs or complements existing policies and legal frameworks for three reasons. First, it is unlikely that the required extent of coordination could be achieved through individual amendment considering the sheer number of relevant EU instruments (Figure 27 in Annex 5), their varying level of attention and obligation relevant for monitoring and planning and different competent authorities in the Member States. None of them covers the two specific objectives outlined in Chapter 4.2. Even if this could be achieved, the result would still be a fragmented, non-coherent monitoring system. Second, comprehensive forest monitoring or integrated planning are presently not mandatory under any EU piece of legislation and the establishment of such an obligation consistently across the diversity of legal instruments outlined is unlikely. Third, establishing a common framework through a simple, single instrument would support the need for promoting a holistic and integrated approach to forests, following the narrative of the new EU Forest Strategy for 2030.

The OPC showed a high degree of support for EU-wide harmonized and timely information on a number of variables. More than 88% of respondents were in favour of indicators on issues like forest health, disturbances, and climate change and impacts and projections. The least popular indicators received support from about 40-50% of respondents with only around 20% being directly against.

The preferred option would entail a combination of elements from both sub-options under option 2. The comparison of policy options in Chapter 7 has clearly shown the need for a binding instrument to meet the strategic objectives for data comparability, quality and availability. Therefore, mandatory monitoring and reporting of forest data based on common harmonised or standardised definitions and methods for a set of indicators was identified as the preferred policy measure. To fully cover the priority policy areas of forest health and resilience and biodiversity, a wider selection of indicators than those in current legislation and existing monitoring and reporting frameworks was found to be necessary. Therefore, in relation to common indicator coverage, the preferred option is 2.2.

A step-wise approach would be applied for selecting the mandatory indicators and parameters – a limited list would be first selected for inclusion in the legislative proposal of the basic act. This list of indicators and parameters was identified considering all of the following aspects: their relevance to the priority policy objectives, the need for higher spatial or temporal resolution compared to the existing monitoring and reporting, availability of common definitions and methods, availability of Earth-observation based tools and methods for their monitoring, and current status of monitoring and reporting in the Member States.

The identified indicators and parameters that have not been selected in the first step (i.e. in the legislative proposal) would be considered for inclusion at a later stage through implementing legislation, based on the assessed priority and methodological needs and taking into accounts recommendations by a dedicated expert group.

The collected and reported data would be made available through FISE, as an existing 'one stop-shop' platform, which will increase transparency and easy access to cross-sectoral information. This is key to building an integrated understanding on forests, their status and ecosystem services.

Recognizing the diversity in relation to the use of EO across Member States, a mandatory use of EO where suitable with an opt-in option for Member States will strike a balance between ensuring high quality data, while reducing costs and leaving room for manoeuvre for Member States. Development costs would be borne by the Commission in a two-step approach by maximising available EO funds under the current MFF, supplemented by channelling available funding earmarked for biodiversity in the different financial instruments. The ambition will be to ensure coverage of all pertinent indicators with an (close to) agreed methodology for data collection. In a second step, the Copernicus budget would have to be adapted under the future MFF in parallel to establishing harmonised and standardised data collection methods for those EO-based indicators currently missing.

More than 60% of respondents in the OPC agree that data from Member States' monitoring systems should be better integrated, and more than half of respondents think that the EU should operate a single monitoring system. These averages cover a preference for continuing current monitoring systems among companies and businesses, while environmental organisations tend to be against a business-as-usual option. Respondents representing Member State public authorities expressed moderate support in favour of integration, though not necessarily for a single EU monitoring system. An opt-in approach represents a balance between the views expressed by stakeholders. See Section 3 of Annex 2 for more detailed information on the responses to the OPC.

As explained in section 2.1, a large majority (84%) of respondents highlighted the importance of more consistent, comparable and timely forest information. This statement is also valid when looking at stakeholder groups separately, e.g. 73% of respondents from the stakeholder group 'business associations' and 92% of academics indicated consistent, comparable and timely forest information as important or very important. This Impact Assessment has shown that a legislative approach is more likely to bring about such data.

Therefore, in relation to monitoring, the preferred option is 2.1.

Mandatory long-term plans following a common set of basic requirements and core elements in combination with the Commission issuing non-binding recommendations on their development will allow Member States context-specific priority setting, targets and measures while ensuring integrated alignment with EU policies on forest conservation and uses.

Only 14 % of the OPC respondents did not identify an added value of strategic plans for forests. Across all stakeholder groups a holistic view on forest status and trends (55%) as well as allowing for overall coordination of long-term forest planning (53%) were mentioned most often as added value. NGO's (30%) were the stakeholder group with the highest share of respondents not agreeing on an EU added value.

Therefore, in relation to integrated long-term planning, the preferred option is 2.2.

In addition, the preferred option includes the use of the expert group set-up in the framework of the new EU Forest Governance, for both coordination and guidance as well to support the Commission in developing common definitions and protocols for indicators and data collection and non-binding recommendations on long-term plans. This reflects the shared competence on forest matters and the need for close cooperation between the Commission and the EU Member States.

Table 28 in Annex 5.4 provides an overview of the core elements of the preferred option in relation to problems, drivers and specific objectives.

Funding is considered as possible add-on to the preferred option. Next to providing Copernicus services free of charge, targeted funding could complement the preferred policy option to support the costs for system alignments. Under the current MFF, 30% of EU budget has been earmarked for climate and environmental actions (with specific targets for biodiversity, at least 7,5% for 2024 and 10% for 2026). The Commission could provide guidance and encourage Member States to use respective funding in the mid-term review of relevant funds during the current financial period and further earmark relevant funds under the next financial period. In addition, opportunities under EU R&I framework programme, such as the upcoming partnership "Forests and forestry for a sustainable future", will further contribute to the development of improved, consistent and up-to-date forest data in Member States.

Furthermore, international engagement should continue as part of the preferred option. One of the aims with this initiative is to build on and maximise synergies with existing international engagement and also provide a structured way of contributing to international efforts therefore contributing to the EU's ambition as a leader in the world.

7.5 Proportionality

The combination of elements selected in the preferred option is proportionate insofar it is clearly limited to those aspects that Member States cannot achieve satisfactorily on their own, and where harmonisation at Union level is needed. Because the scale of the issue at stake and its crossborder dimensions, the EU is the only body that may ensure a consistent monitoring framework bringing together the Member States. As highlighted in chapter 3, common standards for data collection, monitoring and long-term integrated planning cannot be developed at a Member State level.

No option would involve transferring powers from Member States to the EU beyond the necessary monitoring harmonisation (no transfer of powers on the management of forests).

7.6 Legal instrument

The principle of proportionality requires that the choice of instrument is as simple as possible and coherent with a satisfactory achievement of the objectives and with effective enforcement.

The choice of a regulation would fit the subject matter of this initiative and its level of precision and would allow to overcome the problems described in this impact assessment report more effectively than a directive, as it would allow to set common standards that are binding and directly applicable across all Member States without the administrative burden of and the delay for transposing the instrument into national law, contributing to the achievement of the objectives of better forest protection and integrated planning by the Member States. Furthermore, it would set the basis for the adoption of implementing legislation with support of the expert group for the development and

specification of technical requirements, for example as regards indicator harmonisation and standardisation.

7.7 Simplification and improved efficiency

Whilst the preferred option, which would be 2.2 for common indicator coverage, 2.1 for monitoring, and 2.2 for integrated long-term planning, will not require any changes to existing legislation, it will, nevertheless, lead to cost savings or improved compliance in a number of those listed in Figure 27 in Annex 5 and important indirect benefits, ultimately outweighing its costs.

Detailed costs and benefits of the different elements of the initiative, i.e. data harmonization and standardization, the development of enhanced EO for forest management, as well as integrated long-term planning, are discussed in Annex 3. Those include direct administrative and adjustment costs, one-off and recurring, assessed for national authorities, EU institutions and other stakeholders. Direct and indirect benefits of the initiative are also detailed.

8 HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

A plan based on a set of milestones will be designed by the Commission to track the implementation of the actions required to achieve the specific objectives against a specific timeframe (e.g. adoption of technical implementation measures on data collection harmonisation and standardisation and on governance framework).

In addition, the Commission will monitor the roll out and impacts of the measures on a regular basis (biannual) based on the following elements:

- Number of indicators with a common definition
- Number of indicators with harmonised or standardised data collection methods
- Data provision by Member States to FISE
- Data access via FISE (average clicks/month)
- National adaptation strategies and risk-assessment and risk-management strategies relying on common indicators
- Evolution of forest digital services market (in particular, number of SMEs)
- Evolution of number of forest-related certification schemes
- Number of long-term integrated plans adopted by Member States
- Level of alignment of integrated long-term plans with common set of basic requirements and core elements
- Use of EU funds in support of monitoring actions

In addition, the Commission will launch an evaluation based on the abovementioned elements, taking into account the Member States' reports on the integrated long-term plans, which would be presented to Council and Parliament within three years of entry into force of the legal instrument.

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Commission Notice — Technical guidance on the climate proofing of infrastructure in the period 2021-2027 [2021] OJ C/373/1.

Proposal for a Regulation of the European Parliament and of the Council on nature restoration. COM(2022)304 final.

Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) No 691/2011 as regards introducing new environmental economic accounts modules. COM(2022)329 final.

Proposal for a Regulation of the European Parliament and of the Council establishing a Union certification framework for carbon removals. COM(2022)672 final

Communication from the Commission to the European Parliament and the Council [2022] 2022 Strategic Foresight Report Twinning the green and digital transitions in the new geopolitical context. COM(2022)289 final.

ANNEX 1: PROCEDURAL INFORMATION

Lead DG, D*e*cide Planning/CWP references

Lead DG	Decide Reference	CWP Reference	Planned Adoption by Commission
Directorate General for Environment DG ENV Directorate General for Climate Action DG CLIMA	PLAN/2022/205 Legislative proposal for an EU Framework for Forest Monitoring and Strategic Plans	n/a	Q2 2022

Organisation and timing

- The initiative has been first announced in the New EU Forest Strategy for 2030 that the Commission adopted in June 2021[128]
- The call for evidence was open for consultation between 08 April 2022 and 06 May 2022. 117 replies were received.
- The public consultation was open between 25 August 2022 and 17 November 2022. 311 replies were received.
- The Inter-Service Steering Group (ISG) was consulted in written on the consultation strategy in March 2022 and the draft Impact Assessment Report in December 2022-January 2023 and during meetings of the group on 22 March 2022, 09 December 2022 and 10 January 2023. It was co-chaired by ENV and CLIMA, and the other DGs participating were AGRI, CLIMA, DEFIS, ECHO, ENER, EUSTAT, GROW, JRC, REGIO, RTD, SG, SJ, TRADE and CINEA. The minutes were shared with the members of the ISG and all comments received taken into account.

Consultation of the Regulatory Scrutiny Board (RSB)

- ENV and CLIMA outlined the rationale, scope and draft policy options for the initiative to the Regulatory Scrutiny Board at the upstream meeting on 12 September 2022. Following the meeting, ENV and CLIMA redefined the scope of the initiative, the problem description and the policy options. The evidence-base was strengthened reflecting the diversity of EU forests and existing standards and systems in Member States and careful attention given to policy coherence.
- The draft of the Impact Assessment was submitted to the Regulatory Scrutiny Board on the 18th January 2023.
- On 18th February 2023, the RSB issued a positive opinion subject to amendments of the Impact Assessment. In the Table below, the comments and the subsequent changes responding to the comments are shown.

[128] COM(2021)572 final

	COMMENTS RSB	HOW THE IMPACT ASSESSMENT HAS RESPONDED
	The report is not clear about the gaps to be filled and the added value of EU action, in particular regarding long-term forest planning. It is also not clear on the proposed level of EU intervention on long-term forest planning of the Member States.	See key observations 2 and 3 below. A more detailed analysis of the existing monitoring systems in the Member States has been added in Annex 5.2 and in section 2. Comparative tables have been added on the availability of plot-level and tree-level information, on definitions used for monitoring and on integration of Earth Observation in monitoring systems. Further information has been added on data collection frequency and accessibility. The necessity for EU action (section 3) has also been revised with further examples and literature references.
	The report does not present all key policy options, including "hybrid" options.	A hybrid option combining mandatory monitoring elements and optional integrated forest planning has been developed and assessed. The option entails obligatory reporting for a set of indicators and parameters related to EU legislation and policy objectives beyond existing EU/international requirements with data harmonisation for existing indicators and standardisation for the new indicators. The Commission will develop and operate EO-based forest monitoring, complementary to in-situ data collection, and provide these data and indicators to Member States for their reporting. Voluntary integrated long-term planning would be supported by an expert group for coordination and exchange. Following consultation with this expert group, the Commission would issue voluntary guidance to facilitate the drafting of evidence-based integrated forest planning for example by offering a common set of basic requirements and core elements for consideration by Member States. As the hybrid option combines elements from other options (monitoring from the legal option and planning from the voluntary option) it is assessed according to its two building blocks together with these other

		options. Combining different levels of intervention internal coherence is assessed in addition.
1	The report should be clear about the intervention logic. As regards monitoring, the report should clarify whether its main goal is to provide Member States with support in using Earth Observation technology. The report should also clarify how the envisaged monitoring measures will allow Member States to integrate them in their current monitoring and reporting.	Chapters 2 to 4 have been amended to further clarify the need for intervention (problems and drivers) and the objectives. Detailed additional information on the current monitoring systems in the Member States and their specificities has been included in Annex 5.2, showing in particular the patchy and non-harmonized monitoring. This information is also summarized in Chapter 2.1 of the main report. A description of how the new measures will link to existing monitoring frameworks in Member States and how the Commission will support Member States has been included in Chapter 5.2.2, while the link to existing international reporting obligation was strengthened in 7.3.1
2	The report should clearly analyse and discuss the proposed additional obligations for Member States regarding long-term planning and explain why, and to what extent, a governance framework for long-term planning is considered necessary to support the monitoring framework, and why it is needed at EU level.	Section 3.2 on the need for EU action has been revised by underlining that although Member States have planning instruments in place, the lack of harmonized information covered by such plans and of a coordinated governance system affects their comparability, temporal homogeneity and ultimately policy-making at national and EU level. Subsidiarity would be ensured as Member States with established and well-working planning frameworks would be able to continue their instruments, but the added value of EU coordination and governance would be to ensure that plans across the EU have a similar structure for better delivery on forest-related policies. Further, section 5.2.2 now spells out more clearly the added value of a governance framework to achieve coherence between national and EU policies and enable dialogue between the Commission and Member States. This information is supplemented by further and revised information on potential obligations and costs in section 6.3.1.3 and new table 6 that reflects the variety of scenarios in terms of planning and related costs across Member States.

3	Considering the heterogeneity of forest across Member States as well as the monitoring and planning already in place, the report should better justify the EU added value of the initiative. It should present clear evidence that Member States cannot solve the identified problems on their own. In particular, it should justify why long-term integrated planning cannot be developed at Member State level, what the gaps identified in current existing planning activities by Member States are, and what the implications would be for national and local authorities and for forest owners.	As regards monitoring, sections 2 and 3 and Annex 5.2 have been integrated in order to further clarify the harmonization needs. As regards planning, section 2 has been integrated by more clearly highlighting the gaps that are currently present across existing planning instruments. In particular with regard to policy fragmentation, the report now presents the result of an assessment performed on Member States' tools along the key thematic areas of forest resource status and trends, biodiversity, bioeconomy, ecosystem services and climate change. Annex 5 has been further completed with a table showing which forest planning tools are used at present, indicating the heterogeneity of their scope, time reporting, the type of EU action required on them and MS coverage, to support the problem definition as described in revised section 2.
4	The report should set out clearly the division of competences between Member States and the EU level and discuss how this initiative will respect these boundaries. As regards the proposed recommendations the Commission would give on the national plans, the report should demonstrate current deficiencies in terms of Member States' capacity to comply with EU policies and targets which would necessitate not only a common framework but also the use of recommendations. It should indicate clearly how this would respect both subsidiarity and proportionality. Stakeholder and Member State views on the distribution of competences should be presented.	The report highlights across the problem definition and description of policy options the need for integrated and harmonised monitoring and planning frameworks to deliver on policy objectives and targets, such as under LULUCF and Habitats Directive. Furthermore, section 5.2.2 has been revised in order to specify that recommendations will be used only where this is relevant for the alignment of Member States plans with specific policy goals, objectives and targets and will not require Member States to provide the reasons of not addressing the recommendations, thus respecting the subsidiarity and proportionality principles. Stakeholder and Member State views on the distribution of competence has been included in section 3.2 building on the feedback received on related questions in the open public consultation and as expressed by Member States in relation to the initiative at the AGRI FISH Council.
5	Options should be constructed to highlight the specific issues on which policy choices are to be made, as regards both monitoring and planning. The report should treat the "hybrid" option (obligatory monitoring and voluntary planning) as a genuine policy	See key observation 2.

	option, assess and compare it along with the other options proposed.	
6	Provide clear evidence on the need for harmonization.	Additional information was provided on the disparity of data collection and definition used in Annex 3 and 5.2. Further consequences of inadequate data harmonization were explained in the problem definition part of Section 2.1.1. and in Section 3.2 explaining the added value of EU action.
7	The report should present the distributional impacts across the Member States, given that some Member States are more advanced than others. Clarify the additional resources and capacities that the different Member States would need to mobilise for the implementation of this initiative.	The Impact Assessment now includes Table 6 which provides an assessment of the distributional impacts of the proposal on Member States, grouped into three categories based on their current forest monitoring capabilities. Additional information and a finer level of detail was provided on the types of costs in Section 6.
8	The comparison of options, which is mainly qualitative, should explain the scoring methodology used.	The scoring methodology has been outlined in chapter 7 and consistent use of the terminology used ensured throughout the chapter. A set of three key criteria (effectiveness, efficiency and coherence) has been used for the comparison. Based on these criteria, the options are compared to the baseline scenario with "+++" meaning that objectives are fully met, "++" objectives are partly met and "+" slight improvement over baseline.

Evidence, sources and quality

This impact assessment was carried out with the support of a 10-month service contract signed in June 2022. The consortium providing the service consisted of Rambøll Management Consulting A/S (lead), the European Forest Institute (EFI) and the Italian Academy of Forest Sciences (IAFS).

The service contract consisted of 6 main tasks:

- Task 1: Definition of problems, drivers, objectives, and development of policy options
- Task 2: Assessment of the impacts of policy options and comparison of options
- Task 3: Analysis of existing background material and assessment of current forest monitoring frameworks in the EU
- Task 4: Analysis of existing background material and assessment of Strategic Plans for Forests
- Task 5: Organisation of workshops, assistance in meetings and stakeholder consultation analysis
- Task 6: Ad-hoc work

ANNEX 2: STAKEHOLDER CONSULTATION

1. Introduction

The Commission carried out broad consultation activities on the legislative initiative. Consultations started with a Call for Evidence between 08 April 2022 and 06 May 2020 and was followed by an Open Public Consultation between 25 August 2022 and 17 November 2022.

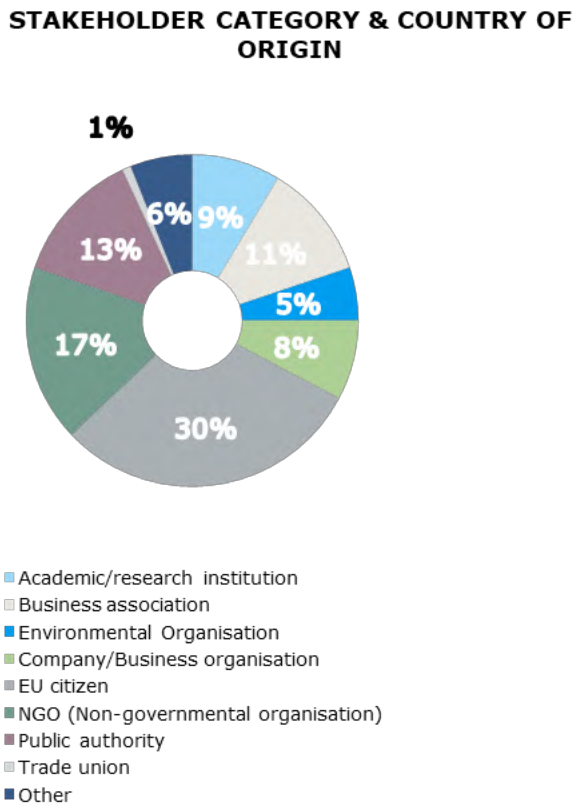
In addition to the Call for Evidence and Open Public Consultation, a series of four thematic expert workshops were also organised in the course of October to November 2022, a dedicated sub-group under the Standing Forest Committee facilitated technical exchange with the Member States through two meetings during November and December 2022, and finally, a thematic workshop was organised by the CZ PRES in which the Commission actively engaged. A summary of the discussions and feedback received is provided in the next sections.

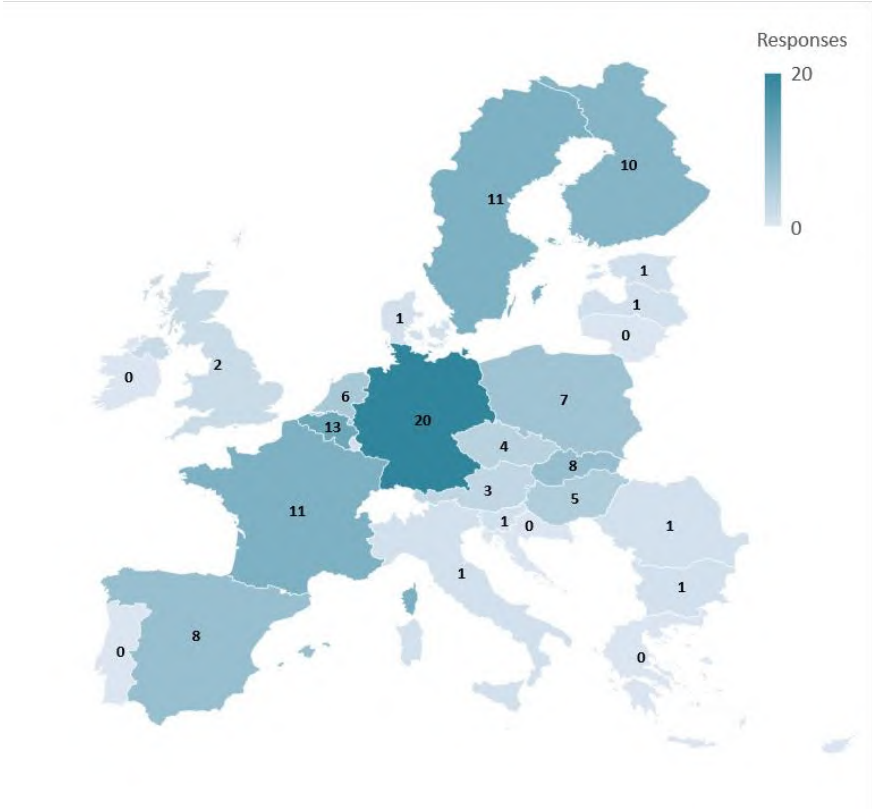
2. Feedback to the Call for Evidence

2.1 *Overview of replies*

In total there were 116 responses submitted, across 21 countries and 9 stakeholder types.

Figure 1 : Proportion of responses per stakeholder category and geographic distribution





The analysis showed a small cluster of three responses where coordination between the respondents was likely. As the number of coordinated responses was low (2.6% of total), they did not have a substantial effect on the overall results. Therefore, they were included in the analysis.

2.2 *Overview of results*

The responses to the call for evidence generally regarded either: (1) the scope of the initiative, (2) data collection content and methodology, (3) monitoring and reporting of data, (4) resource allocation and use, and (5) legislation.

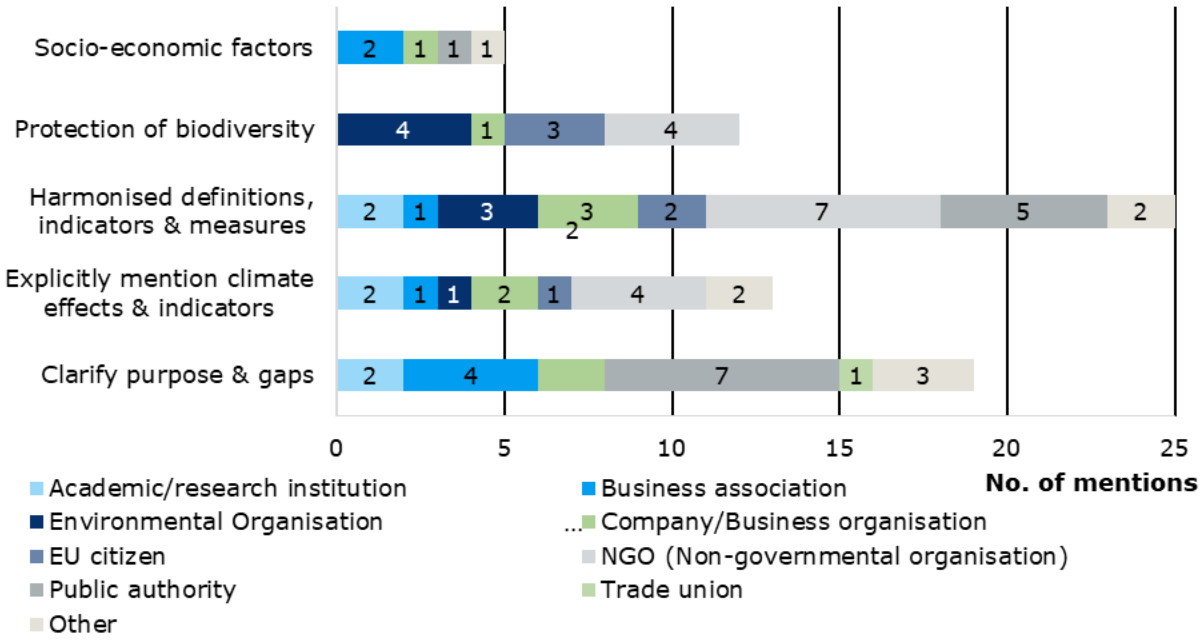
Considering all submissions, the overall support rate for the initiative of an EU Framework on Forest Monitoring and Strategic Plans was 76%. Academic research institutions, environmental organisations, and trade unions were all 100% in favour of the establishment of such a framework, closely followed by business associations (92%), NGOs (90%), company/business organisations (89%), others (86%), and public authorities (80%). EU citizens were the only set of stakeholders where a majority were not in favour of the framework, with only 43% in support. The primary concern expressed is that increased centralisation by this initiative would lead to unnecessary burdens for existing national forest monitoring, and that new legislation may disrupt current management practices in use by forest owners.

2.3 *Scope*

The most prevalent sub-topic addressed regarding the scope of the initiative was the demand for consistent and comparable definitions, indicators, and measures of forest status across all Member States. This includes harmonised definitions of ‘forests’ and sustainability, among others, developed

in cooperation with ones already set out and in use by current monitoring programs from Forest Europe and the FAO, for example. NGOs specifically raised this issue the most often, closely followed by public authorities. The latter was the group most in favour of setting a strong basis for the initiative by clarifying the need for the framework itself and by identifying the current gaps in forest monitoring and data sharing, thus identifying the long-term goals of the legislation.

Figure 4: Sub-themes on the scope of the initiative



Stakeholders specifically mentioned the need to clarify the added value of strategic plans prior to taking any further actions. Other common requests from stakeholders in establishing the scope of the initiative were to explicitly mention the monitoring of climate effects and mitigation potential of forests through the use of holistic indicators, e.g., old-growth forests; to consider biodiversity conservation through special management on Natura 2000 sites; and to take into account socioeconomic factors and the contribution of forests to the EU economy through wood-based products and renewable energy.

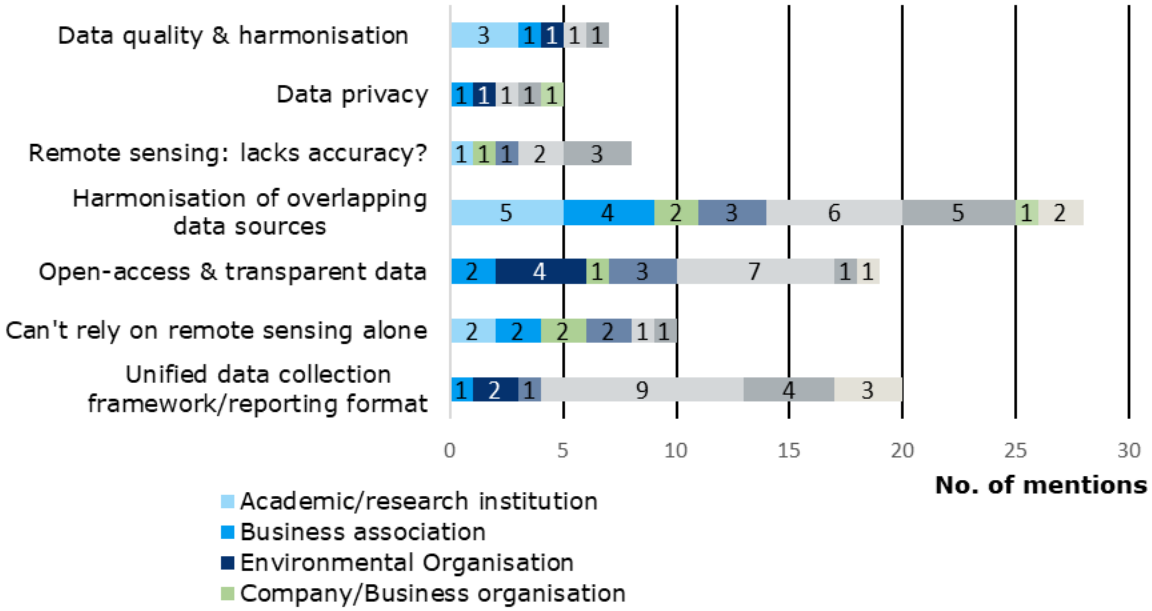
2.4 *Data collection methods*

A large proportion of each of the academic/research institutions, business associations, NGOs, and public authorities commented on the importance of the use of complementary data sources, namely remote sensing or EO, in combination with ground observation and the utilisation of ENFIN[129]. They noted that once sound statistical principles are used in combination, this allows for cross-referencing and will result in improved data quality and overall harmonisation. In contrast, a key issue raised is the danger of relying on remote sensing alone, which is not feasible, as many indicators and measures cannot be assessed without in-situ, ground-based monitoring. Similarly, without consistent and uniformly high-quality resolution across the technologies used to collect data in different Member States, stakeholders are concerned that data collection might be ineffective or inaccurate. However,

[129] ENFIN is the European-wide network which aims to promote NFIs (National Forest Inventories), harmonise forest information, and support forest policy.

remote sensing was praised for its ability to rapidly monitor catastrophic events, such as forest fires. It was also mentioned that in a transboundary capacity where the event may be multi-jurisdictional, the ability to cooperate on early warning systems will be vital with the increasing frequency of extreme weather events due to climate change.

Figure 5: Sub-themes on the data collection methods



50% of NGOs explicitly mentioned the need for a unified data collection framework and reporting format which can be easily compared across Member States, which was once again echoed by public authorities. Some specified that the framework for reporting should be open for public submissions and that the data should subsequently be analysed by professionals or experts in the field. Environmental organisations, EU citizens, and NGOs emphasised that the data within the framework should be open-access, easily and freely available, user-friendly, and transparent in line with the principles of the Aarhus Convention.[130] Academic/research institutions were the primary advocates for the quality control of data and harmonisation in its formatting. Similarly, several different stakeholder groups raised concerns over data privacy and how GDPR will be addressed in an EU-wide data sharing network. EU citizens specifically argued the right to not allow shared access to information on privately owned forested land, while a public authority linked the matter to that of protecting national security and the principles of subsidiarity when considering the use of satellite imagery.

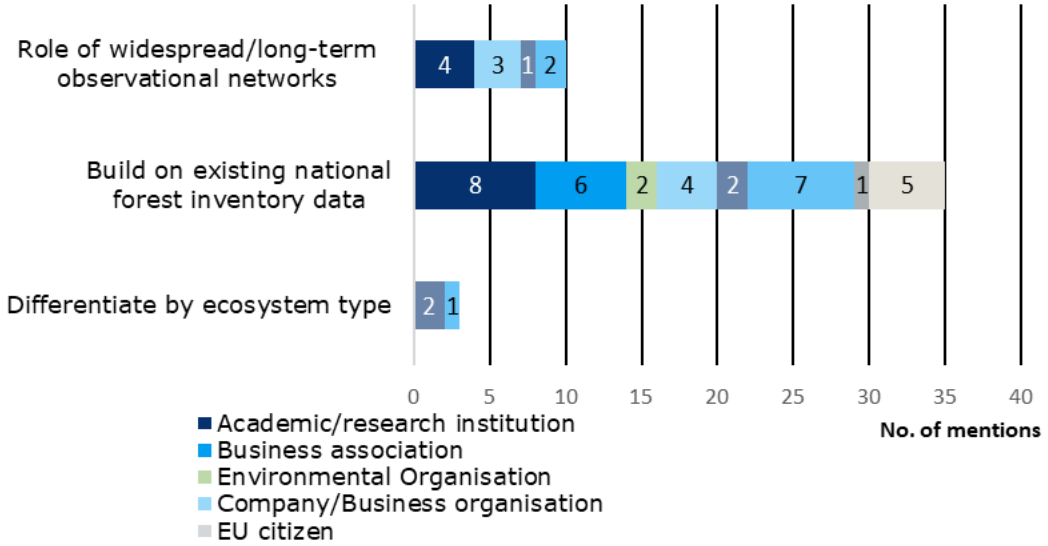
2.5 *Monitoring and reporting*

All stakeholder groups, except for EU citizens, expressed the importance of building the EU-wide forest monitoring network based on existing national forest inventory data, e.g., ICP Forests, NFIs. This would reduce the risk of wasting resources and unnecessarily duplicating data. Stakeholders who were generally not in favour of the initiative questioned the added value of a new framework

[130] The Aarhus Convention (signed in 1998) gives a number of rights to the public regarding the environment including access to environmental information, public participation in environmental decision-making, and access to justice.

compared to these existing reporting systems, and as mentioned previously, they requested clarification of what the current shortcomings are that need to be addressed when creating a new framework. Several stakeholders suggested that the EU should focus on capacity building in Member States before implementing a novel system.

Figure 6: Sub-themes on monitoring and reporting



Several academic/research institutes and company/business organisations highlighted the need to further emphasize the value and role of having a widespread and long-term network of observational sites and ESFRI[131] infrastructures, for example, cross-country NFI harmonisation and J1, and EU-wide satellite imagery from Copernicus-Sentinel1. Additionally, these networks can be supplemented with the help of commercial EO, according to a company/business organisation.

2.6 *Resource use*

A variety of stakeholder types, but mainly business organisations, highlighted the importance of ensuring a long-term source of funding to support Member States to create a stable framework for forest monitoring and reporting. This would involve access to additional monetary resources for countries with currently inadequate national frameworks. It was suggested by a public authority that the implementation of any new data collection systems should be progressive depending on Member State resources. This would allow a greater consideration for delays in data collection or discrepancies in data quality due to the varying technical equipment used for data collection from national to local levels and between countries.

[131] The ESFRI (European Strategy Forum on Research Infrastructures) supports Environmental Research Infrastructures catering to scientific communities and the environmental monitoring activities of European agencies, e.g. ESFRI project 'eLTER RI' handles a range of ecological challenges based on observations.

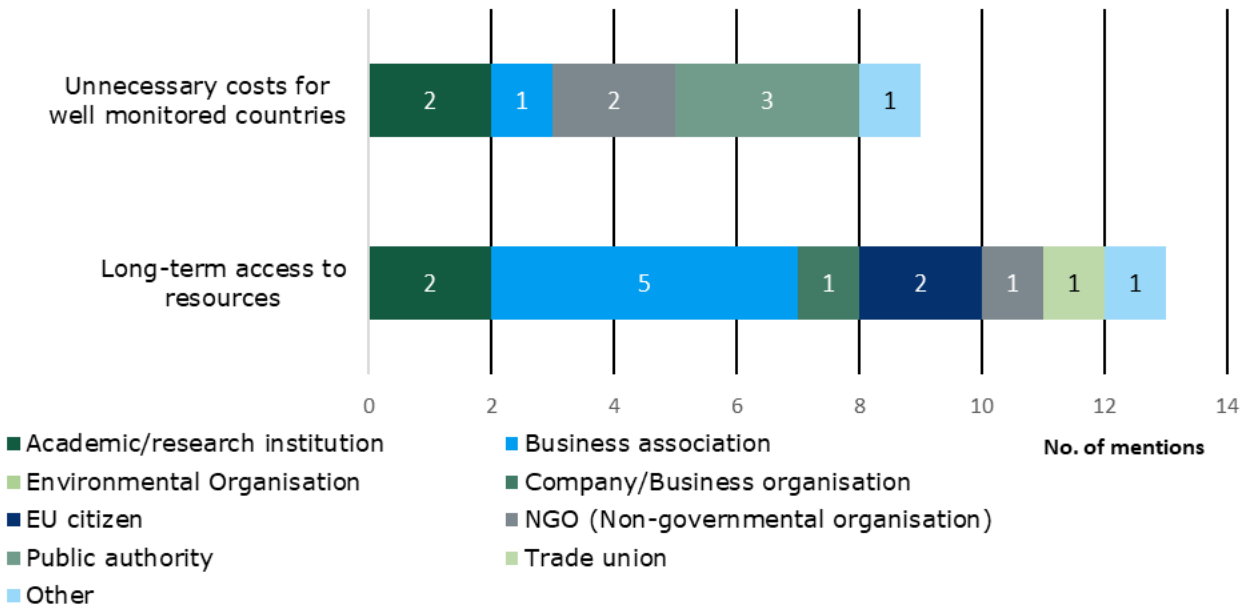


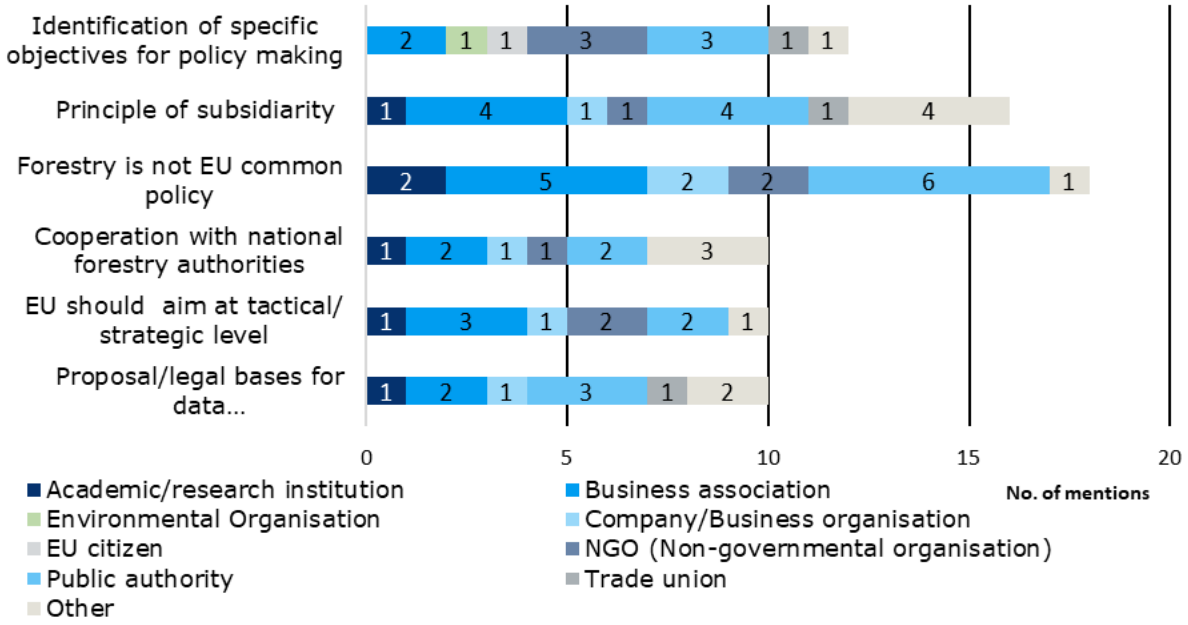
Figure 7 sub themes on resource use

In contrast to this issue, many stakeholders, mostly public authorities, followed by academic/research institutes and NGOs, raised the issue of potential costly overlaps for some Member States. As previously recognised, some Member States have well established NFIs and national monitoring frameworks. Stakeholders were not in favour of an initiative which will create superfluous monetary burdens for countries which are already successfully monitoring and reporting in the forestry sector. Proportionality was identified by respondents as important in this context when ensuring no redundant or parallel inventory systems are being created.

2.7 *Legislation*

A large number of stakeholders, particularly business associations and public authorities, drew attention to the absence of an EU common forest policy. They outlined how new EU legislation must be incorporated into long-term national-level scenarios, rather than via a top-down approach. Many expressed that strategic forest planning should be addressed at the national level, in line with the EU subsidiarity principle. Subsidiarity was explicitly mentioned by mostly business associations, public authorities, and other stakeholders where many agreed that EU level initiatives should aim at the tactical or strategic level and not at the operational or stand level. To this end, stakeholders requested that the initiative should include a "proposal and legal bases allowing for the control of the data provided at national level". The EU would continue to support them in their NFIs while giving control to managers and national authorities, respecting the concept of forestry as a national competence. For the stakeholders who encouraged the harmonisation of EU-wide reporting, they maintained that it shouldn't affect national reporting.

Figure 8: Sub-themes on legislation



Similar to the call for reduced financial burdens on Member States, stakeholders would equally like to minimise any administrative burdens by ensuring the EU closely cooperates with national forestry authorities and build capacity for their autonomous forest management.

A variety of stakeholders, including NGOs and public authorities, considered the identification of specific objectives for policy making as a key factor of the new legislation. They proposed to monitor the effectiveness of policy interventions by integrating specific indicators, e.g., for nature restoration. They outline how the policy goals of the initiative should be linked to the indicators to be clarified

3 Feedback to the OPC

The objective of the OPC was to collect inputs from all relevant stakeholders on the most effective ways to assess and monitor the state of European forests and to develop strategic plans for their development. The questionnaire included 14 mandatory questions in the "About you" section and 20 substantive questions across four main blocks of the survey: Use of forest information, Need for forest information, Strategic plans for forests, and Forest indicators.

3.1 *Respondents*

The OPC survey received 315 contributions in total. The survey data was cleaned and processed and only one contribution was identified as a duplicate and therefore deleted. The resulting 314 contributions came from respondents in 29 countries. The greatest number of responses came from Germany (80), a result likely tied to an identified campaign consisting of 23 contributions of almost identical sets of answers and almost identical comments to the open-text comments. As the share of these responses is very small (7%), and following the Better Regulation Guidelines, these contributions were not deleted. Instead, the analysis below takes into account this campaign and presents the PC results with and without these contributions. Table 9 below shows the full distribution of country of origin for all respondents.

Table 9: Country of Origin

Country of origin	Count	Share	Country of origin	Count	Share
Austria	9	2.90%	**Ireland**	1	0.30%
Belarus	1	0.30%	**Italy**	14	4.50%
Belgium	21	6.70%	**Latvia**	1	0.30%
Bulgaria	1	0.30%	**Lithuania**	1	0.30%
Croatia	2	0.60%	**Netherlands**	7	2.20%
Cyprus	1	0.30%	**Norway**	1	0.30%
Czechia	3	1.00%	**Poland**	29	9.20%
Denmark	2	0.60%	**Portugal**	5	1.60%
Finland	9	2.90%	**Romania**	11	3.50%
France	29	9.20%	**Slovakia**	37	11.80%
France Overseas Territories	2	0.60%	**Spain**	15	4.80%
Germany	80	25.50%	**Sweden**	13	4.10%
Greece	2	0.60%	**United Kingdom**	6	1.90%
Hungary	9	2.90%	**United States**	2	0.60%
Total	**314**	**100%**			

Of the 314 respondents, 51 are providers of forest data, 85 are forest owners (29 of them own forests of less than 5 hectares, 56 of them own forests of more than 5 hectares), whilst the remaining 178 respondents are neither forest owners nor forest data providers.

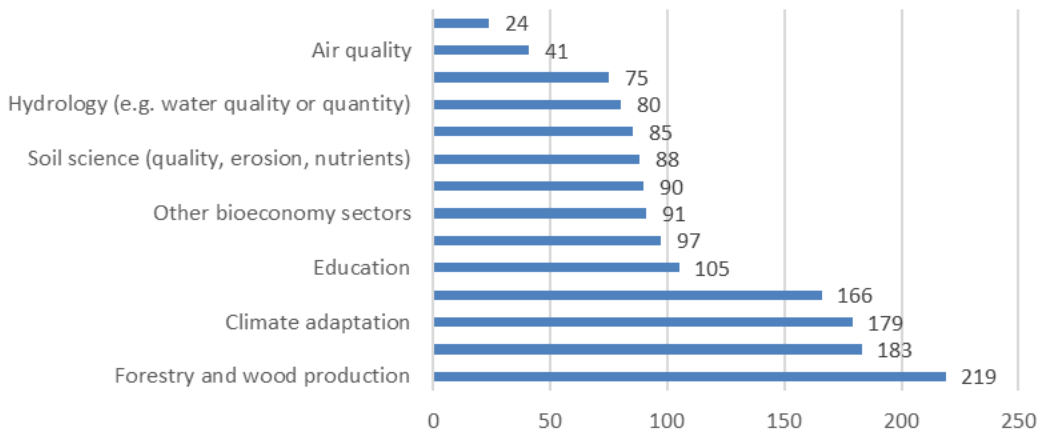
Figure 9 below shows that distribution of stakeholder types; EU citizens, non-governmental organisations and companies/business organisations are the three most represented categories.

Figure 9: Stakeholder types (N=314)

3.2 *Use of forest information*

The first set of questions asked stakeholders about the sources of information they consult and for what purposes and/or sectors. PC respondents consult forest information most often regarding forestry and wood production (almost 70% of respondents), biodiversity (58% of respondents), climate adaptation (57% of respondents) and climate mitigation purposes (almost 53% of respondents). They consult forest information the least for information on air quality (13% of respondents). See Figure 10.

Figure 10: Sector(s) and purpose(s) for which respondents consult forest information



Note: Question asked: For which sector(s) or purpose(s) do you consult forest information? Respondents could select more than one option.

Government publications and websites are the most often consulted sources by respondents (72% of respondents), followed by forest sector organisation and media (66% of respondents), and publications by academics, such as research centres, universities and research projects (almost 66% of respondents). Private data providers, such as companies, business associations and individuals are the least consulted (34% of respondents).

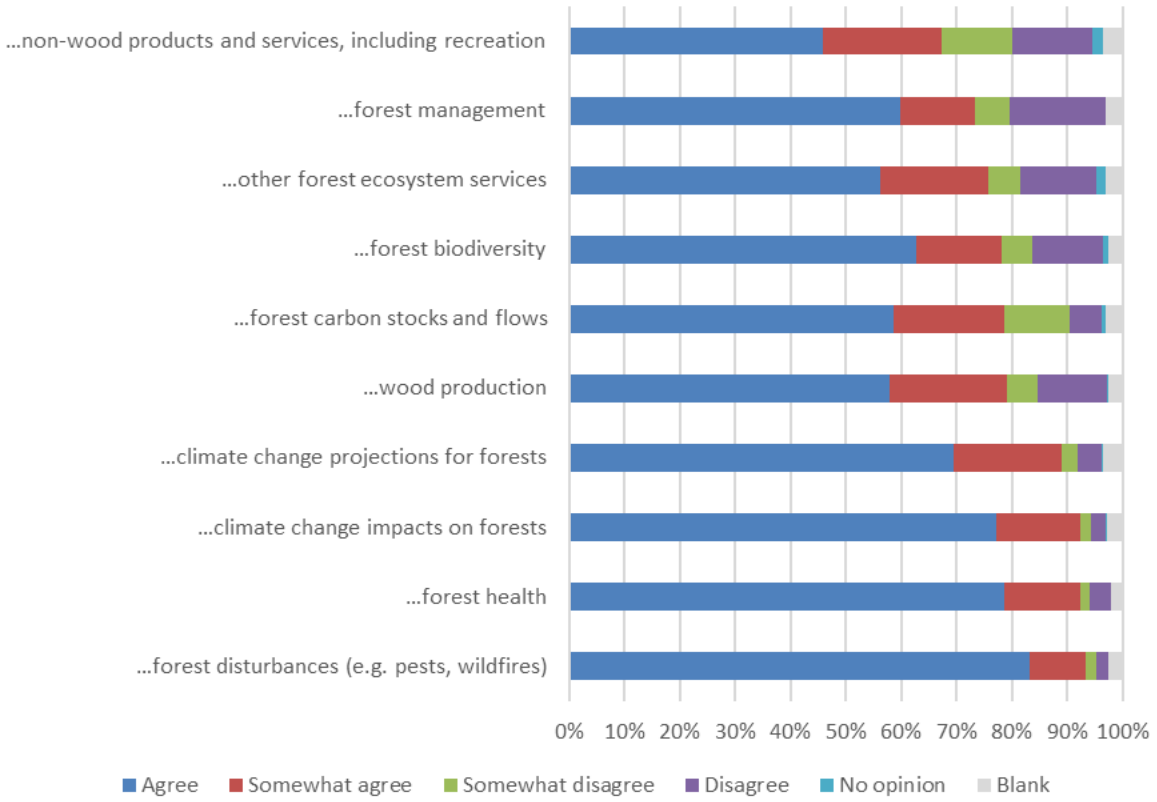
3.3 *Need for forest information*

The second set of questions asked stakeholders about the need for forest monitoring – information needs, challenges to data collection and use, preferred use of monitoring technologies, preferred policy options on forest monitoring systems and financing options for such systems.

More than 92% of respondents *agree* or *somewhat agree* that there is need for EU-wide harmonised and timely information on forest health, forest disturbances (e.g., pests, wildfires), climate change impacts on forests, and climate change projections for forests. And more than 80% of respondents *agree* or *somewhat agree* that there is need for EU-wide harmonised and timely information on forest biodiversity, wood production and forest carbon stocks and flows. See Figure 11.

The majority of both forest owners and providers of forest data *agree* or *somewhat agree* that there is need for harmonised data on forest health, forest disturbances, climate change impacts on forests, climate change projections for forests. Only about half of forest owners, however, agree that harmonised information is needed on forest biodiversity, wood production, forest carbon stocks and floes, other forest ecosystem services, forest management, and non-wood products and services, including recreation. Between 80-100% of forest data providers agree that such data is needed.

Figure 11: Forest information needs (N=314)

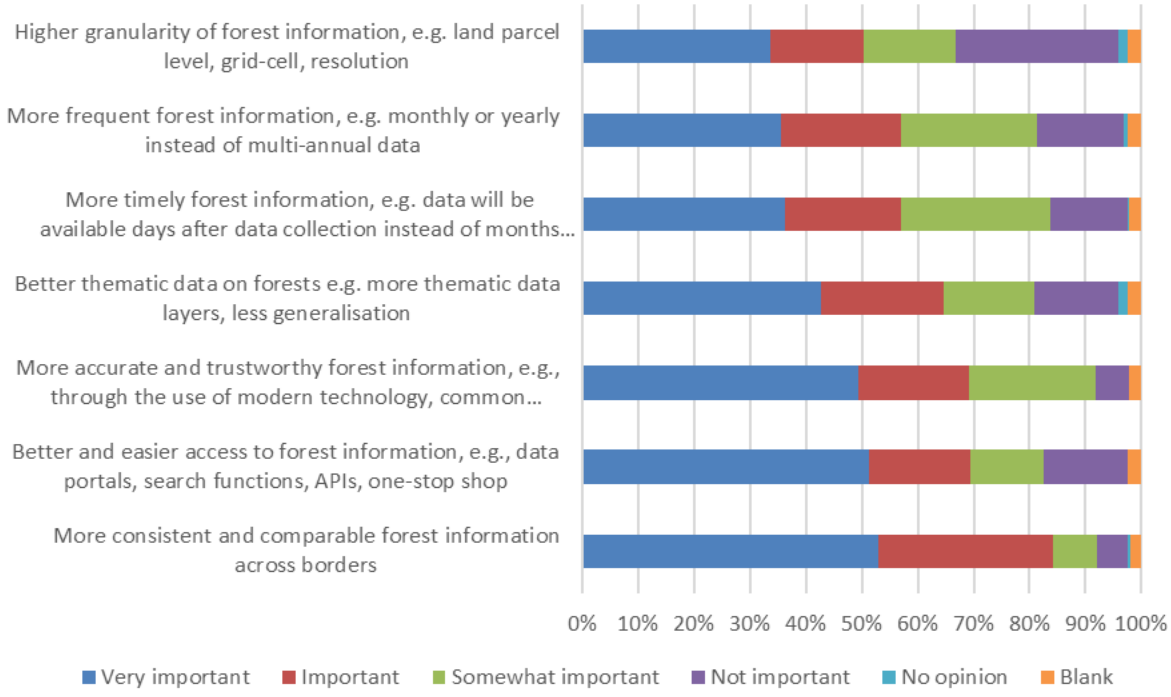


Note: Question asked: To what extend do you agree with the following statement: We need EU-wide harmonised and timely information on…

In terms of the needed improvements to forest monitoring in the EU, 86% of respondents find more consistent and comparable forest information across borders to be very important or important. This aspect was consider highly relevant among all stakeholder groups, e.g. 73% of respondents from the stakeholder group 'business associations' and 92% of 'academics' indicated consistent, comparable and timely forest information as important or very important. More than 66% of respondents find better thematic data on forests (e.g., more thematic data layers, less generalisation), better and easier access to forest information (e.g., data portals, search functions, APIs, one-stop shop) and more accurate and trustworthy forest information (e.g., through the use of modern technology, common definitions and increased transparency) to be very important or important improvements (See Figure 12).

Some respondents used the open-ended comments to point out that the frequency of monitoring entirely depends on the type of data that is being monitored. E.g., whilst yearly reports are sufficient for most data, respondents suggest that forest disturbances need a near-real time reporting. In addition, several respondents strengthen the fact that any EU effort to increase monitoring should build up on existing monitoring mechanisms, and that it should bear clear links with existing EU instruments.

Figure 12: Possible improvements to forest monitoring in the EU (N=314)

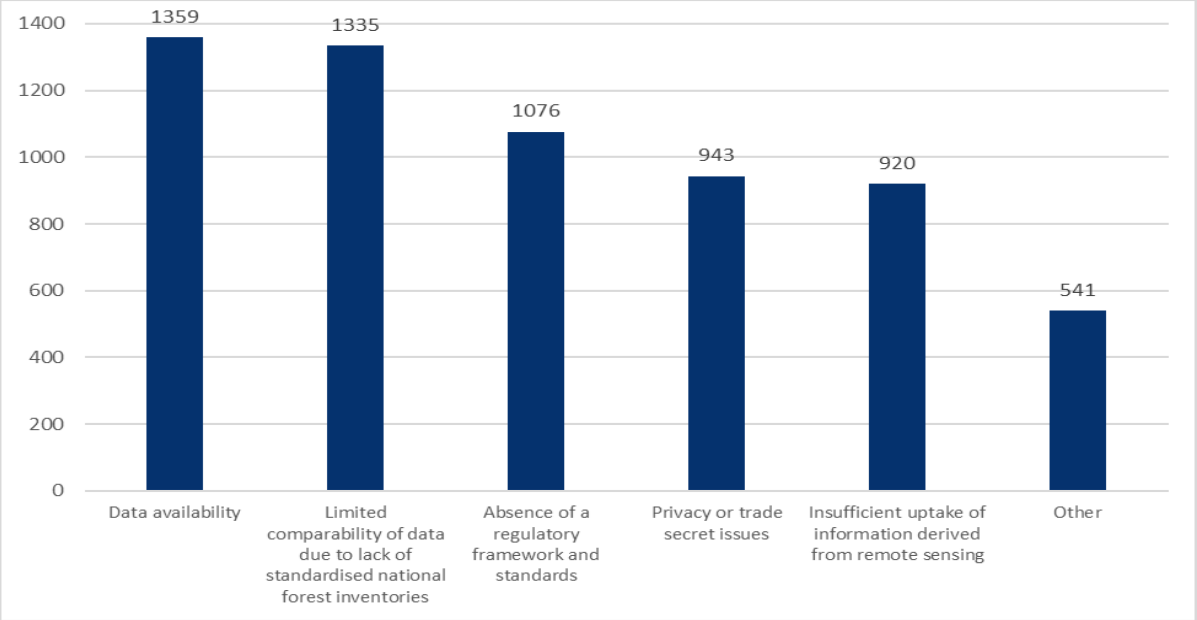


Note: Question asked: Please indicate how important you consider the following possible improvements to forest monitoring in the EU.

Respondents were asked to rank the main current challenges to ensuring EU-wide forest information that is detailed, accurate, regular, timely, comparable and openly accessible. PC respondents ranked data availability as the key challenge, followed closely by the limited comparability of data due to lack of standardised national forest inventories. Insufficient uptake of information derived from remote sensing was ranked last among the provided options. See Figure 13 below. Under "Other", respondents suggested a series of challenges that currently impair detailed and accurate EU-wide forest information. The most popular answers include the lack of clear attributions of responsibility

between the EU and Member States for collecting information, the absence of pan-European definitions, the difference between indicators used, the lack of harmonized methods for collecting data by Member States and the need to link monitoring with existing EU legal instruments. Some respondents also highlighted the need to clarify, at the outset, the purpose of data collection and what sort of data should be gathered and monitored.

Figure 13: Main current challenges to EU-wide forest information

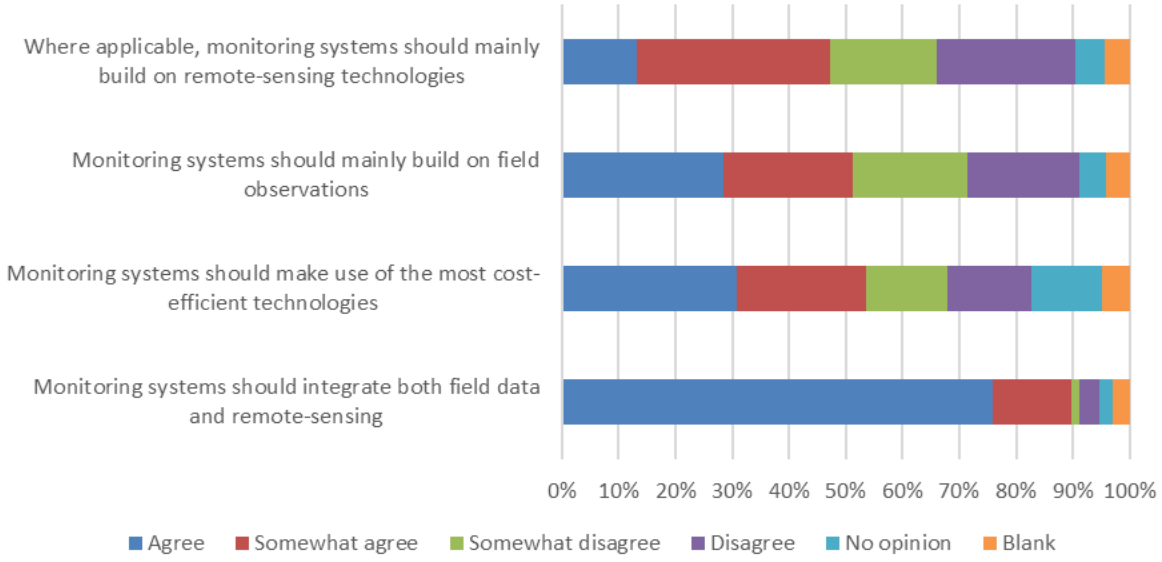


Note: Question asked: In your view, what are the main current challenges to ensuring EU-wide forest information that is detailed, accurate, regular, timely, comparable and openly accessible? Respondents were asked to rank the six options. The results were calculated by assigning six points to each respondent's first choice, five points to their second option, etc. The figure shows the total sum of points the option has received.

When asked about the need for better *open* access to forest information, 68% of respondents agreed, particularly among environmental organisations, academic/research institutions and EU citizens.

Respondents were asked a series of questions about their preferences on monitoring technologies. Almost all respondents (92%) *agree* or *somewhat agree* that monitoring systems should integrate both field data and remote sensing, with academic/research institutions, environmental organisations, public authorities and trade unions completely in favour (100% of respondents for all four categories). See Figure 14. Among those who ticked the "Other" option, the large majority believe that field observations still represent the most appropriate method to collect forest data. Some respondents suggest a combination of field observations and remote sensing, however no respondents deem remote-sensing to be sufficient in itself. In addition, some respondents would like to see a better inclusion of new technologies such as AI in data collection techniques. They also sustain that while new technologies may not be cost-efficient at first, they would prove highly beneficial in the long-run.

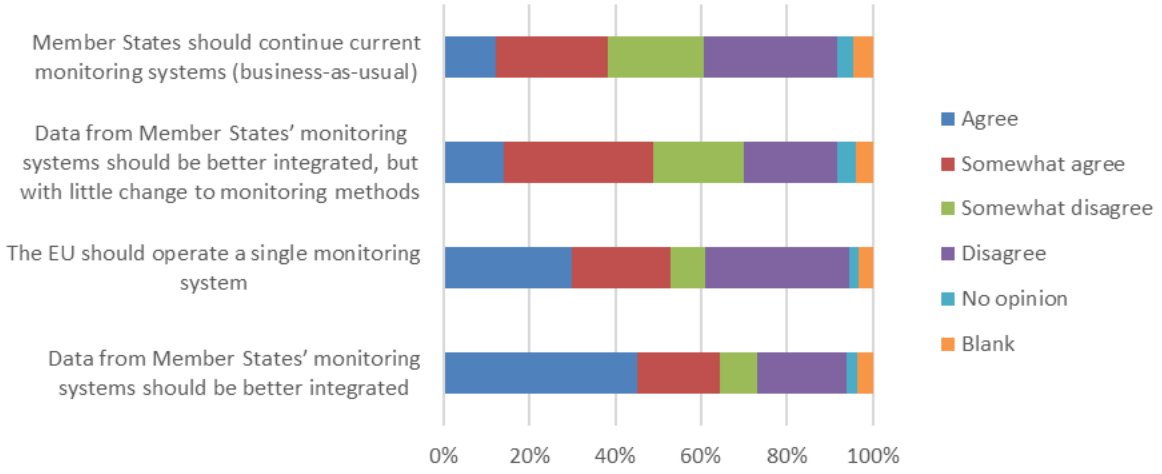
Figure 14: Monitoring technologies (N=314)



Note: Question: To what extent do you agree with the following statements?

More than 60% of respondents agree that data from Member States' monitoring system should be better integrated - split by stakeholder groups, 73% of all respondents from academia and 75% from public authorities agree or somewhat agree. However, this percentage is smaller for business associations with only 36%. Half of all respondents (51%) agree that data from Member States' monitoring systems should be better integrated, but with little change to monitoring methods. The highest support for a single monitoring system is shown by EU citizens with 69% and environmental organisations with 67% agreeing or somewhat agreeing. Conversely, 56% of all respondents from the stakeholder group 'companies' disagree or somewhat disagree. More than half of respondents think that the EU should operate a single monitoring system. Finally, 40% of respondents agree that Member States should continue current monitoring systems (business-as-usual). Business associations and company/business organisations show a preference for business-as-usual, while environmental organisations tend to be against it.

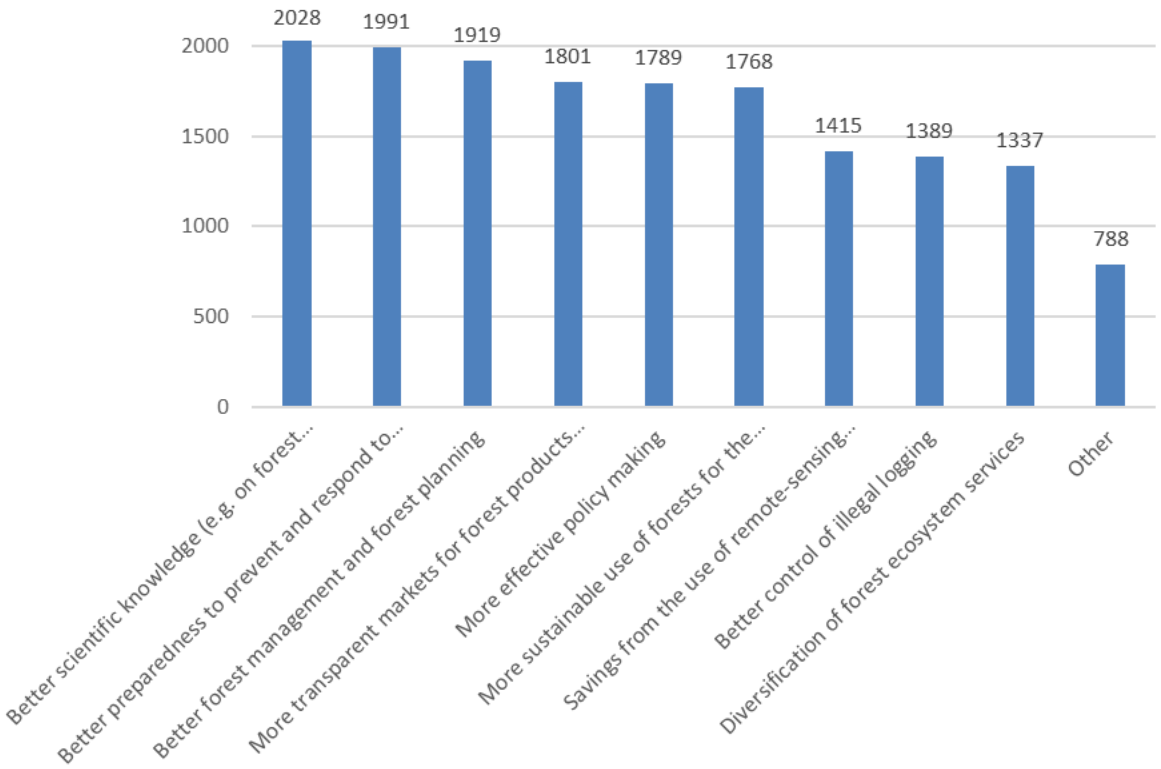
Figure 15: Policy options: Monitoring (N=314)



Note: Question: To what extent do you agree with the following policy options?

Respondents were asked to rank the main benefits of creating an EU-wide forest monitoring system with detailed, accurate, regular, timely, comparable and openly accessible information. The highest rank benefit is Better scientific knowledge, followed by Better preparedness to prevent and respond to natural disturbances.

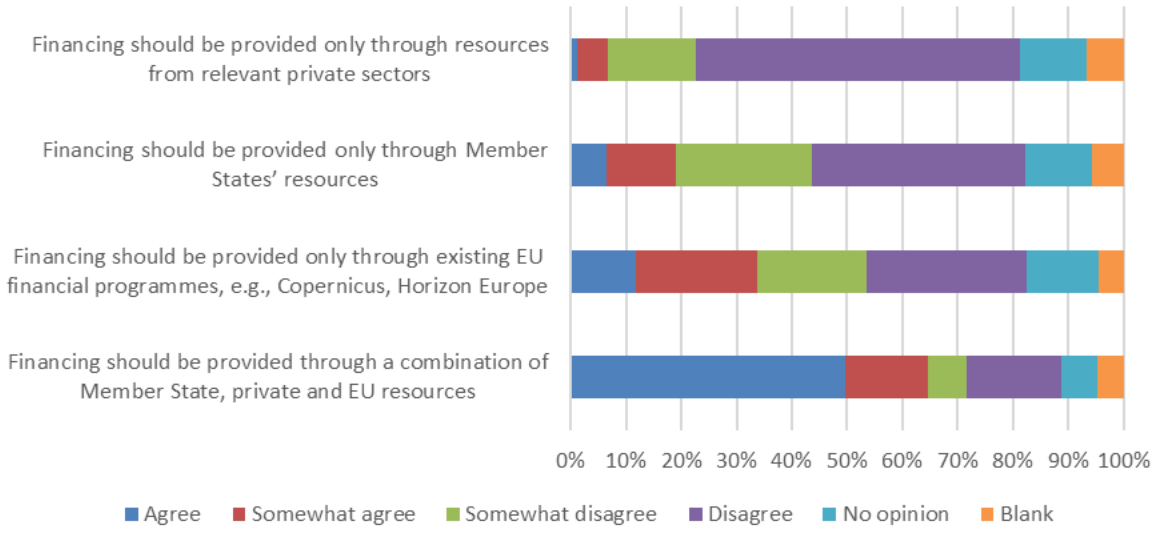
Figure 16: Main benefits from creating an EU-wide forest monitoring system with detailed, accurate, regular timely, comparable and openly accessible information



Note: Question: What are the main benefits from creating an EU-wide forest monitoring system with detailed, accurate, regular, timely, comparable and openly accessible information? Respondents were asked to rank the ten options. The results were calculated by assigning ten points to each respondent's first choice, nine points to their second option, etc. The figure shows the total sum of points the option has received.

The survey asked stakeholders about the financing policy options they prefer. 68% of respondents believe that financing should be provided through a combination of Member States, private and EU resources, with more than 84% respondents from academic/research institutions and environmental organisations in favour of this policy option. See Figure 17.

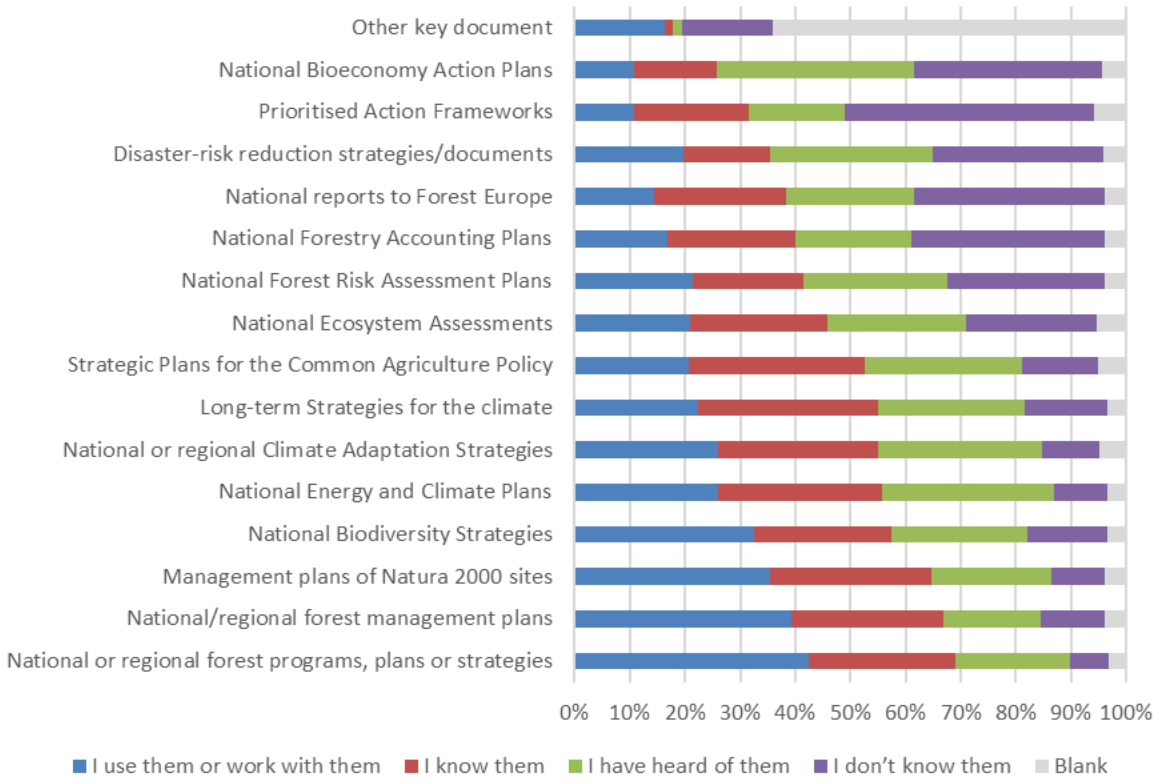
Figure 17: Policy options: Financing (N=314)



3.4 *Strategic plans for forests*

In terms of level of awareness and usage of different strategies and planning tools, 71% of respondents know and use national or regional forest programs. These programs are mostly used by providers of forest data (81% of respondents for this category). At the other end of the spectrum, 27% of respondents know and use National Bioeconomy Action Plans.

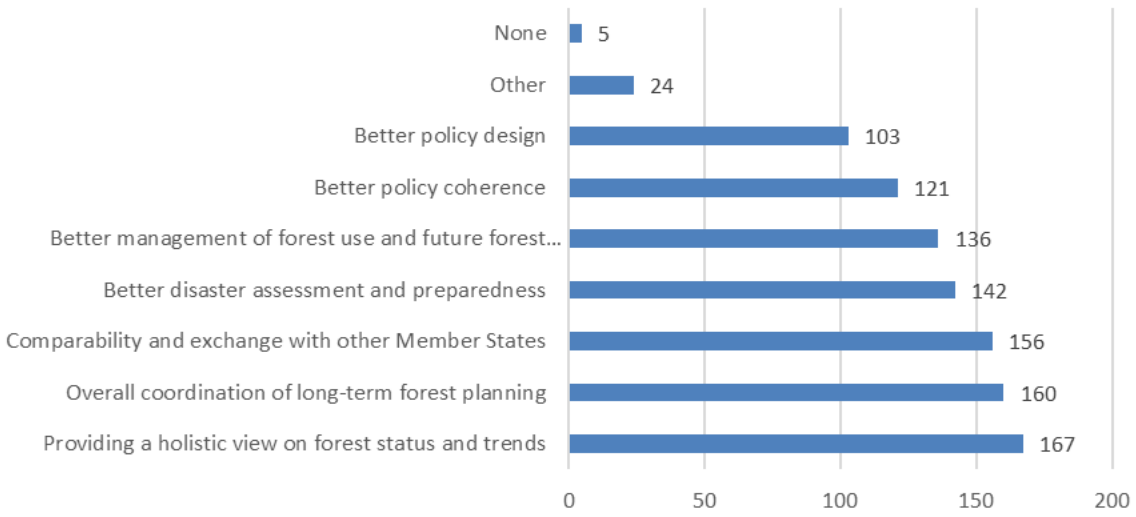
Figure 18: Awareness of strategies and planning tools (N=314)



Note: Question: How well do you know the following strategies and planning tools?

Respondents were asked to select among different options of what could be the added value of Strategic Plans for Forests. Providing a holistic view on forest status and trends, Overall coordination of long-term forest planning, and comparability and exchange with other Member States are the added values selected by the greatest number of PC respondents. Better policy design was selected by the fewest number of respondents. See Figure 19.

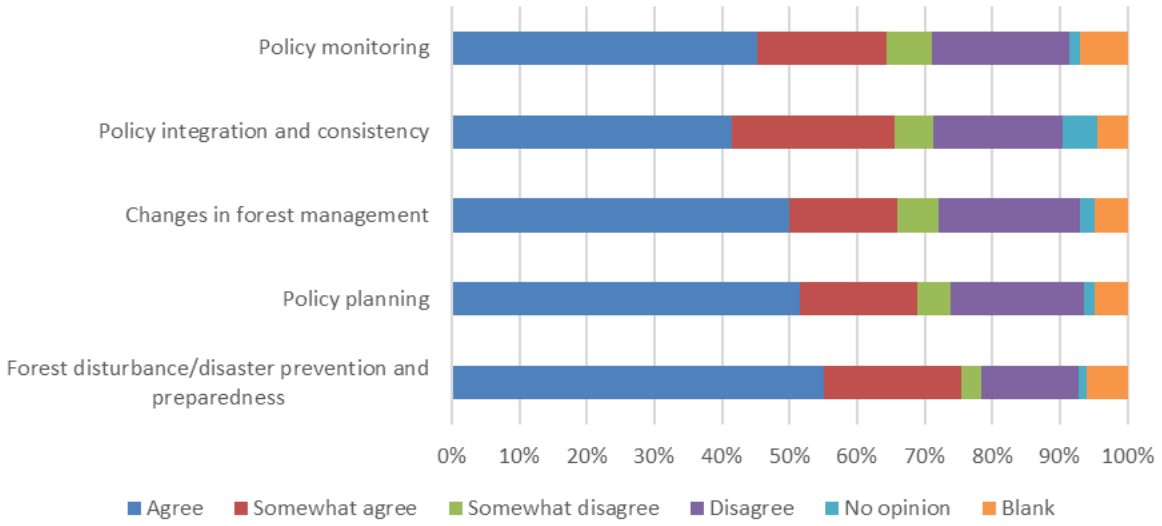
Figure 19: Added value of Strategic Plans for Forests



Note: Question: In your view, what could be the added value of Strategic Plans for Forests? Respondents could select more than one option.

In terms of the issues that respondents think the Strategic Plans for Forests should cover, there is relatively high agreement that all of the five presented issues should be covered (see Figure 20). Generally speaking, providers of forest data tend to be positive towards covering each issue, while forest owners tend to represent the lowest share of agreement. Public authorities partly underlined National competence on forest planning and questioned the added value of including planning in the legislative proposal.

Figure 20: Issues to be covered by Strategic Plans for Forests (N=314)



Note: Question: Do you agree that Strategic Plans for forest should tackle/cover the following issues?

3.5 *Forest indicators*

The last section of the PC survey asked respondents a series of questions on forest indicators.

In terms of relevant forest indicators, 86% of respondents find pest and disease outbreaks (number, area and volume affected, type of pest diseases etc.) to be an important forest indicator to monitor. More than 77% of respondents believe that forest/tree cover, tree species/composition, forest fires (number, area and volume burnt, etc.), are three important forest indicators that should be monitored.

Forest biomass, storms (number, area and volume affected, etc.), forest/tree cover change (gains, losses) and forest growth are considered to be important forest indicators to monitor by more than 73% of respondents.

More than 67% of respondents deem tree age, forest soil properties (carbon, compaction, soil biodiversity), presence of red-listed species, tree age diversity, main management objectives (production, conservation, protection), forest type, forest structural diversity, diversity and share of forest habitats, volume of wood harvested, ratio of annual fellings to annual increment, employment in the forest sector, forest carbon (as far as possible separated among carbon pools) to be important forest indicators to monitor.

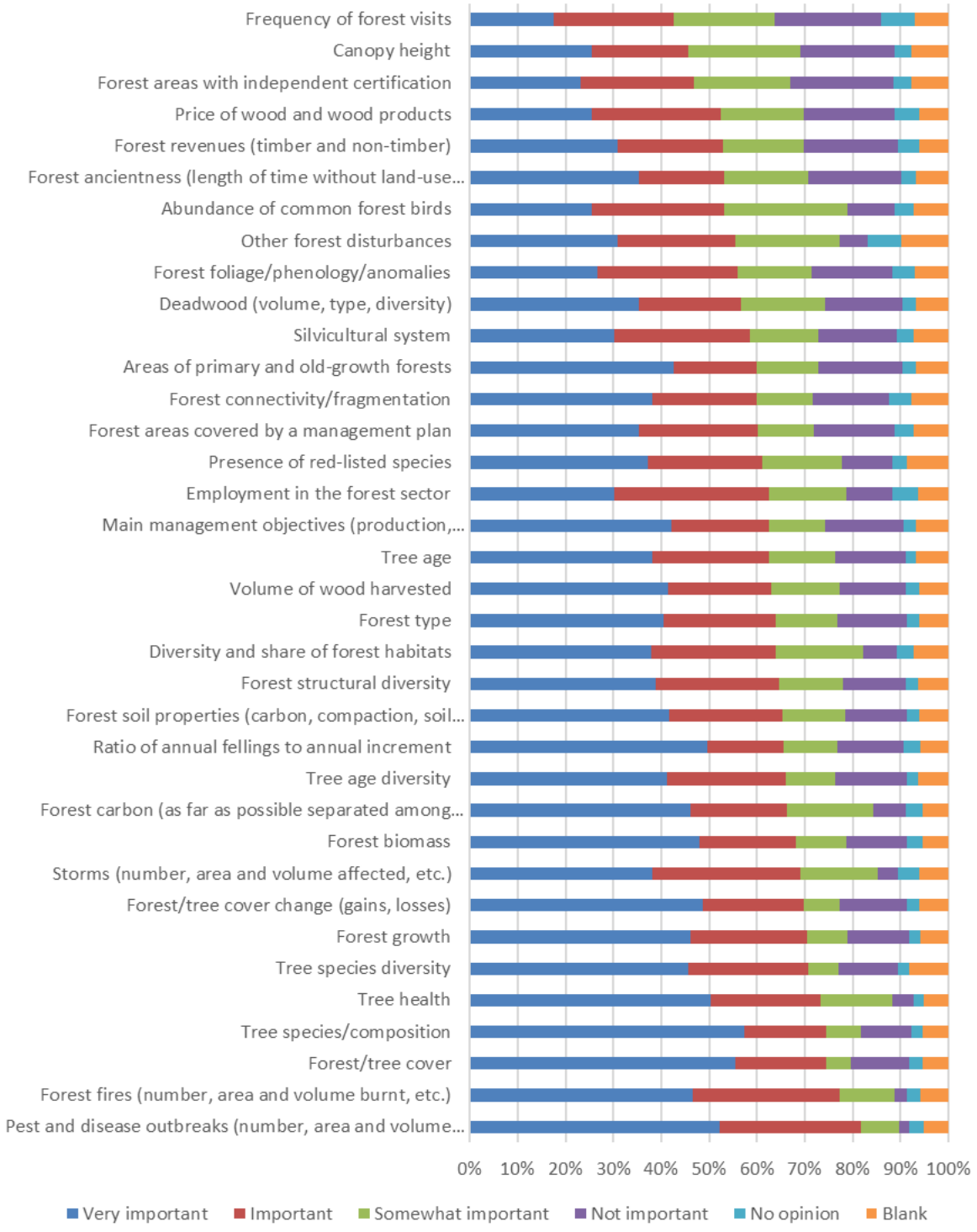
Forest foliage, deadwood (volume, type, diversity), other forest disturbances, forest connectivity/fragmentation, silvicultural system, areas of primary and old-growth forests and forest areas covered by a management plan are deemed to be relevant forest indicators to monitor by more than 61% of respondents.

More than 56% of respondents believe that abundance of common forest birds, forest ancientness (length of time without land-use change), forest revenues (timber and non-timber) and price of wood and wood products should be monitored.

More than 49% of respondents identify canopy height and forest areas with independent certification to be important forest indicators to monitor.

Finally, more than 44% of respondents believe that frequency of forest visits, together with other general indicators specified by respondents, should be monitored (Figure 21). Providers of forest data broadly follow the general pattern described above. Forest owners, on the other hand, find most indicators much less important than the average respondent. An exception are the following indicators, which forest owners find important to monitor to similar extent as the average respondents: Forest fires, Storms, Pests and disease outbreaks, Employment in the forest sector, and Frequency of forest visits.

Figure 21: Important indicators to monitor (N=314)

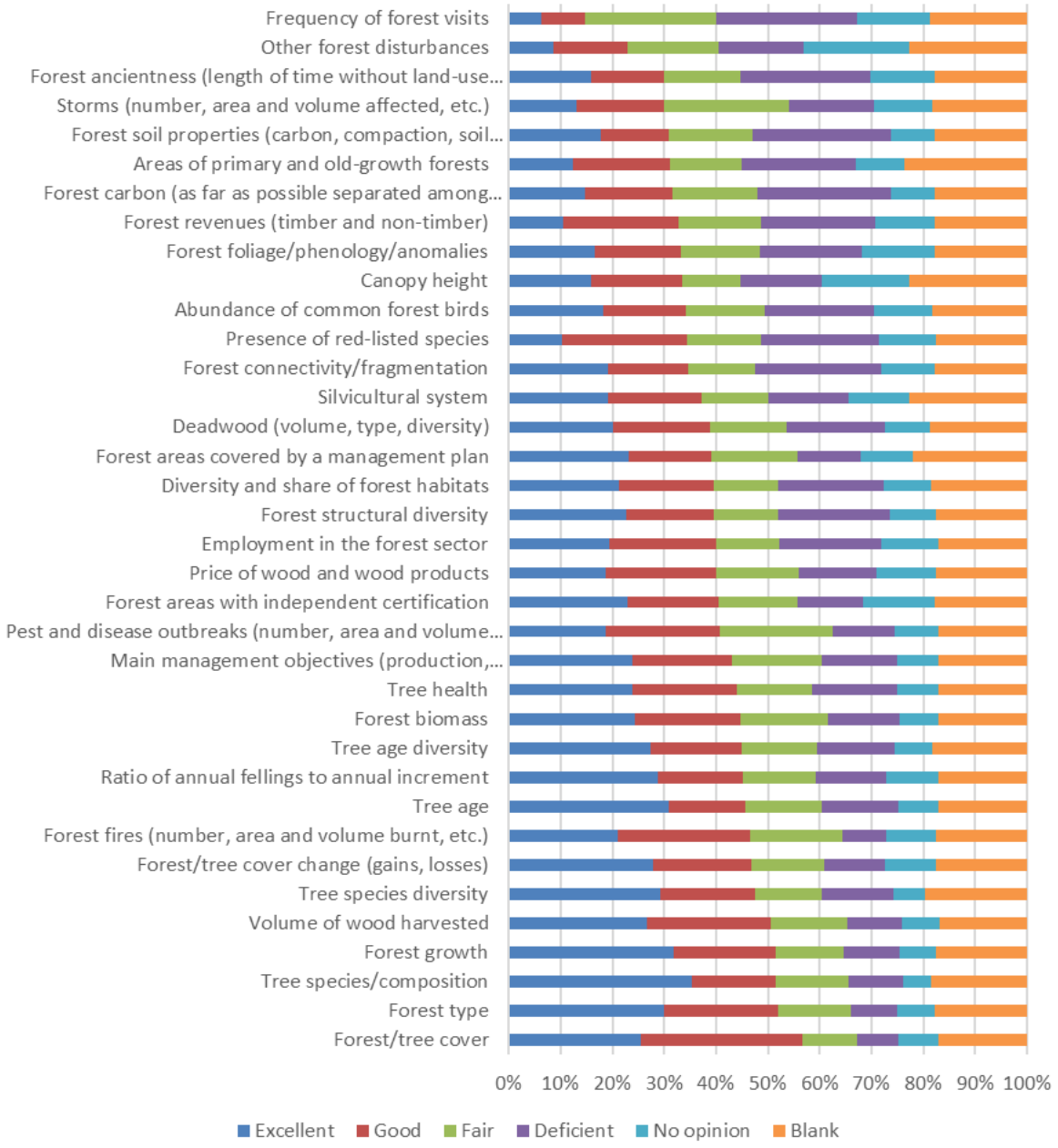


Note: Question: In your view, how important is it to monitor the following forest indicators?

Respondents were also asked to rate the monitoring of a series of forest indicators (e.g., forest/tree cover, forest biomass, tree age, etc.) in their country. More than half of the respondents find the monitoring of the following indicators to be excellent or good: Tree species/composition; Forest growth; Forest type; Volume of wood harvested; and Forest/tree cover. At the opposite end of the

spectrum, the monitoring of the following forest indicators is rated the worst: Frequency of forest visits; Forest disturbances; Storms (number, area and volume affected, etc.); Forest soil properties (carbon, compaction, soil biodiversity); Forest carbon; Forest foliage/phenology/anomalies; and Forest revenues (timber and non-timber). See Figure 22 for details.

Figure 22: Quality of monitoring of forest indicators (N=314)

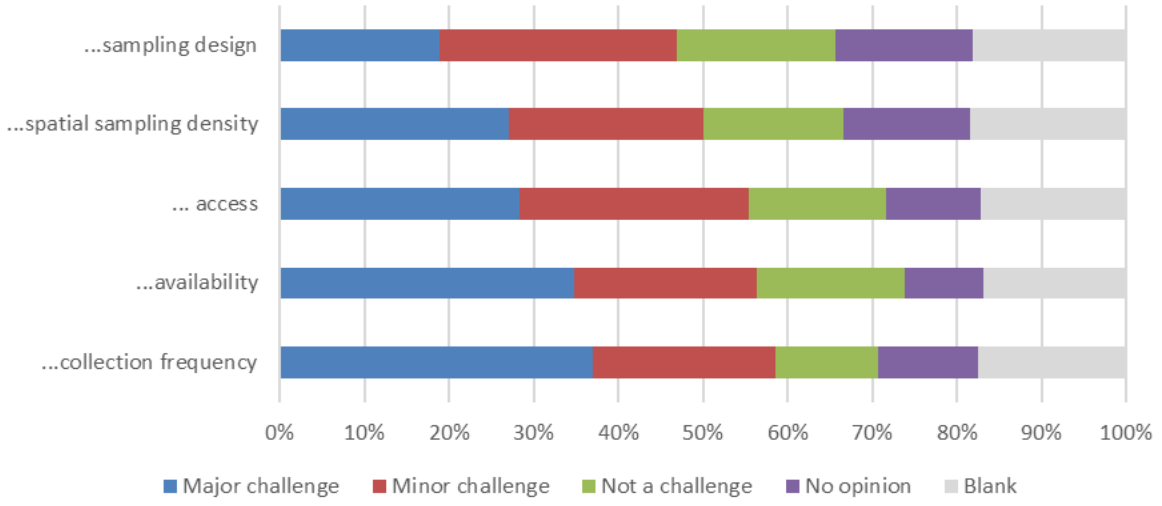


Note: Question: How would you rate the monitoring of the following forest indicator currently monitored in the chosen country?

When asked about the technical challenges to delivering an improved forest monitoring in the EU in terms of ground or in situ data, more than 67% of respondents identify data access, data availability and collection frequency as either a major or minor challenge. While providers of forest data present the highest share of agreement with the abovementioned three challenges (approximately 80% of

respondents agree with these challenges), forest owners have a lower share of agreement (54%). More than 56% of respondents consider ground or in situ data sampling design and spatial sampling density to constitute challenges for improved EU forest monitoring, with providers of forest data presenting the highest share of agreement with these challenges (approximately 63% of respondents for this category), and forest owners presenting the same share of agreement with both challenges (44% for forest owners with less than five hectares of forest, and 50% for forest owners with more than five hectares of forest). See Figure 23.

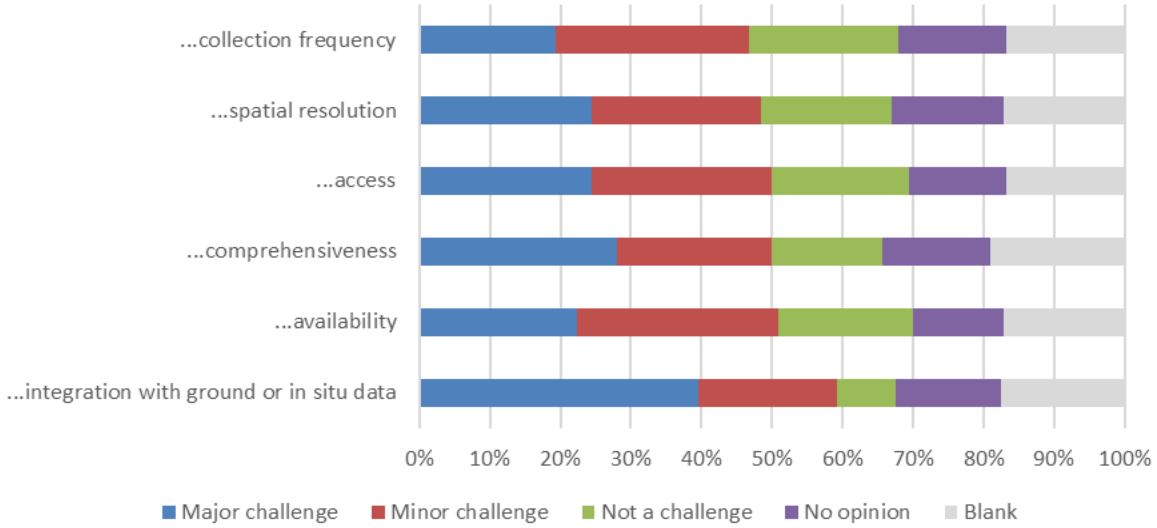
Figure 23: Technical challenges for ground or in situ data



Note: Question: What do you see as technical challenges for an improved forest monitoring in the EU? Ground or in situ data…

As for remote-sensing data, almost 60% of respondents identify data integration with ground or in situ data as a major or minor technical challenge for an improved EU forest monitoring, with providers of forest data presenting the highest share of agreement (84% of respondents for this category). More than 60% of respondents believe that remote-sensing data access, availability and comprehensiveness are either a major or minor technical challenges, with forest owners of less than five hectares of forest presenting the highest share of agreement (56% of respondents agree with these challenges). Finally, more than 56% of respondents agree that remote-sensing data collection frequency and spatial resolution represent technical challenges for EU improved forest monitoring, with providers of forest data presenting the highest share of agreement with these challenges (62% of respondents for this category), and forest owners with less than five hectares of forest presenting the lowest share of agreement with these challenges (approximately 38% of respondents for this category). See Figure 24.

Figure 24: Technical challenges for remote sensing data



Note: Question: What do you see as technical challenges for an improved forest monitoring in the EU? Remote-sensing data…

4. Feedback from thematic expert workshop organised by the Commission

The Commission organised three workshops in order to facilitate discussions among experts and receive detailed input on different topics. These inputs were taken into account in the drafting of this Impact Assessment.

The first workshop, labelled "Strategic plans for forests", took place on 24 October 2022. Discussions revolved around the different administrative levels and spatial scales at which forest planning take place, the types of monitoring provisions needed in strategic frameworks, as well as specific particularities for small-scale forest owners.

The second workshop, labelled "Present and future possibilities of Earth Observation for operational forest monitoring", took place on 25 October 2022. Discussions revolved around the appropriate scales of spatial resolution and in time, the merits of using EO for collecting data on different indicators, existing EO-based monitoring of forests in the EU and beyond, as well as the role of in-situ data in an EO-based monitoring system.

The third workshop, labelled "Benefits and costs of forest monitoring", took place on 30 November 2022. During the workshop, expert participants discussed and identified main benefits and costs of a number of elements: more harmonised forest monitoring, strategic planning, a greater role of remote sensing in forest monitoring, as well as environmental, social and macro-economic benefits.

5. Discussions in the SFC sub-group

Four meetings of the Standing Forestry Committee's sub-working group on Forest Monitoring and Strategic plans took place on 10 November and 20 December 2022, and 30 January and 26 May 2023 respectively. The meetings were opportunities for Member States to exchange views on, e.g., the discussions taken place in the expert workshops (see above), a preliminary list of forest indicators, the OPC results and the added value of long-term integrated planning at EU level. These inputs were taken into account in the drafting of this Impact Assessment.

6.1 Recommendations from CZ PRES workshop

The CZ presidency of the Council hosted a workshop on 14-16 September 2022 in Kutná Hora, Czech Republic, named "Towards harmonised Forest Observation, Reporting and Data Collection Framework – are we there yet?" in which the Commission actively engaged. The workshop covered discussions on technical aspects as well as governance of EU a forest monitoring system and was structured around presentations from Commission services and panel discussions.

Participants of the workshop:

1. stressed the importance of reliable, verified harmonized or standardized and up-to-date information and communication on the state and development of EU forests, inter-alia for informed both policy- and decision-making at the EU level;

2. reiterated the irreplaceable role of field-collected data for ensuring reliability, accuracy and comprehensiveness of derived information;

3. acknowledged fast development of new and innovative technologies in data acquisition, especially in the area of remote sensing, as well as in their processing;

4. stressed the importance of combining remote sensing and field-collected data for improving information on forests, and the need for mutual and timely exchange of both kinds of data;

5. acknowledged the importance of international processes steered by e.g. FAO, UNECE and Forest Europe for further development of existing sets of forest-related indicators;

6. stressed the importance of relevant tools to communicate information on forests, such as FISE, FRA platform and INForest;

7. welcomed the results of previous efforts on harmonization and evaluation carried out by ENFIN , ICP Forests, the scientific community, and others;

8. noted that different types of information on forests serve different purposes, and therefore has to be communicated clearly to safeguard the credibility and coherence of forest information systems;

9. noted the joint efforts towards a harmonized Forest Observation, Reporting and Data Collection framework (Framework);

10. emphasized the role of national and international experts in the interpretation and validation of the results of the Framework.

The participants encouraged the European Commission and other relevant decision-makers to:

11. further clarify objectives of the future Framework including forest strategic planning as well as interlinkages with EU policies and legislation;

12. prepare together with the Member States and in consultation with relevant stakeholders the list of indicators to be covered by the Framework based on clear principles, taking into account existing data sources, reporting demands and the cost-effectiveness of the whole process notably within the proposal impact assessment;

13. build on the available knowledge and create further synergies in collecting forest-related data and indicators;

14. promote further harmonization or standardization of forest-related information;

15. support further development of widely available tools for estimating the above-mentioned indicators (see paragraph 12) based on synergistic use of existing field data, remote sensing data relying on an unbiased statistically rigorous inference; in these efforts to respect the legal limitations and ensure the integrity of the national monitoring systems;

16. work together with the Member States to ensure the consistency of forest-related information at national and EU levels to safeguard its credibility.

They also encouraged Member States to:

17. support further development and implementation of spatially and temporally harmonized or standardized national forest inventory and monitoring methods, designs and analytical tools combining ground based and remotely sensed data;

18. participate actively in the development of the Framework, including sharing of national expertise on combining field data and remote sensing.

6.2 Summary from SE PRES workshop

The SE presidency of the Council hosted a workshop on 1-2 February 2023, Uppsala, Sweden, named "Towards harmonised forest monitoring and reporting for the EU" in which the Commission actively engaged. The meeting built on the outcomes of the workshop held by the CZ Presidency (see 6.1). The workshop focused on three areas: (i) users, areas of uses, and ways of presenting forest information, (ii) components and governance of a forest information system for the EU, and (iii) relevant monitoring methods.

The main observations from the workshop are as follows:

• Several areas of uses and users of forest information at EU level derive directly from existing legislation (e.g., the LULUCF regulations and the Habitats Directive).

• Information should be tailored for specific users and areas of uses. A main objective would be to guide EU-level policy implementation and development, but EU level forest information could also serve other stakeholders and actor needs.

• New EU legislation and several EU strategies could benefit from a common core set of indicators. Further analysis is needed to specify these indicators and their definitions. Coordination with Forest Europe, FAO/FRA, ENFIN and ICP Forests, as well as Eurostat, EEA, CBD, and UNFCCC would secure consistency with existing definitions and other established, international processes.

• Coherent information between EU and Member State levels is important to avoid confusion, when information on the same features originate from different sources.

• A stepwise approach could be recommended for building a forest information system for the EU, where the vast amounts of data and information available from existing national and multilateral programmes would be the foundation. Cost-efficiency is important to take into account, as well as financing.

• Increased harmonisation of results from existing inventories could be needed. Efforts to standardise core parts of forest inventories between Member States could possibly be considered in the long-term perspective.

• Building trust is imperative - through openness, transparency, and data availability for research. Strict procedures for quality assurance and quality control should be adopted in all parts of a future EU forest information system, e.g. through local level validation.

ANNEX 3: WHO IS AFFECTED AND HOW?

Practical implications of the initiative

This section reports potential costs and benefits from this initiative for the most pertinent actors: EU institutions, National authorities and other stakeholders, notably businesses including forest owners.

Table 10: Summary of benefits

I. Overview of Benefits – Preferred Option	
Direct benefits	
Harmonisation/ standardisation of forest monitoring	**European institutions** • Cost savings from having access to and utilising higher quality forest data acquired from and for all the Member States through common mandatory reporting. This will result in reduced administrative costs for data gap filling exercises currently undertaken by the JRC.
Forest monitoring systems including enhanced remote sensing	**National authorities** • Potential cost savings if the current Earth Observation (EO) activities at Member State level are complemented or replaced by EU level monitoring. Savings depend on the current EO-based monitoring activities in Member States. • Benefits from replacing ground-based data collection with remote sensing. Extrapolated results from a case study on replacing a single indicator (ground-based mapping of clear-cuts) with Copernicus satellite-data shows potential cumulative benefits of between EUR 28 million to 38 million by 2035 across all MS. **Forest managers** • Cost-free EO data available to forest owners and managers which will facilitate acquisition of timely and accurate information on carbon stocks and fluxes in their forest for the purposes of certification of carbon removals - can replace costs linked to baseline-setting, monitoring and verification of such data through other methods. • In a case study in Sweden, the greater role of EO was estimated to bring annual benefits ranging between EUR 6 and EUR 11 million annually for private forests owners from increased compliance with forest management obligations, leading to higher returns in the long-term. **Forest-based industry** • Comparable information on forests allows for planning investments at larger scale than national and opens up investment opportunities.
Indirect benefits	

Most benefits of the initiative are indirect since it creates the conditions for environmental, economic and social benefits to be achieved through more targeted and evidence-based actions by policy- and decision-makers, including forest managers.
• **Easy access to forest data** through a single digital platform, reducing the administrative burden for businesses, citizens, and administrations in search of forest-related information, in line with the EU Digital Agenda. • **Greater trust in forest data** and enhanced use from different stakeholders, **stimulating the additional use of forest data** beyond traditional users such as policymakers, e.g. scientific community, , certain actors within the forest industries, data-based services, financial sector. • **Better information on the quality and quantity of ecosystem services** provided **in view of a future implementation of payments for ecosystem services** that would compensate and reward forest managers, incentivizing them to **enhance or maintain ecosystem services provided by forests**, for instance within the framework of the EU Certification of Carbon Removals or the Sustainable Finance Taxonomy Regulation (Climate Delegated Act). • Higher climate change mitigation potential of forests through **enhanced carbon storage and sequestration.** The economic value of the EU forest area's net carbon sink can be estimated at €32.8 billion. EU forests and wood products currently remove approximately 380 MtCO2 eq per year. Improved and timely data on forest-based removals through this initiative could stimulate further adoption of sustainable carbon farming practices across the EU and better forest mitigation policies. • **Better control of illegal logging**: A solid evidence base for illegal logging activities through EO monitoring of key variables such as tree cover, spatially explicit designation of areas by management objective or protection status could help combat illegal logging. Using national examples, illegal operations made up around a quarter of all logging in Bulgaria between 2006 and 2013, generating hidden revenue of over EUR 50 million per year. • **Reduced forest disturbances and enhanced resilience of forests**: Forest damage from disturbances can have large economic consequences. For example, forest fires caused damages worth approximately €1.5 billion per year in Europe in the 1998 to 2009 period and biological invasions in European forests were estimated to cost €20.9 billion over a 60-year period. The impact of future temperature increases on 32 tree species in Europe by 2100 is expected to reduce the value of European forest land by 27% due to a predicted decline in economically valuable species. The existence of an EU-wide framework for timely EO monitoring and long-term planning will improve early and rapid detection of forest disturbances and adaptation of forests and the forest-based sector to the changing climate. • **More sustainable provision of economic, social and cultural forest resources**: Timber provision was estimated at around EUR 16 billion in 2021 and the value of regulatory and cultural ecosystem services (i.e. flood control, water purification and recreation for which forests were the main contributor to the total value of nature-based recreation) was estimated at about EUR 57 billion.

The most relevant and quantifiable costs additional to baseline are indicated in Table 11 below. The baseline is built on data collection in all Member States to assess the extent to which relevant activities are already conducted in Member States. Based on this baseline, cost in Member States can vary widely, depending on the extent to which they already collect data on relevant indicators, already use EO, or already develop integrated plans.

Table 11: Overview of Costs

I. Overview of Costs – Preferred Option		
	Stakeholders	
	One-off **(Administrative costs)**	**Recurrent** **(Administrative costs)**
Harmonisation/standardisation and reporting	**EU institutions** • Costs from development of harmonisation methodologies based on internal expertise, expert group recommendations and through financing research and projects; • Inclusions of additional knowledge products on the FISE platform (additional ca 30% of the current running annual costs for contracts). **MS national authorities** • One-off human resources for contributing to the development of harmonised methodologies in an expert group • Human resources-related costs for training and/or hiring of staff to harmonise data, and collect data according to a new standard	**EU institutions** • Quality assurance and quality control of the reported data from Member States **MS national authorities** • **Harmonisation:** Limited costs for application of harmonised definitions and methods to existing data sets (approximately EUR 10 000 per indicator) and to existing ground data collection • **Standardisation:** The cost of standardised data collection will depend on the variable measured (i.e. whether new expertise and tools are needed) • Recurring limited costs for human resources for processing and reporting of data
Forest monitoring systems including enhanced remote sensing	**EU institutions** • One-off costs for developing EO data products for the pertinent indicators and its technical specifications • No major additional costs linked to set-up of EO technologies as building on already existing EO systems (namely Copernicus' Sentinel I and II satellites) • Potential costs for establishing a network of ground plots for measurements related to validation and calibration of EO data.	**EU institutions** • No additional costs linked to operation of EO technologies as building on already existing EO systems (Copernicus) • Data processing costs for EO-based indicators that are not currently produced by Copernicus Land Monitoring Service and additional costs in case of increased frequency for existing ones - around EUR 500 000/year per an EO-based indicator

	MS national authorities *(Costs depending on indicators already measured in MS, forest area in MS, adequateness of existing sampling grid, number of indicators, reporting frequency)* • Designing and establishing new sampling plot network (if needed) • Hiring/training of staff and capital costs (i.e. equipment and tools) for measuring new indicators (if needed) • Human resources for developing workflows for new data collection obligations	**MS national authorities** • Possibility to shift costs to EU institutions if using data provided by EU and not using the 'opt-in'. • Additional average annual cost for operating a National Forest Inventory is 42 EUR/km2 of forest area (based on three Member States NFI costs – 5-year interval and use of EO included. Only considered additional cost if no running NFI currently present). **Businesses** • No major impacts on businesses related to regulatory burden were thus identified under the 'SME Test' - data collection for the large majority of indicators would be directly undertaken by public authorities, with no risk that the burden or costs would be passed down to businesses. • Economic indicators based on statistical information such as production and uses of timber and non-timber products, some basic reporting obligations might arise for forest owners and forest-based industries, but they are estimated to have negligible costs as they are based on existing datasets.
Integrated long-term planning	**MS national authorities** • Limited costs depending on already existing information, structures and expertise in the MS • Where no comparable information, structures and expertise is in place yet, one-off costs for developing new or adaption existing multisectoral stakeholder dialogue; one-off costs for developing new or adapting existing methodologies for forecasting • Case study: Germany spent EUR 500 000 for the preparation of their 2050	**EU institutions** • Limited costs for issuing recommendations **MS national authorities** • Limited costs for reporting depending whether MS already have something comparable in place • Recurring costs for conducting the forecasting exercise • Recurring costs for conducting the stakeholder consultation exercise • Recurring costs for drafting the report

	forest strategy and EUR 100 000 for dissemination	

Costs related to the 'one in, one out' approach							
		Citizens/Consumers		**Businesses**		**Administrations**	
		One-off	**Recurrent**	**One-off**	**Recurrent**	**One-off**	**Recurrent**
Total	Direct adjustment costs	0	0	0	0		
	Indirect adjustment costs	0	0	0	0		
	Administrative costs (for offsetting)	0	0	0	0		

On the costs related to the 'one in, one out' approach, overall the initiative should generate insignificant administrative costs to businesses and citizens compared to the baseline since the initiative does not introduce new direct administrative requirements applicable to these groups (s. section 6.3.2.)

Relevant Sustainable Development Goals

Table 12: Overview of SDG relevance

Relevant SDG	Expected progress towards the Goal	Comments (possible synergies and trade-offs between specific SDGs)
SDG no. 3 – Good health and well-being	The physical and mental health benefits associated with healthier forests could contribute to SDG 3 through targets 3.4[132] (e.g. as mental health improvements from forest visitation and recreation, or from reduced obesity) and 3.9[133] (as reduced mortalities from the reduction of air pollution).	
SDG no. 6 – Clean water and sanitation	The potential of this initiative to restore forests (which are important water-related ecosystems) and improve their health, could contribute to water purification and water availability through the filtration of sediments and harmful pollutants, as	

[132] By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being
[133] Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all

	well by maintaining the physical structure and integrity of water sources such as rivers and lakes. Overall, these services alleviate additional pressures on water treatment facilities and can reduce costs for suppliers and consumers. Therefore, this initiative could contribute to targets 6.1[134], 6.3[135], and 6.6[136].	
SDG no. 7 – Affordable and clean energy	Under the assumption that this initiative can facilitate more sustainable management of forest resources, there is potential for a greater or more long-term provision of biomass for bioenergy into the future. As a renewable energy source, this would contribute towards target 7.2[137].	A potential trade-off of an increased use of biomass for bioenergy is the over-harvesting of forests resulting in ecosystem degradation, which could conflict with SDGs 13 and 15.
SDG no. 8 – Decent work and economic growth	A monitoring and planning framework which contributes to the sustainable long-term provision of forest resources and also supports the development of new bioeconomic activities and employment opportunities around forest ecosystems (e.g. eco-tourism) can contribute to SDG 8, specifically target 8.9[138].	Important trade-offs may be the shift in employment from traditionally unsustainable forest sectors to emerging or existing sustainable forest industries, or the natural decline of some forest sectors. This may have trade-off effects on SDG 8 target 8.1 on sustaining economic growth if typically more profitable industries are in decline.
SDG no. 12 – Responsible consumption and production	The facilitation of evidence-based decision making, and more informed forest management decisions can contribute to more sustainable consumption and production of forests resources, as is specified under SDG 12. As a natural resource with high natural capital value, the sustainable management and efficient use of forest resources could greatly contribute to target 12.2[139]. Sustainable management within agroforestry could lead to reduced food losses in the production chain as specified under target 12.3[140].	
SDG no. 13 – Climate action	Healthier forests as a potential benefit of this initiative can contribute to combatting climate change and its impacts. Forest ecosystems can act as sinks to store carbon, as well as remove carbon from the atmosphere through sequestration. Healthier forests are more resilient to climate-related or exacerbated disturbances such as fires, flooding, droughts, and pest and disease outbreaks. Therefore, this can contribute to target 13.1[141] to strengthen resilience to climate-related hazards and natural disasters.	

[134] By 2030, achieve universal and equitable access to safe and affordable drinking water for all
[135] By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
[136] By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
[137] By 2030, increase substantially the share of renewable energy in the global energy mix
[138] By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products
[139] By 2030, achieve the sustainable management and efficient use of natural resources
[140] By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses
[141] Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

SDG no. 15 – Life on land	An EU-wide framework for forest monitoring and integrated long-term planning could facilitate better management decisions and policymaking to ensure forest ecosystems are protected, restored, and sustainably managed, all important factors of SDG 15. Better sustainable forest management and improved monitoring of the state of forests can contribute to healthier forests in the EU through reduced biodiversity loss, reduced forest disturbances and enhanced resilience to climate change. Equally the initiative could lead to reduced deforestation; reduced land and soil degradation; control of invasive species; and could inform planning for reforestation and afforestation, as a part of targets 15.1[142] 15.2[143], 15.3[144], 15.4[145], 15.8[146], and 15.9[147].	

[142] By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements

[143] By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally

[144] By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world

[145] By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements

[146] By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species

[147] By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts

ANNEX 4: ANALYTICAL METHODS

Introduction

This Annex describes the analytical methods used in the impact assessment. It is structured around different steps of the impact assessment, namely

- Identification of problems and objectives
- Identification and analysis of impacts

In addition, it explains the method for developing the country fiches developed as part of the impact assessment.

Identification of problems and objectives

The purpose was to clearly identify the problems and drivers that constitute the starting point (and raison d'être) for the new Legislative proposal for an EU Framework on Forest Monitoring and Integrated Long-Term Forest Planning, as well as to defining the general and specific objectives that the proposed policy options could aim to deliver on. The work was organised along the following stages:

- 1.1 where problems and problem drivers regarding forest monitoring and forest planning in the EU were described;
- 1.2 where requirements for an EU monitoring system and integrated planning were formulated; and
- 1.3 where a set of preliminary policy options for consideration were developed.

Stage 1.1: Describe and define problems and problem drivers regarding forest monitoring and forest planning in the EU.

Step 1: Gather information

Subtask 1.1 target was to gather information and conduct a detailed overview of problems and their drivers concerning the forest monitoring systems and forest planning in the EU. The overview is preliminarily based on literature review and expert knowledge as well as to some extent stakeholder views. Stakeholder views were collected by participating in recent forums discussing the forest monitoring in Europe.

For the literature review, around 60 sources such as books, scientific papers, projects reports, EU support documents were reviewed. The review focused on screening relevant sources, which covered a critical assessments of monitoring options and related topics, for mentions of problems and drawback of the current forest monitoring system in EU. All references are listed in chapter 9 of this report.

Step 2: Draft the problem descriptions

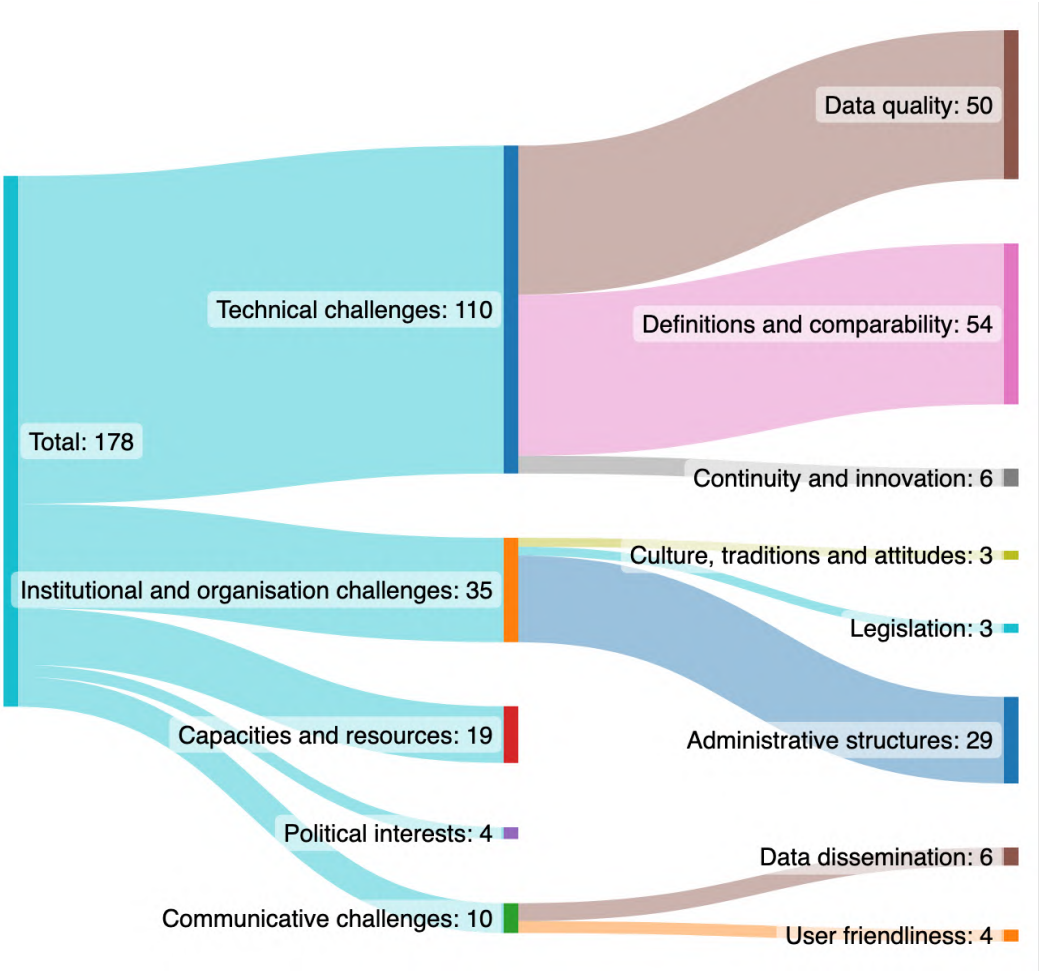
From the 60 references that were reviewed, altogether 178 problems were identified as key obstacles on the roadmap towards forest monitoring in the European Union. Aiming to have a clear understanding of the collected data, two consecutive categorisation approaches were performed.

In a first categorisation approach, two category levels were developed. Based on the description of the identified problems, five different categories were created, and the problems were distributed among these categories according to their scope.

After this step, the problems inside each one of the five categories were further divided into a secondary category level to provide additional information and obtain a better overview of the identified problems.

The results of this exercise are presented in the following Figure.

Figure 25: Problem categorisation

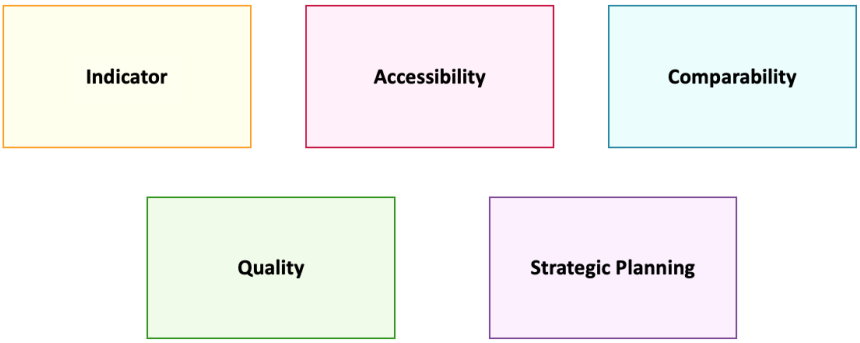


Source: Own illustration

The results made it possible to recognise that part of the identified problems shared, to some degree, the same main drivers and consequences.

Therefore, a second categorisation approach was performed, where not only the main subject of the problems was considered, but also the roots and consequences of the problems. This approach allowed the identified problems and drawbacks of the current forest monitoring system in the EU to be summarised into five main areas (next Figure) grouped

Figure 26: Main problem areas



Conforming to the five main identified areas, upon (i) identifying the problems, the problem analysis was further refined by (ii) estimating the scale of the problem; (iii) analysing its causes/drivers; (iv) identifying stakeholders in a sense of who own and/or can solve a problem and; (vi) assessing the likelihood that the problem may persist.

As a result the five main problem areas where then grouped into two main problems:

- lack of data comparability and quality (including insufficient indicator coverage and limited accessibility)
- lack of integrated long-term forest planning

According to the Better Regulation Tool #14 guidelines, a detailed formulation of the main problems elements was carried out (Table 13).

Table 13: Overview of main problem elements

Category	Function	Description
General description	Indicating nature	Qualitative overall description of the problem.
Scale	Indicating relevance	Quantification and, were feasible, monetisation of the extent to which the defined problem affects the attainment of the Regulation´s goals.
Main drivers	Indicating causes	Indicating which factors have caused the problem and influence the identified trends.
Consequences	Indicating consequences	Main health, environmental, economic, political and social effects which are likely to occur under no-policy change scenario.
No-policy change scenario including trends	Indicating baseline scenario	Description of the policy measures currently in place. Possible paths of development of the problem, bearing in mind its drivers and consequences.
Stakeholders	Indicating actors (to be) involved	Political, economic and societal actors which are affected by/concerned with the identified problem.

Step 3: Development of problem trees

As a next step of the analysis the problem descriptions were illustrated in problem trees of the main problems areas, including their underlying drivers and impacts. As already pointed out, the drivers as well as impacts of the problem areas are interlinked. Data was condensed into one problem tree for structuring the legislative initiative as a whole: establishing what the problem is, what its negative consequences are, and identifying the issues that might have to be addressed by an EU intervention.

At this step also the problem drivers were further scrutinized – including additional material for describing the *exogenous* drivers, e.g., the EU Strategic foresight reports and the trends in key questions about forests in the EU.

Stage 1.2: Formulate requirements for an EU monitoring system and Integrated Long-Term Forest Planning according to the EU Forest Strategy.

This step includes defining the scope of parameters and information products that will be part of the monitoring system, defining the characteristics of the monitoring system, as well as the characteristics of the integrated forest plans.

Based on the description and definition of the problems and problem drivers regarding forest monitoring and forest planning in the EU, requirements for an EU monitoring system and integrated forest plans are defined. In addition to those requirements outlined by the forest strategy, problems and needs identified in the first step (stage 1.1) will be translated into possible requirements towards the monitoring system. This includes defining the scope of parameters and information products that will be part of the monitoring system, defining the characteristics of the monitoring system, as well as the characteristics of the integrated forest plans. Purpose, specific and operational objectives for an EU monitoring system and integrated forest plans are described.

Stage 1.3 - Develop preliminary policy options

Step 1: Construct a baseline "no-policy-change" scenario

A draft "no-policy-change" scenario was developed, in line with the Better Regulation Tool #16. Currently no legislative framework on forest monitoring exists in Europe and the "no-policy-change" scenario builds on the assumption that no proposal on the EU Framework on Forest Monitoring and Integrated Long-Term Forest Planning is adopted (i.e. "no action" scenario).

The "no-policy-change" scenario is the counterfactual against which the impact of the different policy options are compared. This scenario covers the evolution of the legal framework considering relevant external factors and elements, such as EU-level and international policies which are assumed to remain in force, and the foreseen policy and socio-economic development that will influence the problem drivers and solution drivers.

The no-policy-change scenarios are described in view of the specific objectives.

Step 2: Compile a wide range of alternative policy options

Development of the policy options was an iterative process, starting with a long-list of policy options. In reviewing the long-list of options, three thematic strands were developed, and the more detailed policy options were developed along these core policy elements: (1) the Standardisation of data collection, (2) the further development of remote sensing-based monitoring systems and (3) the development of integrated forest plans. A set of policy options will consider as many realistic alternatives as possible.

Step 3: Identify most viable policy options and measures
With the set of policy options produced, the next step is to reduce the number of policy options that will be subjected to a more in-depth analysis of impacts. The aim of the screening of policy options is to arrive at a shortlist of the most promising options.

Identification and analysis of impacts

Identification of impacts

First, the most significant impacts from the selected policy options were identified following the methodology outlined in the Better Regulation Toolbox (see Table 14 below). Impacts include social/environmental/economic, positive/negative as well as direct/indirect. They have been assessed the based on the expected significance in terms of changes relative to the baseline (i.e., the incremental changes). To this end, data collected from the country fiches were an important input. Then, the most important impacts were identified and further assessed in Section 6.

Table 14: Impact Categories

Key Impacts	*Description of the impact*	Impact categories		
		Environmental	Economic	Social
Climate	Having better quality and more timely information on the respective relevant forest indicators, and long-term integrated forest planning integrating these policy areas will have the indirect impact of enabling better national and EU policy- and decision-making in these impact areas	x	x	
Quality of natural resources (soil, water		x	x	
Biodiversity, including flora, fauna, ecosystems, and landscapes		x	x	x
Land Use		x		
The likelihood and scale of environmental risks (forest fires, droughts, biological agents etc.)		x	x	x
Efficient use of resources	Improving awareness of forest-based industries on the availability of primary and secondary forest resources	x	x	

SMEs and Conduct of Business	Improving the knowledge base of small and medium forest holdings and forest-based industries which may improve their business decisions Bringing new opportunities to companies offering EO-services		x	
Public authorities and budgets	Both costs and avoided costs to national public administrations. Costs would result mainly from additional monitoring, reporting and planning, while avoided costs mainly from the use of Commission-operated EO		x	
Digitalisation and innovation	Where appropriate, the initiative will aim to reuse existing data produced by Copernicus or Eurostat and make it accessible to data users through a single portal (FISE). By putting emphasis on EO as a basis of the EU monitoring system, the initiative will be a potential driver of innovation for the use of remote-sensing monitoring technologies.		x	

Comparison of policy options

Once the impacts of each of the policy options have been identified and analysed, they were compared based on their relative strengths and weaknesses. This was done by listing and summarising the impact of each option in tabular form. Table 15 below presents a list of relevant criteria (compared to baseline scenario so that their added value can be clearly identified) to compare the options.

Table 15: Overview of criteria for comparison

Criterion	Definition	Data source
Impacts per stakeholder group	An overview of the extent to which differ stakeholder groups are affected and how.	• Outcome of assessment of environmental, social and economic impacts.
Effectiveness (coverage of identified requirements)	The extent to which different options would achieve the general objective of the initiative.	• Outcome of assessment of environmental, social and economic impacts.
Efficiency	An analysis of the net benefits of the impacts, i.e. comparing the benefits and the costs	• Outcome of assessment of economic impacts, as well as the estimates of administrative burden.
Coherence	An analysis of the coherence with other EU legislation and policies. Internal coherence is analysised in addition where different levels of intervention are combined.	• Outcome of assessment of environmental, social and economic impacts.

Using those criteria, the policy options were compared in a comparison table for each criterion using a simple sign framework as outlined in the following Table.

Legend of signs to be used in the comparison table

Sign	Legend
++	Objectives are partly met

Sign	Legend
+	Slight improvment over baseline

Method for developing the country fiches

After agreeing on templates for the country fiches on the existing monitoring frameworks as well as strategic planning frameworks, the fiches were filled for each MS, based on an extensive literature review.

This resulted in a set of draft fiches for each MS. Those draft fiches were then shared with relevant stakeholders in each Member State for feedback and revisions.

Based on the feedback, the fiches were revised, and a final version was created for each.

Raw data used for figures

Figures 1 and 2 in chapter 6 have been created based on the below data. (Source: Eurostat 2021)

Table 16: Data Overview for Figures 1 and 2

Country	Area			Economics		
	total area	forest area	Share of total	GDP (average 2016 - 2020)	Gross economic value added from forestry and logging (average 2016-2020)	Share of forestry and logging of overall GDP
Austria	83,882 km2	38,992 km2	46%	378,091 Million €	2,044 Million €	0.54%
Belgium	30,665 km2	6,893 km2	22%	454,732 Million €	406 Million €	0.09%
Bulgaria	110,995 km2	38,930 km2	35%	56,145 Million €	676 Million €	1.20%
Croatia	56,594 km2	19,391 km2	34%	51,228 Million €	325 Million €	0.63%
Cyprus	9,253 km2	1,725 km2	19%	21,214 Million €	4 Million €	0.02%
Czechia	78,870 km2	26,771 km2	34%	204,792 Million €	2,680 Million €	1.31%
Denmark	42,926 km2	6,284 km2	15%	300,307 Million €	624 Million €	0.21%
Estonia	45,336 km2	24,384 km2	54%	25,349 Million €	824 Million €	3.25%
Finland	338,441 km2	224,090 km2	66%	231,035 Million €	5,414 Million €	2.34%
France	638,474 km2	172,530 km2	27%	2,328,556 Million €	6,515 Million €	0.28%
Germany	357,568 km2	114,190 km2	32%	3,329,208 Million €	7,681 Million €	0.23%
Greece	131,692 km2	39,018 km2	30%	175,942 Million €	75 Million €	0.04%
Hungary	93,013 km2	20,530 km2	22%	132,738 Million €	535 Million €	0.40%
Ireland	69,946 km2	7,820 km2	11%	324,828 Million €	167 Million €	0.05%
Italy	302,073 km2	95,661 km2	32%	1,732,208 Million €	2,411 Million €	0.14%
Latvia	64,586 km2	34,108 km2	53%	28,496 Million €	1,219 Million €	4.28%
Lithuania	65,286 km2	22,010 km2	34%	45,072 Million €	514 Million €	1.14%
Luxembourg	2,595 km2	887 km2	34%	60,331 Million €	27 Million €	0.05%
Malta	315 km2	5 km2	1%	12,554 Million €	0 Million €	0.00%
Netherlands	37,368 km2	3,695 km2	10%	766,011 Million €	312 Million €	0.04%
Poland	311,928 km2	94,830 km2	30%	489,633 Million €	5,331 Million €	1.09%
Portugal	92,226 km2	33,120 km2	36%	200,503 Million €	1,290 Million €	0.64%
Romania	238,397 km2	69,291 km2	29%	200,926 Million €	2,331 Million €	1.16%
Slovakia	49,035 km2	19,259 km2	39%	88,732 Million €	1,199 Million €	1.35%
Slovenia	20,273 km2	12,378 km2	61%	44,977 Million €	539 Million €	1.20%
Spain	505,983 km2	185,722 km2	37%	1,168,855 Million €	1,983 Million €	0.17%
Sweden	447,424 km2	279,800 km2	63%	474,878 Million €	9,291 Million €	1.96%

Further discussion on the costs of the preferred option on Member States

This section provides further information and a discussion on the methodology and results presented in Table 6 found in Section 6.3.1.

Current baseline of importance of forestry sector and implications

In Estonia, Finland, Latvia and some extent Sweden, the forest-based sector plays a larger economic role compared to other countries, which seems to have contributed overall positively to their current baseline regarding plot number and density, integration of EO and number of indicators that are currently monitored. Those countries are expected to face the lowest cost (or even save cost) as compared to other Member States. Given the economic importance of the sector which is predicted to be positively influenced through this initiative due to increased long-term sustainability of forest resources, it can be expected that these Member States benefit economically in the long term. This is in addition to the wider benefits from better forest health which are described in the impact assessment report.

At the other end of the spectrum, there are Member States where the forest-based sector plays little or no role, such as Cyprus, Greece, and Malta. In these Member States there are also limited forest monitoring provisions in place regarding plot density, integration of EO, and indicators monitored. At the same time, Cyprus and Malta, and to a limited extent also Greece, have a comparably small area of wooded land in their territories. In light of the high number of additional indicators which would become obligatory through this initiative, a significant cost would arise, while the direct economic benefits would be limited (although wider environmental and social benefits from better forest health would still apply).

Current baseline of number of observation plots and implications

Finland, Germany, Spain, and to some extent also Poland and France, have a high number of monitoring plots already in place. In those countries this leads to a comparably high density of monitoring plots at or above the EU median. Thus, the monitoring of additional indicators could lead to relatively higher costs since they have to are measured throughout more plots. At the same time, there is a strong likelihood that no additional monitoring plots would need to be created., since their monitoring plot density is at or above the EU median.

On the other hand, Greece, Italy, Slovenia and Slovakia have a relatively low number of monitoring plots currently in place, leading to a low density of plots. As discussed earlier in this report, this might lead to the need to create additional plots in order to assure EU wide harmonisation of data.

Current baseline of number of time interval between subsequent plot visits and implications

Regarding the current time interval between subsequent plot visits, there are two major groups within the MS, which conduct observations every 5 or every 10 years, respectively. Given the assumption that data collection would be required to happen at least every 5 years under this legislative initiative, this would lead to additional costs for those MS which currently conduct the assessments every 10 years.

The costs for Member States with a current 10-year cycle would likely be considerably lower than double the current costs, since expertise, infrastructure, and equipment had to be maintained and incremental cost would only arise from hiring additional staff during data collection and analysis.

On the other hand, considerable costs can be expected for the countries Croatia, Cyprus, and Greece where thus far only one assessment has been conducted; or Malta and Bulgaria, where no structured assessment has yet been conducted. In those cases there would be – in addition to the staff costs for collection and analysis of data - costs for training and equipment.

Explanation of the categorisation in Table 6

Group 1- Facing high costs

This group includes countries for which high costs can be expected. The main driver of this is the absence of regular NFI. There are high one-off costs to be expected from developing and putting in place the system, such as training of staff, purchase of equipment, and others. Within this category countries like Greece and Cyprus also have the lowest numbers of the potential indicators already monitored.

This category also entails two countries with small forest size (CY, MT). While in theory this means that they thus face less overall cost for monitoring, on the other hand this also means that their costs per area for monitoring and strategic planning would likely be much higher than for other countries, since the overheads for the organisation, planning, training etc. are spread over a smaller area.

Group 2 – Medium cost

This is the largest group of countries. The group includes countries which already have NFIs in place (though often at a lower frequency), and/or where forestry might not play a very strong role.

Group 3 – High economic interest and lower expected costs

These are the countries in which forestry plays a big role. They thus typically already have a well-functioning monitoring and planning in place, and all organise their assessments every 5 years and would thus face little to no additional costs from the planned 5-year frequency.

ANNEX 5: BACKGROUND ON FOREST MONITORING AND FOREST-RELATED PLANNING

5.1 EU Forests and their Governance at EU level

The carbon sink capacity, biodiversity, economic potential and vital ecosystems services of forests all depend on the health, resilience and adaptiveness of forest ecosystems and related biodiversity preservation and restoration needs.

In contrast to other ecosystems such as grasslands and croplands with annual plants, forests are particularly challenged by such pressures, because they adapt only with delay and after deep transformations e.g. of their species composition. Tree mortality has accelerated in the last decade, because of extreme weather events and harvesting for different economic purposes has gone up. Climate change projections leave little doubt that increasingly frequent and severe heat waves, droughts, wildfires, and insect and pest outbreaks will have serious impacts on many forests in Europe.

The European Green Deal[148] called for action to improve the quantity and quality of the forested area in the EU and to enhance the resilience of forests for reaching climate neutrality, a higher biodiversity ambition, a healthy environment, to improve human health and well-being and to promote the circular bioeconomy. The ensuing EU Biodiversity Strategy for 2030[149] sets out a comprehensive, systemic, and ambitious long-term plan for protecting nature and restoring essential functions, reversing the degradation of ecosystems including forests. Building on the EU Biodiversity Strategy, the New EU Forest Strategy for 2030[150] recognises the multifunctional role of forests, including the contribution of the entire forest-based value chain for achieving a sustainable and climate neutral economy by 2050. Building on these premises, the Forest Strategy sets out a vision and defines concrete actions to improve the quantity and quality of EU forests and strengthen their protection, restoration and resilience. Finally, reflecting the requirement set out in the European Climate Law[151] to 'ensure continuous progress in enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change', the EU Adaptation Strategy[152] sets out to make adaptation smarter, more systemic and faster – including for forests. More adaptive and resilience-enhancing forest management is needed to ensure the continued delivery of forest's socioeconomic functions and to ensure vibrant rural areas.

Forest Governance is cross-cutting several EU policies. Figure 27 in this Annex provides an overview of main EU policy fields and instruments affecting forests. Legislative instruments are highlighted in bold, proposals adopted (or announced, in the case of the Soil Health Law) by the Commission lighter in shading. The new EU Forest Strategy 2030 is included in the overview in the same colour as the legislative initiative on forest

[148] COM(2019)640 final
[149] COM(2020)380 final
[150] COM(2021)572 final
[151] Regulation (EU) 2021/1119
[152] COM(2021)82 final

monitoring and integrated strategic planning since it provides for the legislative initiative but also benefits from it.

Figure 27: Overview of EU policy relevant for Forest Monitoring and Integrated Long-Term Forest Planning

As laid out in the New EU Forest Strategy for 2030, today the information concerning the status of forests in the EU, their social and economic value, as well as the pressures they face and ecosystem services they provide, is patchy. Since 2006, when the Forest Focus Regulation expired, no comprehensive reporting requirements exist. In addition, there are challenges related to the use of remote sensing data together with ground-based data (i.e. lack of interoperability, common definitions, ambiguity in data interpretation, lack of long and comparable very high resolution time-series, limitations of the current standard forest products from Copernicus).

Also, there is insufficient planning for the forests, which would address in a coordinated manner and provide a comprehensive picture of the multifunctionality of forests in the EU, especially regarding climate mitigation and adaptation, ecological condition of forests, forest damage prevention and control, and forest biomass demand and supply for different socio-economic purposes.

Combined with the need for more detailed sustainable forest management indicators and thresholds on certain climate and biodiversity aspects, this leads to a situation where, on the one hand, Member States have agreed at EU level to rely to a great extent on forests and forest-based bioeconomy in the EU's transition to a climate-neutral economy. On the other hand, there are several scattered monitoring and reporting mechanisms, but no strategic framework, which would bring these together and make it possible to comprehensively and jointly with Member States demonstrate that the EU is on the right track and that the forests can actually deliver on their multiple demands and functions."

5.2 Forest monitoring in the EU

The first EU regulatory instruments on forest monitoring were adopted in 1986[153] to monitor the effects of atmospheric pollution and wildfires. Further provisions detailing forest monitoring requirements in relation to forest fires were developed in separate Regulations in 1992 and 1994[154]. In 2003 these schemes converged in the Forest Focus Regulation[155], which also addressed the need to monitor forest condition and the effects of climate change. At the end of 2006, based on simplification grounds, the Forest Focus Regulation was repealed by the LIFE+ regulation[156] providing a single financial instrument for the environment and functioning on the basis of repeated open calls. One of the consequences of this simplification/consolidation was that there was no longer a dedicated financial support scheme (and related requirements on Member States) on forest monitoring. Therefore, there have been no comprehensive monitoring requirements for forests at European level since, apart from certain information collected by EUROSTAT[157] and for emissions and removals in the LULUCF sector[158] . The repeal of the Forest Focus Regulation in 2006 and the Green Paper on Forest Protection and Information in the EU of 2010[159], however, highlighted the need for a continuous assessment and monitoring of the state, dynamics and future evolution of European forests.

During the past decades, remote sensing-based data collection, processing methods and data storage capacities have been evolving significantly and nowadays many countries and private companies operate satellites with EO capacities. On the European side, the EU EO Copernicus program has been a major game changer and plays a leading role globally with high quality instruments providing data and information services operationally under a free and open data policy. Besides the advancement of space-borne technologies, data collection via airborne technologies - airplanes or drones for digital photographs, scanning systems, or ranging instruments such as LIDAR - play a crucial and increasing role for forest monitoring including on biomass estimates and forest species and forest composition monitoring. Technology is also evolving for ground monitoring, which remains crucial for the development of EO techniques.

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[153] Council Regulation (EEC) No 3528/86; Council Regulation (EEC) No 2158/92
[154] https://effis.jrc.ec.europa.eu/about-effis/legal-background
[155] Regulation (EC) No 2152/2003
[156] Regulation (EC) No 614/2007
[157] Annual statistics on the area and value of wooded land, the quantity and value of timber, the economic activities of forestry and logging, and employment in the sector. There is currently no official data collection that provides quantitative information about environmental functions of forests.
[158] Such as forest area, emissions and wood volumes.
[159] COM(2010) 66 final.

In contrast to existing EU legal obligations and the indisputable advancement of technologies potentially enabling to collect a wealth of information for forests, several problems are currently in the way of a comprehensive and consistent forest monitoring in Europe. This is clear from studies that have analysed the ability of countries to report with sufficient quality and complete data to international processes such as Forest Europe[160,161] and other studies that looked at data availability and potential for harmonisation or standardisation of forest information at national level[162] or in context of forest monitoring[163,164]. Also, above-mentioned progress in data collection technologies does not automatically turn into better accessibility to collected data.

At present, the most common forest monitoring framework adopted by MS is based on National Forest Inventories (NFIs). These are rolling national forest data collection programmes, whereby the frequency of data collection, the data collection and processing methods, and the measured forest parameters vary greatly from one country to another. Usually, data provided by NFIs from different countries are therefore not directly comparable. Initially motivated by a fear of forest over-exploitation and hence designed to monitor timber resources, many NFIs have gradually evolved to provide answers to a broader range of questions. They are typically based on ground measurements taken from a grid of forest plots, which are then surveyed and extrapolated to obtain a statistical figure for the whole region or country, and the sample plots and schemes were not developed to be linked with remotely sensed forest information. The operation of a measurement network such as NFIs is very expensive. Sites need to be re-visited at specific intervals which requires field units, transport and mission costs, in addition to in-office QA/QC and data post-processing.

Not all Member States have NFIs, and the sum of NFIs is far from constituting a coherent monitoring system. Each NFI in the MS has specific characteristics, with different temporal cycles, data accessibility, degrees of international standardization/harmonization and integration with remote sensing. These are presented in the following as a gap analysis towards a consistent EU monitoring framework.

Time frame

The time interval between two subsequent field revisits varies within different NFIs. Across Europe, most MSs adopt a five-year revisit cycle (i.e., Belgium, Czech Republic, Denmark, Estonia, Finland, France, Hungary, Ireland, Latvia, Lithuania, Poland, Romania, and Sweden), while a 10-year cycle occurred in Germany, Spain, Italy, Luxembourg, Portugal, Slovenia, and Slovakia. Other MS either does not have a planned NFI (i.e., Malta, Bulgaria), or only happened once (i.e., Croatia, Cyprus, Greece). Lastly, Austria and the Netherlands adopted a specific time span between the measurement of subsequent NFI, the first every three years (where one-third of the sampling plots were surveyed every year) while the latter has a planned cycle of four years.

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[160] Baycheva-Merger and Wolfslehner 2016
[161] Linser and Wolfslehner 2022
[162] Diabolo project 2019
[163] European Commission, Directorate-General for Environment et al. 2020
[164] Van Brusselen et al. 2021

For gap filling the solution would be to have annual estimates produced by the NFI on the basis of permanent monitoring system where every year a proportion of 1/n plots (where n = years of the NFI rotation, most frequently 5 years) are visited in the field.

Data accessibility

One of the possibilities to create pan-European estimates of forest variables is to re-elaborate raw plot level (or even tree level) data acquired by the NFIs, in conjunction with remotely sensed data. Many such hybrid systems exist in literature. To do so the NFI data should be accessible.

The traditional way the NFIs produce their results is with design-based estimates for large aggregated regions and published on the national websites in the form of reports. Nowadays, some MSs upload plot and tree-level information surveyed during NFIs in openly accessible form. This is the case of Germany, Italy and the Netherlands. For research purposes, MSs could provide plot-level information (as in Pucher, Neumann and Hasenauer, 2022). On the other hand, public access to aggregated NFI data exists in most MSs.

None of the MSs publish open access the real coordinates of all the plots, but for scientific purposes, these data can be obtained upon request, as in Sweden, Finland, and Germany. Moreover, Sweden provides an openly accessible database where the coordinates of temporary sample plots - along with the forest information surveyed in them - are reported from 2007 to 2021. Indeed, these temporary plots were only surveyed once within each Swedish NFI campaign.

The availability of publicly accessible NFI data is not reported for Greece, Denmark, Latvia, and the Netherlands (SoEF, 2020).

Table 17: Availability of plot-level and tree-level information.

MS	Plot-level data availability	Tree-level data availability	Language
AT	Upon request		
BE	Upon request	-	
BG	-	-	
CY	-	-	
CZ	-	-	
DE	Public	Public	Local
DK	-	-	

EE	Upon request	-	
ES	Public	-	Local
FI	Upon request		
FR	Upon request		
GR	-	-	
HR	Upon request		
HU	-	-	
IE	-		
IT	Public	Public	Local - EN
LT			
LU	-	-	
LV			
MT	-	-	
NL	Public	Public	Local
PL	Upon request	-	
PT			
RO	Upon request	-	
SE	Public (for temporary plots)	-	
SK	Public	-	Local
SL	-	-	

Different definitions and methods

To ensure the specific objective of data comparability, forest variables across the EU should be based on common definitions. For some variables also the standardization of methods is needed, especially for biodiversity indicators that are sensible to the size of the sampling unit. In Europe, NFIs adopted different basic definitions and methodologies, leading to inconsistencies and lack of comparable data. In this context, the need for

harmonization among MSs reporting, especially regarding the definition of forests, is pivotal. In fact, even if all countries based their national definition on the extent, percentage of tree crown cover and tree height, a difference exists between member states on these criteria (when reporting is available). According to the FAO – FRA standard definition, **forest** is defined as "land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use."

A minimum height of 5 meters is used in the majority of MSs. Indeed, 20 MSs use this threshold (74%), while 6 MSs (22%) uses a minimum height of 2 meters, and just one MS use a minimum height of 3 meters (4%). On the other hand, the criterium used for minimum size area is further diverse. 10 MSs (37%) uses the same criterion as FAO – i.e., 0.5 ha - while 7 MSs (26%) uses a minimum size of 0.1 ha. The remaining MS uses a minimum size of 0.3 ha (11%), 1 ha (11%), 0.25 ha (7%) or 0.05 ha (4%) respectively. Finland uses both 0.25 ha and 0.5 ha. Lastly, approximately half of MSs use a minimum crown cover of 10% as a criterion (48% - 13 MSs), while the rest uses higher percentage, namely 20% (26% - 7 MSs), 30% (22% - 6 MSs), and 25 (4% - 1 MS), of crown coverage. Totally, 6 MSs use the same forest definition as FAO – FRA (22%), namely Denmark, Finland, France, Italy, Lithuania and Sweden. In particular, Finland and Sweden adopted a second national definition of forest. Here, forest is also defined as "a land capable of producing an annual increment of volume growing stock of at least 1 m^3 per ha per year over the rotation under the most favorable tree species composition, and not used for any other purpose than forestry or forestry related purposes".

Table 18: Summary of Member States forest definition criteria.

MS	Crown cover (%)	Height (m)	Area (ha)	FAO-FRA harmonization
FAO – FRA	*10*	*5*	*0.5*	-
AT	30	2	0.05	
BE	20	5	0.5	
BG	10	5	0.1	
CY	10	5	0.3	
CZ	20	5	0.5	
DE	10	5	0.1	
DK	10	5	0.5	X
EE	30	2	0.5	
ES	20	3	1	
FI	10	5	0.25/0.5	X

FR	10	5	0.5	X
GR	25	2	0.3	
HR	10	2	0.1	
HU	30	5	0.5	
IE	20	5	0.1	
IT	10	5	0.5	X
LT	30	5	0.1	
LU	10	5	0.5	X
LV	20	5	0.1	
MT	30	5	1	
NL	20	5	0.5	
PL	10	2	0.1	
PT	10	5	1	
RO	10	5	0.25	
SE	10	5	0.5	X
SK	20	5	0.3	
SL	30	2	0.25	

Currently, the only variable that could possibly achieve a good level of harmonization at the European level is forest area. For other forest variables, such as growing stock volume, biomass, deadwood, or carbon content, much work is still necessary to clarify definitions so that estimates can be directly compared or aggregated for international reporting (Rondeux et al., 2012, Gschwantner et al., 2019, Gschwantner et al., 2022). Hence, while the FAO had some success in harmonizing definitions for their reports, only MS-level totals are published.

To eliminate this gap standardization or harmonization procedures can be applied, both of them are based on common agreed definitions at international level. If common definitions are not agreed, then the only solution is to acquire the data with multiple definitions. A typical example is Finland where the NFI uses both a national forest definition and the FAO standard definition. In this way, the NFI can provide estimates on the basis of both definitions.

Integration of Earth Observation

Differences among MSs forest monitoring frameworks relate also to the use of EO within NFIs. Indeed, while most countries currently implement Earth Observation sensing within their forest monitoring frameworks, along with fieldwork, eight MSs have not implemented it yet. This is the case of Bulgaria, Croatia, Cyprus, Estonia, Germany, Malta, Romania and Slovakia.

On the other hand, these countries could benefit from external research combining earth observation with ground data acquisition, mostly occurring at test sites. Here, the EO methods used are related to the analysis of satellite imagery, aerial photogrammetry and Airborne Laser Scanning (ALS) data. In this context, Sweden and Finland provide virtuous examples of efficient integration between NFI and EO, where the databases are openly accessible, and up-to-date maps and results are provided. Thus, in Finland, two forest inventory systems are used, the NFI - conducted by the Natural Resources Institute Finland (LUKE) every 5-10 years, collects information on national and regional forest resources - and the remote-sensing based inventory carried out by the Finnish Forest Centre (Metsäkeskus) that implement laser scanning to assess forest stock and management activities. On the other hand, many MS currently cannot benefit from this integration, even if progresses have been made. This is the case of France and Denmark. Here, NFI provides maps that are usually only visible in GIS online, and countries could benefit from national research activities frameworks, which are much more advanced than in other countries. Similar situations occurred in Italy, Poland, Germany and Ireland, where research activities are currently carried out to develop maps based on NFI data at national level. Many other MS – Spain, Portugal, Slovakia, Czech Republic, Austria, Lithuania, Latvia, Greece, Belgium, Slovenia and the Netherlands – are currently conducting research at test areas, developing maps mostly related to species composition. On the other hand, no further information on the integration of EO and NFI, or on related research activities, has been available for Luxemburg, Malta, Cyprus, Romania, and Bulgaria.

Table 19: Summary - how is EO currently integrated in forest monitoring programs in the different EU countries?

Classes	**Countries**	**Integration NFI - EO**
The NFI is **fully integrated** with multisource remote sensing, a long list of multiple spatial products are available, full open access policy adopted, long research track. The link between the NFIs and forest disturbance monitoring, especially for forest logging mapping, is relatively less evident and relevant data is not integrated in the NFI. The Finnish maps from the NFI are more difficult to access and are mainly available in local language only.	Sweden, Finland	done

The NFI **provides maps**, usually only visible in GIS on line, research activities in the country are advanced and carried out at national level	France, Denmark, Germany	ready
The NFI **does not provide maps** but research activities in the country are advanced and carried out at national level	Italy, , Ireland, Poland	
The NFI **provides maps** only for species composition. Research activities still do not demonstrate examples of country level wall-to-wall spatial estimation of forest variables.	Spain, Portugal, Slovakia, Czech Republic, Austria, Lithuania, Latvia, Greece	Advanced
The NFI **does not provide maps**, research is mainly in test areas	Belgium, Slovenia, Nederlands	not yet ready
No information available	Luxemburg, Malta, Cyprus, Romania, Bulgaria	

Summing up, table 20 informs about today's survey-based forest monitoring systems.

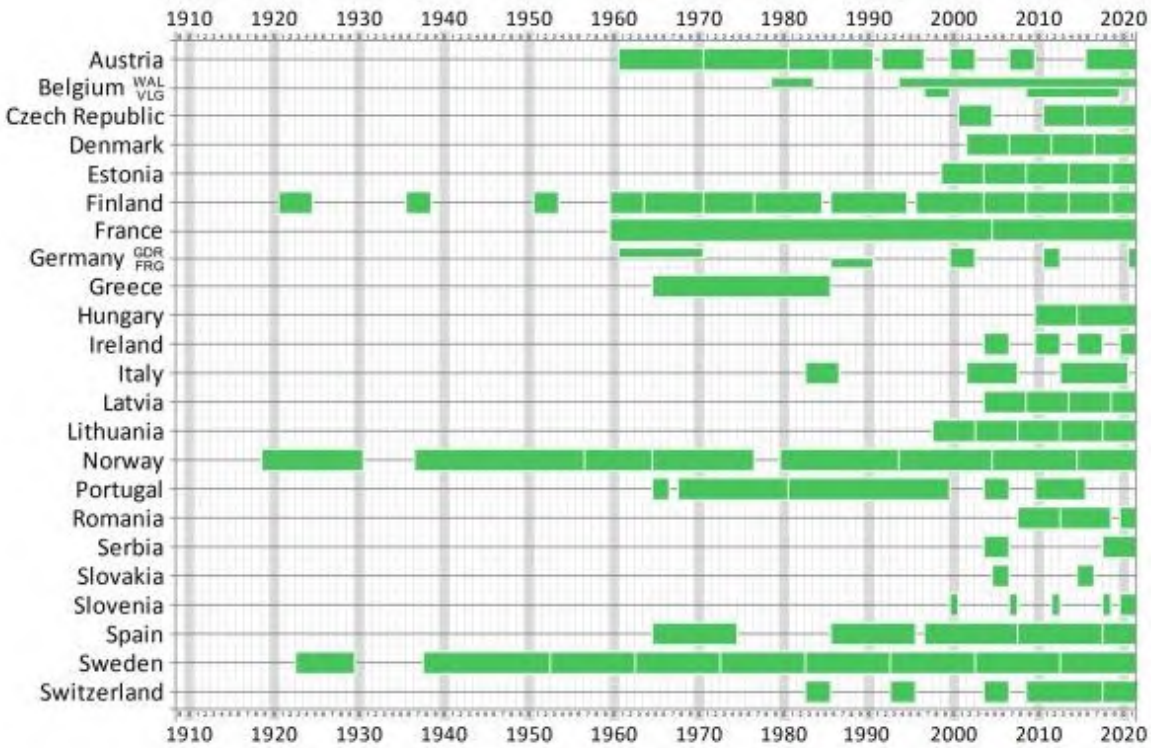
Table 20: National Forest Inventories in the EU

MS	Indicators	NFI interval	NFI sampling density (km)	NFI-based EO	EO method(s) - including external research
AT	21	The field measurement period lasted for 3 years. The sampling grid is systematically divided into three parts so that each year one third of the grid (covering the whole country) is inventoried.	3.889 x 3.889	x	• Aerial photogrammetry • Satellite imagery • LIDAR
BE	31	According to the current sampling design, half of the plots visited annually are re-measured after 5 years to assess increments; the remaining plots are re-measured after 15 years.	1x0.5	x	• Aerial photogrammetry • Satellite imagery • ALS
BG	/	Until now, due to the lack of financial resources, Bulgaria has not started a NFI.	/	/	• Satellite imagery
CY	/	The NFI occurred once	/	/	• Satellite imagery
CZ	23	In 2016, the third cycle began on a continuous basis with a five year re-measurement period.	2x2	x	• Aerial photogrammetry • Satellite imagery
DE	20	The programmed interval between two successive cycles is 10 years.	4x4	/	• Satellite imagery

MS	Indicators	NFI interval	NFI sampling density (km)	NFI-based EO	EO method(s) - including external research
DK	17	Approximately one-third of the plots are permanent and are re-measured in every 5-years cycle	2x2	x	• Aerial photogrammetry • Satellite imagery • ALS
EE	15	The Estonian NFI is based on a grid of sample plots, covering the entire country, a quarter of which is permanent and re-measured every five years	5x5	/	• Aerial photogrammetry • Satellite imagery • ALS
EL	20	No further NFI campaign were carried out in Greece after 1992.	Random process of selection on 95220 photo-plots	x	• Satellite imagery
ES	21	The programmed interval between two successive cycles is 10 years.	1x1	x	• Aerial photogrammetry • ALS
FI	19	Starting from the 10th NFI (2004–2008) a five-year rolling system, so called "panel system" has been used, meaning that one fifth of NFI plots are measured each year over the whole country, and the whole sample is measured in five years.	6x6 - 7x7 - 10x10	x	• Aerial photogrammetry • Satellite imagery • ALS
FR	22	Since 2010, the sampling strategy is composed of point systematically revisited 5 years after the first visit	1x1	x	• Aerial photogrammetry • Satellite imagery • ALS
HR	15	The planned time interval between inventories is 10 years and the period for field assessments of the entire area of the Republic of Croatia should take no more than2 years. Currently, the NFI in Croatia was carried once	4x4	/	• Aerial photogrammetry • Satellite imagery
HU	17	The full cycle was completed by sampling 1/5 of the nodes each year in a cycle of 5 years.	4x4	x	• Satellite imagery
IE	22	Ireland NFI occurs on a 5-years basis, between the starting date of cycles.	2x2	x	• Satellite imagery
IT	17	The programmed interval between two successive cycles is 10 years.	1x1	x	• Aerial photogrammetry • Satellite imagery • ALS
LT	21	Since the beginning in 1998 (1998-2002) the NFI has been implemented on a continuous basis with an interval of 5 years remeasurement cycle	4x4	x	• Satellite imagery
LU	20	The programmed interval between two successive cycles is 10 years.	1x0.5	x	• Aerial photogrammetry • ALS
LV	15	The programmed interval between two successive cycles is 5 years.	4x4	x	• Satellite imagery • ALS
MT	/	No NFI	/	/	• /
NL	20	The current time span between the measurements of the NFI5 and NFI6 is 7 years, but the planned cycle is 4 years	1x1	x	• Aerial photogrammetry • ALS

MS	Indicators	NFI interval	NFI sampling density (km)	NFI-based EO	EO method(s) - including external research
PL	14	Each tract located in forest area is revisited after 5 years.	4x4	x	• Satellite imagery • ALS
PT	21	The programmed interval between two successive cycles is 10 years.	2x2	x	• Aerial photogrammetry
RO	17	The Romanian NFI is designed as a continuous forest inventory with a five-year cycle.	2x2	/	• Satellite imagery
SE	19	Annual NFI plots' assessment. Permanent clusters are re-inventoried with five-year intervals	Permanent cluster [squares]: 300m-800m-1000m-1200m; Temporary cluster [rectangular/square]: 300x600m - 400x800m - 1500m - 1800	x	• Aerial photogrammetry • ALS
SI	22	The inventorying is to be caried out periodically (5-10 years)	4x4	x	• Aerial photogrammetry • ALS
SK	15	The programmed interval between two successive cycles is 10 years.	4x4	/	• Aerial photogrammetry • ALS

Figure 28: Historical timeline of sample-based NFIs in 23 European countries over time as presented by Gschwantner et al (2022).



What kind of EO data?

For the NFIs, and in general for forest monitoring, the most useful type of remotely sensed data is **Airborne Laser Scanning** (ALS). Based on LiDAR point data, it is in fact possible to develop very accurate models for estimating many forest variables, not just those based on species composition, or to volume/biomass/carbon, but also those related to structural diversity, under canopy vegetation, etc. ALS is in general acquired not specifically for forest applications and thus the moment and characteristics of the acquisition are frequently not optimized for forest applications. Moreover, depending on scale economies, it can be expensive and the raw point clouds over large areas are still very large dataset that cannot be easily manipulated in a fast way. As a result, ALS cannot yet be acquired with the same frequency of satellite data.

GEDI data, acquired by LiDAR on board of the International Space Agency is an interesting source of information but their use is still related to research activities. Future possible Satellite Laser Scanning missions could become a relevant source of information for forest applications.

In second position we have a more traditional source of information provided by **optical sensors**, with multiple bands acquired in the visible and infrared wavelengths. The most used satellite for such applications was Landsat. With a 30 m resolution, a 16 day revisit time, 7 bands, and an uninterrupted time series dating back to 1972, Landsat images were the most common source of information for estimating forest variables until the advent in 2015 of Sentinel-2 images. Operated by ESA in the framework of the Copernicus system, the EU EO program, Sentinel-2 satellites have more bands, a higher frequency (5 days) and a smaller pixel (10 m). Sentinel-2 images can be considered nowadays the most important satellite source of information for monitoring EU forests. The main limiting issues for optical imagery are related to cloud coverage and to the so call "saturation effect". When the top canopy cover is full, additional changes in the amount of wood volume/biomass cannot be easily detected. A long list of other optical data was used as an alternative or in conjunction to Landsat imagery, especially before the advent of Sentinel-2, including but not limiting to SPOT and ASTER imagery.

In third position **microwave** data acquired by Synthetic Aperture Radar (SAR) satellites. They have the major advantage of being able to operate also in adverse meteorological conditions. Different applications exist for L, C and X bands but most usually this data complement ALS or optical imagery.

5.2.1 Further information on indicators

Methodology

The first step in the selection of indicators and parameters for Table 21 was a comprehensive screening exercise to identify all relevant indicators and forest data being currently monitored or and/reported in existing forest monitoring and reporting schemes and frameworks. The main identified reporting frameworks were SoEF report[165], FAO-

[165] Forest Europe 2020

Global FRA[166] and forest and forestry data collected by EUROSTAT[167]. Other international monitoring frameworks considered were ICP Forests, while on the EU level the Copernicus-based EFFIS and other forest data gathered by the Copernicus Land Monitoring Service were included in the overview. The overall overview similarly includes indicators whose monitoring and reporting is obliged under existing EU legislation, mainly the LULUCF Regulation and Habitats Directive, and those which are part of legislative proposals adopted by the Commission, namely the proposal for a Regulation on Nature Restoration[168] and the proposed amendment of Regulation (EU) No 691/2011, introducing Forest and Ecosystems Accounts[169].

As next step, this wider selection of indicators was compared against forest monitoring needs as identified in:

- the report of the Standing Forestry Committee's *Ad hoc working group on forest information* [170];
- the views of the stakeholders expressed in the OPC (see Annex II) on both the perceived importance of monitoring a specific indicator and their assessment of the current quality of the; and
- an internal analysis of new policy needs stemming from the objectives of recently adopted strategic documents such as EU Biodiversity Strategy for 2030 and the new EU Forest Strategy, as well as needs to strengthen the implementation of existing legislation such as the Habitats Directive and the LULUCF Regulation.

These indicators were then categorised into four broad categories: *Biomass resources and management, Forest bioeconomy, Forest health and resilience, and Forest protection and biodiversity*.

Taking this selection of indicators and forest data and **following the step-wise approach** suggested by Policy Option 2, the list further specifies key indicators which would most likely be considered for their inclusion already in the proposal of the basic act. This selection was based in considering all four of the following aspects: links to priority policy and strategic objectives, availability of common definitions and methods for the relevant indicator, current status of monitoring and reporting in the Member States, and the need for higher spatial or temporal resolution compared to the existing monitoring and reporting.

The remaining indicators in the list would be considered potential candidates for inclusion within the monitoring system at a later stage, depending on the evolution of policy needs and advice of the expert group envisioned to be set up under all policy options.

Where no additional requirements are foreseen in terms of higher spatial resolution or frequency of data collection for indicators that are reported under legislative obligations are monitored by or reported to the Commission services or the EEA without a legislative framework (e.g. forest fire-related indicators under EFFIS) or are reported to international

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[166] FAO 2020
[167] https://ec.europa.eu/eurostat/web/forestry
[168] COM/2022/304 final
[169] COM/2022/329 final
[170] Standing Forestry Committee 2012

frameworks such as FAO FRA or Forest Europe , such indicators are not considered to be within the scope of the proposed legislation. A non-exhaustive list of these indicators is shown in the last part of Table 21.

Where, on the contrary, additional requirements are foreseen to complement existing legal monitoring obligations, the indicator is included within the scope of the proposal.

Forest soil-related indicators which could be within the scope of the upcoming Soil Health Law proposal are not included in the table because the present initiative does not foresee to impose additional reporting requirements on such indicators.

The choice of including an EO requirement for the monitoring of certain indicators was based on information acquired both from external experts in two technical workshops[171] as well as an internal analysis by the JRC which identified indicators for which EO-based monitoring brings clear benefits in terms of the required data quality. This was analysed against the frequency and spatial resolution requirements of each indicator in order to fulfil their expected role in policy- and decision-making.

For instance, EO was considered an essential monitoring method for meeting the data requirements of monitoring disturbances, for which high frequency and spatial resolution is important to provide useful information for the purposes of early warning and timely forest management interventions – hence the indicated EO obligation.

Regarding the spatial and temporal data resolution, expected needs were identified for most indicators to be considered for the legislative proposal of the basic act based on a preliminary analysis and expert advice acquired in the workshops organised for the purposes of the Impact Assessment.

As the last step, a mapping exercise was done per indicator on their coverage in Member States, looking at whether each indicator was either reported in the SoEF 2020 report or monitored in Member States' NFI, as shown in the analysis of national monitoring systems that is available in the final report[172].

In order to report information for the SoEF reports, many countries use the forest data collected during the NFI process. However, this is not always the case. In many Eastern European countries, particularly for older reporting periods, forest management records (stand-level inventories) were used for reporting to SoEF – e.g. forest regeneration, invasive species, forest damages, naturalness. While most countries now have developed NFIs, still for some indicators data may be a combination of NFI and forest management records or even solely based on such records. Hence, differences between the data collected in NFI and the data presented in the SoEF report for some of the indicators can be explained by the fact that the SoEF is not exclusively based on the NFI data.

[171] The workshops were organised with the help of external consultants and took place online on 25 October and 30 November 2022. See the final report [to be published with the IA]
[172] See the final report [to be published with the IA]

Table 21: Overview of indicator and parameters

Indicators and parameters and their key policy areas	Inclusion in the proposal of the basic act	EO requirement included in the proposal	Data Resolution needs (spatial and temporal)	Current Monitoring and Reporting	Existing or proposed legal obligations	Data availability SoEF	Data availability NFI	Link to policy objectives
Biomass resources and management Forest bioeconomy Forest health and resilience Forest protection and biodiversity	Marked indicators to be considered for their inclusion in the proposal of the basic act	Marked indicators to be considered for a mandatory EO monitoring in the legal proposal	Needs identified for the legislative proposal	Frameworks in which the indicator is already being reported	x - in force (x) - proposed by COM	Reported by EU27 countries [number of reporting countries for the latest reporting year in SOEF2020]	Number of countries monitoring a given indicator as identified in the analysis of NFIs	Link to a legal obligation or a strategic policy target
Indicators and parameters included under sub-option 2.1								
Forest area (and annual changes)	X	X	Annual updates	Copernicus-HRL/CLC/SoEF/Eurostat	x LULUCF Regulation ---------- (x)	26	26 AT BE BG CY CZ DE DK EE EL ES FI FR HR HU IE IT LT LU LV NL PL PT RO SE SI SK	Informs reporting on land use change under LULUCF Regulation Regulation on deforestation free

					Forest and Ecosystem Accounts proposed under amendment of Regulation (EU) No 691/2011			products (identifying deforested areas)
Tree cover density	X	X	Annual updates	Copernicus – High Resolution Layers (3 year cycle)	(x) Forest and Ecosystem Accounts proposed under amendment of Regulation (EU) No 691/2011	26	26 DK EE EL AT BE BG CY CZ DE ES FI HR IE IT LT LU LV NL PL PT SE SI RO SK HU FR	Regulation on deforestation free products (link to forest degradation) LULUCF regulation – information on tree cover changes to inform estimates of carbon stock changes on forest land Renewable Energy Directive – link to sustainability criteria relating to minimising clearcuts
Forest type (EEA typology)	X		Plot level data	SoEF/Copernicus HRL Forests/Corine Land Cover – only 3 to 4 forest types ICP Forests Level I – EEA typology		-		Habitats Directive – the EEA typology is aligned with Annex I habitats categorisation Allows stratification of forest data according to forest type - informs implementation of Adaptation Strategy on climate impacts across the types

Growing stock (volume)	X	X	Plot level data 5 year monitoring frequency	SoEF/ FAO FRA	(x) Forest and Ecosystem Accounts proposed under amendment of Regulation (EU) No 691/2011	22	24 AT BE BG CZ DE DK EE EL ES FI FR HR HU IE IT LT LU LV NL PT RO SE SI SK	Evolution of EU timber resource important for the implementation of the Bioeconomy Strategy Informs carbon stock change reporting under LULUCF Regulation
Structure (dbh classes)	X		Plot level data; 5 year monitoring frequency	SoEF	(x) Nature Restoration Regulation Proposal	20	25 AT BE BG CZ DE DK EE EL ES FI FR HR HU IE IT LT LU LV NL PL PT RO SE SI SK	Data on forest structure allows assessments related to forest resilience (Adaptation Strategy), biodiveristy (nature restoration Proposal) and carbon stocks (LULUCF)
Aboveground Biomass	X	X	Annual updates, integration of areal laser-scanning data with ground observation required	LULUCF/SoEF/ESA Biomass Climate Change Initiative	x LULUCF Regulation	22	21 AT BE BG CZ DE DK EE EL FI FR HR HU IE IT LT LU LV PT RO SE SI	Informs reporting under LULUCF Regulation on carbon stock changes
Net annual increment of growing stock volume (on all forest)	X		Reporting based on the latest NFI	SoEF	(x) Forest and Ecosystem Accounts proposed under amendment of Regulation (EU) No 691/2011	18	18 AT BE BG CZ DE EE ES FI FR HU IE IT LT LU LV NL PT SE	LULUCF Regulation – NAI as an indicator for forest growth and carbon sink Adaptation Strategy – indicator of forest health and resilience

Roundwood removals	X	X	Annual	ESTAT (JFSQ)		26	18 EE AT BG CZ DE ES FI IE LT LV NL PT SE SI RO SK HU FR	LULUCF Regulation – informs reporting on emissions from harvesting Bioeconomy Strategy – links to the objective of 'managing natural resources sustainably'
Main management objective (production/ protection of soil and water/biodiversity conservation/social services/multiple use)			Geographically explicit data on location	FAO FRA			25 AT BE BG CZ DE DK EE EL ES FI FR HR HU IE IT LT LU LV NL PL PT RO SE SI SK	Forest Strategy – informs on progress towards the objective of multifunctionality of forests
EU supply,uses and trade of woody biomass (energy and material)	X		Annually	ESTAT (JFSQ and JWEE)				Bioeconomy Strategy – improving knowledge on the current forest biomass supply and demand
Wood energy - feedstock sources (primary/secondary biomass)	X		Annually	ESTAT (JFSQ and JWEE)	X Governance Regulation (EU) 2018/1999	17	2 DK LV	Renewable Energy Directive – improves knowledge basis on the application of the cascading principle
Harvested quantity and market value of non-wood forest products	X			SoEF/FRA		22	/	Forest Strategy – informs on progress towards the objective of multifunctionality of forests

Value of marketed forest services				SoEF/INCA		12	/	Forest Strategy – informs on progress towards the objective of multifunctionality of forests
Defoliation	x	x	More frequent than monthly updates	ICP Forest/Copernicus	x CLRTAP	ICP Forests	24 BE BG CY CZ DE DK EE EL ES FI FR HR HU IE IT LT LU LV MT NL PL PT SI SK	Adaptation Strategy – information on climate impacts on forests
Forest Habitat types location (Annex I of Habitats Directive)	X		Geographically explicit data on location (improved granularity)	Habitats Directive	X Annex I of Habitats Directive			Habitats Directive – improved implementation through monitoring of the habitats
Tree species richness and composition	X		Plot level data 5-10 years	SoEF		20	26 AT BE BG CY CZ DE DK EE EL ES FI FR HR HU IE IT LT LU LV NL PL PT RO SE SI SK	Allows stratification of forest data according to dominant tree species - informs implementation of Adaptation Strategy on climate impacts across different forest types Information on the presence of invasive species (IAS Regulation)
Naturalness	X		Spatially explicit information on the location of the forest areas divided into	SoEF	x Regulation on deforestation free products	23 (using a different definition of naturalness than	4 BE CZ LT RO	Informs the implementation of the Regulation on deforestation free products

			naturalness classes			intended for the legal proposal)	(Using a different definition of naturalness than intended for the legal proposal)	
Introduced tree species				SoEF		21	3 ES FI RO	-
Deadwood - volume and type (standing/lying)	X		Plot level data	CBD/ SoEF	(x) Nature Restoration Regulation Proposal	19	25 DK EE EL AT BE BG CZ DE ES FI HR IE IT LT LU LV NL PL PT SE SI RO SK HU FR	Informs on progress towards the proposed nature restoration targets Informs reporting on the Deadwood carbon pool udner the LULUCF Regulation
Threatened forest species	x			SoEF, Habitat Directive Reporting if in Annex II	X Habitats and Birds Directive	16	10 BE BG ES FI LU LV PT SE SK FR	Informs on the presence of Annex II species of Habitats Directive in forest ecosystems
Invasive forestspecies	x		Geographically explicit data on invasive forest species	Surveillance system under Article 14 of the IAS Regulation	x Invasive Alien Species (IAS) Regulation		3 ES FI RO	IAS Regulation- Information on the presence of invasive species
Additional indicators and parameters included under sub-option 2.2								
Silvicultural regime (Clear-cutting/ continuous cover/coppice etc.)	X	X	Aggregate national data on forest area per				25 AT BE BG CZ DE DK EE EL ES FI FR HR HU	Tracking the implementation of the Forest Strategy's goal of

			silvicultural regime Plot level data				IE IT LT LU LV NL PL PT RO SE SI SK	promoting close-to-nature forestry Renewable Energy Directive – link to sustainability criteria relating to minimising clearcuts
Forest disturbance recorded in terms of area size and volume distinguished by: regular harvest; storm; drought; fire; biological agents;	X	X	For early warning through EO – at least monthly updates For aggregated datasets with disturbance agent attribution – annual updates	EFFIS (for wildfires) and Drought Observatory SoEF and FAO FRA		16	22 AT BE BG CY CZ DE DK ES FI FR HR HU IE IT LT LU LV NL PT SE SI SK	LULUCF regulation – information on tree cover changes to inform estimates of carbon stock changes on forest land Adaptation Strategy – informs on climate impacts on forests and facilitates risk preparedness, assessment of forest resilience and adaptation needs
Forest degradation	No, instead including forest naturalness classes as defined in the Regulation on					6		-

	deforestation free products							
Tree mortality							18 AT BE BG CZ DE EE ES FI FR HU IE IT LT LU LV NL PT SE	-
Old growth and primary forest area	X		Geographically explicit data on location				12 BE BG CZ DE FI FR HR LU LV PT SE SK	Linked to the ambition of the Biodiversity Strategy to map and protect all remaining primary and old-growth forests in the EU Renewable Energy Directive – link to sustainability criteria relating to no-go areas in primary and old-growth forests
Diversity of non-tree plant species	x		Plot level data				5 AT BE ES IE LT	Reported data may inform benchmarking related to assessment of sustainable forest management (Forest Strategy)
Relevant indicators and parameters where no additional monitoring requirement was identified								

Forest Area available/not available for Wood supply				ESTAT/SoEF/FAO FRA JRC FAWS mapping	(x) Forest and Ecosystem Accounts proposed under amendment of Regulation (EU) No 691/2011	25		
Forest management plan (share of forest area)				FAO FRA/FRA			18 AT BE BG CZ DE EE EL ES HR HU IT LU LV PL PT SE SI SK	
Third-party certification (share of forest area)				SoEF/UNECE/FAO		24		
Gross value added of forest sector				SoEF/ESTAT		27		
Net revenue				SoEF/ESTAT		22		
Investments in forests and forestry				SoEF		19		
Forest Sector employment				SoEF/ESTAT		25		
Regeneration type				SoEF		22	5 BG HU RO NL LV	

Burnt areas (size)	x			EFFIS				
Active fires (number)	x			EFFIS				
Wildfire risk				EFFIS				
Deposition and concentration of air pollutants				ICP Forest	x CLRTAP	/	25 AT BE BG CY CZ DE DK EE EL ES FI FR HR IE IT LT LU LV MT NL PL PT SE SI SK	
Soil condition (pH, CEC, N, C, …) -C/N ratio, nitrate, nitrate leaching				ICP Forest	x CLRTAP	/	22 BE BG CY CZ DE DK EE EL ES FI FR IE LT LU LV MT NL PL PT RO SI SK	
Common forest bird species	x			PECBM/Birds Directive Reporting	X Birds Directive ---------- (x) Nature Restoration Regulation Proposal	N/A	12 BE BG CZ ES FI IT LU LV NL PT SE FR	

Protected forests			Geographically explicit data	SoEF/ESTAT/Natura 2000/EEA GIS Map	x Habitats and Birds Directives (Special Areas of Conservation and Special Protection Areas)	17	17 EE AT BE BG CZ DE ES FI IT LT LU LV PT SE SI MT HU	
Forest connectivity	x			SoEF/JRC	(x) Nature Restoration Regulation Proposal			

Based on the analysis carried out in the Table 21, we were able to determine the overall indicator coverage of the different policy areas in each Member State, considering all indicators and parameters. Table 22 below shows the relative coverage.

Table 22: Indicator coverage per MS across different policy areas

	Biomass resources and management	Forest bioeconomy	Forest health and resilience	Forest protection and biodiversity
Austria	92%	100%	50%	62%
Belgium	92%	78%	100%	77%
Bulgaria	92%	78%	83%	62%
Cyprus	33%	100%	67%	8%
Czechia	92%	89%	83%	69%
Germany	92%	89%	83%	46%
Denmark	83%	89%	100%	54%
Estonia	92%	89%	83%	54%
Greece	83%	56%	50%	15%
Spain	92%	56%	83%	77%
Finland	83%	100%	100%	69%
France	83%	100%	83%	62%
Croatia	92%	100%	83%	62%
Hungary	92%	67%	50%	54%
Ireland	83%	56%	100%	46%
Italy	92%	67%	67%	54%
Lithuania	83%	89%	83%	62%
Luxembourg	83%	56%	83%	54%
Latvia	92%	89%	83%	69%
Malta	8%	33%	50%	8%
Netherlands	83%	67%	83%	62%
Poland	83%	89%	67%	54%
Portugal	92%	89%	83%	54%
Romania	83%	78%	50%	46%
Sweden	92%	100%	67%	62%
Slovenia	92%	100%	67%	54%
Slovakia	92%	100%	83%	54%

5.2.2 Harmonisation and standardization

In order to ensure the specific objective of data comparability, forest indicators across the EU should be based on common definitions and approaches. This objective can be achieved in two different ways: harmonisation or standardisation. While data harmonisation is concerned with making data from different sources compatible and comparable, data standardisation is concerned with establishing and enforcing standards for data to ensure its quality and consistency (Box 1). Depending on the existence and

quality of data for individual indicators, harmonisation or standardisation may be the appropriate approach.

Box 2: Harmonisation and standardisation

Harmonisation utilises available data and translates them into an agreed system, in order that data collected and derived through different methods become comparable. The process typically involves identifying and resolving differences in the definitions, structures, formats, or meanings of the data. The goal of data harmonisation is to make it easier to work with data from different sources, and to enable the integration of data from multiple sources to provide a more comprehensive view of a subject or phenomenon. Data harmonisation can be time consuming and resource intensive, and in some instances it can be challenging to resolve differences between different data sources.

Standardisation refers to the process of establishing and implementing standards for data, in order to ensure that data is collected, stored, and used consistently and accurately. It defines a common standard and forces pertinent systems to adopt this standard. Data standards can include rules or guidelines for data formats, data quality, metadata, and other aspects of data management. The goal of data standardisation is to improve the interoperability, reliability, and usability of data, and to facilitate the exchange and sharing of data between different organisations or systems. Data standardisation may require the development of new tools or methods, and it may be challenging to reach consensus on data standards.

5.3 Forest-related planning in the EU

A National Forest Strategy is a strategic document that defines the overall direction of forest policy and planning (in the absence of a strategy, a legal instrument such as a forest law or code might be seized).

A National Forest Programme is an instrument that includes a suite of measures to implement a strategy on national level (e.g. research initiative, funding instrument, communication campaign).

A Forest Management Plan addresses the operational level, i.e. concrete actions how to manage forests on sub-national level (not to be mistaken with planning instruments at the level of the undertaking).

The table below provides an overview of current forest strategies or equivalent instruments in the EU, which have been categorised according to their official labelling to the extent possible.

Table 23: Forest strategies or equivalent instruments in the EU

Planning Instrument	National Forest Strategy or other document if NFS is lacking	(a) National Forest Programme (b) Forest Management Plan (c) Other planning instrument
Austria	National Forest Strategy 2020+	(a) Created in 2005

Planning Instrument	National Forest Strategy or other document if NFS is lacking	(a)National Forest Programme (b)Forest Management Plan (c)Other planning instrument
Belgium	No National Forest Strategy	(c)Regional long-term visions (Flanders 2017/2018)
Bulgaria	National Forest Strategy 2013-2020	No programme or similar instrument could be identified
Croatia	National Forest Strategy published in 2003	(b)Every 10 years
Cyprus	No National Forest Strategy, but Forest Law of 2012	(c)Forest Policy Statement, 2013
Czech Republic	National Forest Policy up to 2035; National Forest Act of 1995 amended in 2021	(a)for the period of 2013, still under implementation
Denmark	Danish Forest Act of 2004 amended in 2019	(a)Created in 2002, amended in 2018
Estonia	The process to develop a forest strategy until 2030 was launched in 2019; currently: Forest Policy 1997	(a)Programme 2016-2020, evolved from National Forest Act 2013, formerly 2006
Finland	National Forest Strategy 2025	(a)&(b) regularly revised
France	Forest Code; Law for the future of food, agriculture and forests enacted in 2016	(a)National Forest and Wood Program (2016-2026)
Germany	National Forest Strategy 2050, before: National Forest Strategy 2020	(a)Set-up 1999-2006, but no definite endpoint of activities
Greece	National Forest Strategy 2018-2038	Forest Management Plans and National Forest Programme for forest fires.
Hungary	National Forest Strategy 2016-2030	(a)&(b) existing

Planning Instrument	National Forest Strategy or other document if NFS is lacking	(a)National Forest Programme (b)Forest Management Plan (c)Other planning instrument
Ireland	National Forest Strategy 2014-2020. New draft National Forest Strategy 2022 – 2030 published	(a)NFP as basis for NFS
Italy	National Forest Strategy 2014-2020	(a)New Programme as of 2019, valid for 20 years
Latvia	No National Forest Strategy; but National Forest Policy amended in 1998 & Law on forests	(c)National Forest Policy amended in 1998 & Law on forests responsible for forest management
Lithuania	Amendment of the Law on Forest (last amendment in 2018); new National Forest Sector Strategic document is under preparation	(a)Forestry Sector Development Programme for 2012-2020
Luxembourg	A draft law on a New Forest Code was placed before Parliament in January 2018	(a)Programme of 2003 &(b)Management Plan
Malta	Outline strategy for implementation of a national restoration and afforestation project	No Programme or similar could be identified
Netherlands	National Forest Strategy for 2030 was launched in 2020	(b)Although forest management plans are not required by law, it is generally presumed that most forest areas are included in a long-term management plan
Poland	No National Forest Strategy could be identified, but Forestry Act of 1991 and national forest policy, 1997	(b) existing
Portugal	National Forest Strategy 2015	(b) & (c)regional forest programmes

Planning Instrument	National Forest Strategy or other document if NFS is lacking	(a) National Forest Programme (b) Forest Management Plan (c) Other planning instrument
Romania	National Forest Strategy 2018-2027	(a) existing
Slovakia	Forest Act amended in 2018	(a)approved in 2007 & (b)
Slovenia	No National Forest Strategy could be identified Forest Act of 1993 serves as reference	(a) Programme of 2007 & (b) existing
Spain	Spanish Forestry Plan 2002-2032 and Forestry Law lastly modified in 2015	(a)A NFP process has resulted in a Spanish Forestry Plan 2002-2032
Sweden	National Forest Programme of 2018 based on Forestry Act with the most recent major amendments in 2014	(a)National Forest Programme launched in 2018 & (b) existing

Currently, several planning instruments address forests from specific policy perspectives, without coordination and communication among departments and services involved. Moreover, these instruments often do not have same reporting cycles nor duration making comparability of relevant information difficult.

The table below presents an overview of current forest planning instruments in the EU.

Table 24: forest planning instruments in the EU

Planning instrument	Forest-related dimension	Reporting/reviewing interval	Commission action (approval, recommendation, acknowledgement)	MS that have submitted the plans (latest applicable round)
National Forestry Accounting Plans	Forest Reference Level in the context of LULUCF	Once for the period from 2021 to 2025	Technical assessment	All EU MS
National or regional adaptation strategies	Forestry (sector)	5-year compliance check: comprehensive review process in 2027 and 2032	Comprehensive review by EEA	All EU MS
National Energy and Climate Plans	Decarbonisation, renewable energy and energy efficiency	10-year long cycle, update at 5-year and progress reports on a biennial basis	Assessment and country-specific recommendations	All EU MS
Long-Term Strategies	Decarbonisation, renewable energy and energy efficiency	Every 10 years; update every 5 years, where necessary. At least 30 years perspective	Assessment	All EU MS ex. IE, PL, RO
CAP Strategic Plans	Financial instrument to support investments (afforestation, agroforestry, prevention and restoration of damage, provision of ecosystem services etc),	From 2023 to 2027. One yearly amendment possibility	Formal approval	All EU MS have submitted the CAP SP (FI, IE, LU, NL, SE foresee no forestry

Planning instrument	Forest-related dimension	Reporting/reviewing interval	Commission action (approval, recommendation, acknowledgement)	MS that have submitted the plans (latest applicable round)
	management commitments and horizontal measures (advisory services, cooperation etc)			measures with CAP funds); BE has two regional plans
Environmental Implementation Reviews	Circular economy and waste management; biodiversity and natural capital; climate action	First in 2016, previous EIR in 2019, latest review by COM in 2022	Review/recommendation	All EU MS ex. HR, LU
Prioritised Action Frameworks for Natura 2000	Overview of the measures and financing that are needed to implement the EU-wide Natura 2000 network – including for significant area covered by forest habitats	Financing programmes, the present one 2021-2027 was due by end of 2021 (previous 2014-2020); as deemed appropriate by MS	Assessment	All EU MS except DK (Jan.2022 situation)
National Biodiversity Strategies or Action Plans	Variable forest-related dimension depending on country circumstances	Reporting intervals varying between 5 and 10 years, depending on MS and consecutive submissions (EU BDS: revised NBSAP by end of 2021, or as min. submit national commitments for the most important targets + there should be regular review cycle)	N.A.	All EU MS, except LT (chapter in environmental policy guidelines) and SE (integrated environmental policy); 2030-strategies in NL and PT, updates ongoing (AT, BG, DE, FI, FR, HU, IE, IT, SK)

Planning instrument	Forest-related dimension	Reporting/reviewing interval	Commission action (approval, recommendation, acknowledgement)	MS that have submitted the plans (latest applicable round)
National Ecosystem Assessments	Ecosystem services (state and trends)	Irregular at country initiative	N.A.	BG, CZ, DE, ES, IT, NL, PL, PT, FI,
Management plans of Natura 2000 sites [173]	Forest management plans, integration of conservation objectives and measures (such as deadwood, old trees, old-growth forests and a diverse structure) for the purposes Habitats and Birds and Birds Directives	Planning obligation depends on MS and can be also varying by region	N.A.	Countries where national obligation are in place: CZ, DK, EE, ES, FR, IE, LT, LU, NL, PL, SE, SI Countries where sub-national obligations are in place: AT, BE, DE
N2K – Article 17 reporting	Conservation status and trends in forest habitats, restoration needs, status and trends in forest bird species; pressures for habitats and species	Every 6 years (2001, 2007, 2013, 2019, next planned for 2026)	Assessment (EEA)	ES, EE, DK, DE, CZ, CY, BG, BE, AT, SK, SI, SE, RO, PT, PL, NL, MT, LV, LU, LT, IT, IE, HU, HR, GR, FR, FI
National Bioeconomy Strategies and Action Plans	Biomass production, bioresources, bioproducts,	N.A.	N.A.	All EU MS have Bioeconomy Strategy at

[173] https://ec.europa.eu/environment/nature/natura2000/management/docs/conservation%20measures-Annex%202.pdf

Planning instrument	Forest-related dimension	Reporting/reviewing interval	Commission action (approval, recommendation, acknowledgement)	MS that have submitted the plans (latest applicable round)
	bioenergy (emphasis given to sustainability dimensions, ecosystem services or, for example, biodiversity varies); innovation RTDI, biotechnological solutions			national level, ex. EE, DE, BE, SL, GR, BG, RO which have other policy initiatives dedicated to bioeconomy
Disaster-risk reduction strategies (Sendai Framework 2015-2030 UNDRR.org)	Variable attention to forest depending on the significance of forest related risks	yearly	N.A.	Variable number by criterion
National Forest Risk assessment Plans	To identify and evaluate risks to forests, including natural (biotic and abiotic) disturbances, and detrimental impacts from climate change or human activities	N.A.	N.A.	No EU-level requirement
National reports to Forest Europe	6 criteria and 35 quantitative indicators (describing the forest status and changes) as well as 17 qualitative indicators (describing the national forest policies, institutions and instruments towards SFM)	Approx. 5 yearly	Not Applicable	All EU MS

Table 25: planning instruments and initiatives regarding bio-economy in the EU

Country	Forest bioeconomy (main documents)	Level	Elements covered
Austria	National Bioeconomy Strategy National Forest Strategy	national	Optimised tree species Several mentions
Belgium	Bioeconomy Strategy in Flanders	regional	Forests mentioned as sources of biomass & in relation to sustainable resource use
Bulgaria	Bioeconomy strategy for the Stara Gora region	regional	Information about the use of forest for purposes of bioeconomy and overall goal to sustainably manage forests
Croatia	National Forest Policy and Strategy 2020	national	Sustainable climate-neutral development; Using bioneric raw-material for sustainable, circular economy
Cyprus	no indication of substantial plans or strategies relating to the forest bioeconomy		
Czechia	Ministry of Agriculture, Bioeconomy Concept	national	Agroforestry & bioeconomy as a tool to reinsure the sustainable use of natural resources, incl. forestry
	National Forest Policy up to 2035		Proper recognition to wood as a renewable strategic material and its use in bioeconomy
	Bioeconomy Platform of the Czech Republic		Objectives of the Platform are to deepen knowledge in the respective fields of bioeconomy by means of research and education and to promote their use in practice at the level of enterprises and public administration while respecting principles of sustainable development
Denmark	Energy Political Agreement 2018	national	Speed up the transition from coal-based heat and power to biomass-based platforms allows for grants to be provided for biomass-based production of electricity. The Political Agreement was updated in 2018
	Promotion of Renewable Energy Act 2018		Promote the use of renewable energy sources, which includes, a.o., biomass energy sources
Estonia	General Principles of Climate Policy until 2050	national	Promotes SFM and the positive effect it has on the carbon stock
	Climate Change Adaptation Development Plan until 2030		The use of wood is continuously promoted and the carbon stock in wood products and buildings is increased, thereby replacing the use of non-renewable natural resources

Country	Forest bioeconomy (main documents)	Level	Elements covered
	Estonian Forestry Development Programme until 2020		Sets the objectives to use wood as a renewable resource in industry and energy sector up to the amount of annual increment. Wood industry is inclining towards long term-wood products incl wooden houses. Proportion of wood fuels as resource of primary energy has been ca 16% annually. Transformation of fossil fuel boiler houses into wood fuel ones has been publicly supported
Finland	National Forest Strategy 2025	national	The role of forests, sustainable forest management and forest-based bioeconomy
	The Finnish Bioeconomy Strategy		Forest Strategy as foundation for the Bioeconomy Strategy, from which the marginal conditions related to the availability and growth of Finnish forest biomass can be determined
France	National Forest and Wood Program	national	Reference to the National Bioeconomy Strategy and to the uses of wood
	National low carbon strategy		
	The National Bioeconomy Strategy		Several references about variety of uses of biomass and new materials
Germany	BMEL Forest Report	national	Long-lasting wood products, cascading use of wood, substitution of non-renewable materials
	Forest Strategy 2050		Information and goals until 2030: The cultivation of site-appropriate tree species is further supported; The Charter for Wood 2.0 dialogue process is strengthened; The wood construction rate is increased; Resource policy with wood is expanded; The knowledge about wood production and use is strengthened; Regional value-added and supply chains of the resource wood are strengthened; Resource-efficient wood utilization is strengthened
	National Bioeconomy Strategy		Sustainable climate-neutral development; Using bioneric raw-material for sustainable, circular economy
Greece	National Forest Strategy	national	Recognition of the value and enhancement of the contribution of forest ecosystems to the bio-economy and the circular economy
Hungary	National Forest Strategy	national	Role of forests in bioenergy is emphasized
	Presentation on bioeconomy "Power4Bio"		Overview and objectives of the Hungarian bioeconomy strategy
Ireland	National Forest Programme	national	Priority 5c: Facilitating the supply and use of renewable sources of energy, of by products, wastes, residues and other non-food raw material for purposes of the bio-economy
	National Policy Statement on the Bioeconomy		Several mentions of forestry as one of the sources for the bioeconomy, e.g. on p. 7 of the Statement it says: "Approximately 10.7% of Ireland is under forests which produce 3.2 million cubic metres of material each year and this is forecasted to increase to 8 million by 2035."
Italy	National Forest Strategy	national	Improve resource use efficiency by optimizing the multifunctional contribution of forests to the development of the bioeconomy and forest economies and rural and inland areas interior of the country,

Country	Forest bioeconomy (main documents)	Level	Elements covered
			also promoting the expansion and enhancement of forests in urban and suburban settings to improve well-being and environmental quality
	National Bioeconomy Strategy		Forestry as part of the biodiversity strategy
Latvia	National Bioeconomy Strategy	national	The vision of the Latvian bioeconomy development strategy – the bioeconomy industries in Latvia are innovation leaders in maintaining, increase, effective and sustainable use of natural capital value in the Baltic States. The goal of the strategy is to keep employment in the traditional sectors of the bioeconomy in 2030 at the level of 2015, i.e., 128 thousand people. Forest sector as important part of Latvia's bioeconomy can contribute with potential to increase the economic value of the forest and higher added value product production in wood working sector
Lithuania	Lithuanian Bioeconomy Strategy	national	Exploration of the potential of the forest and forest-based sector
	Forestry Sector Development Programme for 2012-2020		Forest as source for biofuels
Luxembourg	National Forest Programme	national	Wood Production and Carbon Storage
Malta	no indication of substantial plans or strategies relating to the forest bioeconomy		
Netherlands	National Forest Strategy	national	Aim to stimulate high-quality use of wood and reduce its use for energy, in line with efforts to stimulate bio-based construction in the context of the circular economy and the sustainable sequestration of carbon in materials
	Climate Agreement 2019		Stimulate the use of wood and other natural products for construction and renewable energy. Balance emission of GHG on the one hand and the sequestration of greenhouse gases and production of renewable energy and biomass on the other hand
	The Transition Agenda, 2018		Five roadmaps for different industries (including construction and biomass and food) setting out the agenda for these industries to become circular by 2050. Promoting the use of bio-based material such as wood
Poland	no indication of substantial plans or strategies relating to the forest bioeconomy		

Country	Forest bioeconomy (main documents)	Level	Elements covered
Portugal	Action Plan for Sustainable Bioeconomy – Horizon 2025 (Government Order 183/2021)	national	Promotion of active sustainable forest management; Scale up the unity of management areas (ex: from Integrated areas of Landscape Management to Forest Management Unities & land tenure reform); Strengthening research, development & Innovation, envisaging the sustainability of raw materials supply and along the value chains, is too considered of outmost relevance to promote bioeconomy based on forests
Romania	National Forest Strategy	national	Increasing the competitiveness and sustainability of forest-based industries, bioenergy and the bioeconomy as a whole
Slovakia	CELEBio bioeconomy dossier (Bio Based Industries Joint Undertaking under the EU Horizon 2020 under grant agreement No 838087)	national	Biomass supply from forestry
Slovenia	National Forest Programme	national	Promote the use of lower quality wood, wood residues, waste wood and waste wood products for energy and biofuels, including second-generation biofuels, in compliance with environmental standards
	Overview of state of play on bioeconomy in Slovenia (Ministry of Agriculture, Forestry and Food)		Overview of strategic documents and target sectors
Spain	Spanish Bioeconomy Strategy	national	Description of benefits and best practices for forestry-related production
	Spanish forest strategy		Timber as a source of bio-energy - Reference to EU energy policy & exploration of possibilities Promotion of the use of forest products, extensive livestock and forest tourism
Sweden	Sweden`s National Forest Programme	national	Sweden`s forest industry to become a world leader in creating and utilizing innovation, sustainably producing processed forest products for a growing bioeconomy, and satisfying the demand for sustainable, fossil-free products and services in global markets
	The Swedish bioeconomy strategy – work in progress		An inquiry on a national bioeconomy strategy is ongoing. It will present its suggestion for a national bioeconomy strategy by 31 October 2023
	National forestry accounting plan for Sweden		Forests as “green gold” to contribute to employment and sustainable growth; main aim: LULUCF Reporting

5.3 - SWOT Analysis for integrated long-term forest planning in the EU[174]

A SWOT provides a structure for a systematic analysis of factors relating to a new product, technology, management, or planning; and includes both, internal factors (strength and weakness) and external factors (opportunities and threats). The influence of an internal factor entirely derives from the study object, whereas external factors originate from the outside the object and can either be positive (opportunities) or negative (threats). In the context of this analysis, 'internal' is defined as national level, while 'external' refers to interplay between EU and Member States.

To operationalise the general SWOT structure, for each of the four elements (strengths, weaknesses, opportunities, and threats) a number of factors are defined along which the analysis is then structured (Table 26).

Table 26: Overview of the SWOT factors for integrated forest plans

	Positive	Negative
Internal Environment	**Strengths** Comprehensive national policies and instruments that can create synergies and help further develop integrated forest plans	**Weaknesses** National policies and instruments that are missing or likely to hamper synergies and the further development of integrated forest plans
External environment	**Opportunities** Political, institutional, social, economic, technological and/or sectoral and cross-sectoral features which create positive potential for further uptake of integrated forest plans	**Threats** Political, institutional, social, economic, technological and/or sectoral and cross-sectoral features which create negative potential for further uptake of integrated forest plans

SWOT analysis

The SWOT analysis is to identify a list of key issues that are relevant for the development of integrated long-term forest plans (IFPs) from national and EU's perspectives. As this relates to all 27 EU Member States in summary, not every element is valid for each country, but tries to identify certain patterns, that might be considered for the set-up of IFPs.

[174] Based on the Study on Member States country fiches on forest monitoring and planning instruments (to be published...).

Table 27: Overview of SWOT factors for integrated forest plans

	Positive	Negative
Internal Environment	**Strengths** • Comprehensiveness of planning documents • Existing national expertise as key for forest planning • Established stakeholder networks • National Forest Programmes	**Weaknesses** • Lacking strategies responding to major forest-related EU topics • Incoherence of planning instruments • Missing coordination and communication • Too many emerging issues
External environment	**Opportunities** • Further develop monitoring schemes • Harmonise funding schemes • Guidance for connecting different objectives • Improve clarity on impacts of new EU instruments	**Threats** • Planning as part of the subsidiarity • Lack of trust in new EU instruments • Uncertainty for forest owners • Unclarity on impacts of integrated forest plans

Outline of factors

<u>Strengths</u>

- **Comprehensiveness of planning documents**
  In most countries, there is long history of planning of forest management and other forest-related issues (e.g. water, biodiversity). These instruments have been constantly modernized, yet they are not always intertwined. For IFPs these sources provide a good starting point in many countries as regards data, objectives, and implementation instruments.

- **National expertise as key forest planning**
  National forest expertise is widely perceived as key asset for forest planning. There are long-lasting structures, proven interrelations between administration and forest owners/managers, and function control mechanisms in place. IFPs will require involvement of national experts and making use of national governance and communication structures as well as bottom-up initiatives.

- **Established stakeholder networks**
  Stakeholder organisations and associations are set up in most countries and build an essential backbone in forest governance and in connection policy and practice. Participatory stakeholder involvement is one of the key success factors for strategic

processes, and SPs bear the opportunity to broaden the gathering beyond sectoral boundaries.

- **National forest programmes**
  National forest programmes exist in many countries and are proven tools for a multi-stakeholder dialogue. Ideally, they are also adaptive to bringing new strategic issues together. IFPs could build on such processes where existent, and demonstrate good practices on how strategic planning can be performed combining both EU goals and national competences.

Weaknesses

- **Lacking strategies responding to major forest-related EU topics**
  Currently, the forest policy arena is developing dynamically. Since forest-related policies are a cross-cutting matter it is difficult to find comprehensive and long-term collection for implementation of EU instruments, even on national levels. This phenomenon might also be referred to as policy fragmentation. IFPs might be an instrument to overcome this fragmentation.

- **Incoherence of planning instruments**
  Forests are directly or indirectly subject to a variety of planning instruments, also on national level. This can lead to horizontal incoherence among instruments both in terms of goals, content, competences, terminology and planning horizon, and may hamper their implementation in actual forest management.

- **Missing coordination and communication**
  Missing coordination happens often if both there is a split/partial overlap in national competences, and if there is no cross-sectoral exchange or conflict between forest stakeholders and others. IFPs might be platform that stipulates such exchange between authorities, administrations, and stakeholders.

- **Too many emerging issues**
  In recent years, things around forests and forestry changed quickly. For both forests and administration, this makes it difficult to move due too economic and capacity constraints. IFPs would need to lift such issues that first require tactical response to a strategic and prospective level.

Opportunities

- **Further develop monitoring schemes**
  An EU-wide forest monitoring instrument can build on a variety of national monitoring instruments as a solid ground for further development. In addition, synergies should be sought with other reporting schemes (e.g. global forest reporting). Currently, there are a lot of activities and funding ongoing for further developing forest monitoring, which will give new impetus and grounding to IFPs.

- **Harmonise funding schemes**

EU forest funding is often less prioritised compared to other sectors. It is an opportunity to harmonise and substantiate funding on the basis of IFPs. This entails aspects such as, conservation, carbon sequestration, and provision of other ecosystem services.

- **Guidance for connecting different objectives**
  The EU Forest Strategy contains a certain level of complexity, as does forest-related policy in general. Guidance in wake of IFPs on how to balance the different objectives, create synergies in forest management and handle trade-offs would make the outcome of the process more tangible.

- **Improve clarity on impacts of new EU instruments**
  Creating clarity on the wealth of new instruments that have a connection to forests (e.g. taxonomy, zero deforestation) and how they are interrelated or should incorporated in IFPs might be an asset.

Threats

- **Planning as part of the subsidiarity**
  Forest Planning is widely seen as clear competence of the Member States according to their national priorities, and especially forest-rich countries with a highly developed forest sector either don't see the need for a new instrument or are in opposition. The success of IFPs will depend on untangling this situation.

- **Lack of trust in new EU instruments**
  There is a certain level of mistrust by many countries on turning things upside down in forestry domain with a wealth of new instruments, especially legal ones. Lack of trust is a clear threat to the uptake and implementation of IFPs.

- **Uncertainty for forest owners**
  Additional legal frameworks may increase the uncertainty of forest owners about the background of a new instrument on monitoring and integrated long-term planning and the interference with their management practices (e.g. whether it is used to control their actual management). It requires strong communication to explain the objectives and non-objectives of IFPs, and the system boundaries of their application.

- **Unclarity on impacts of strategic plans**
  Unclarity about the instrument of IFPs and its potential impact on forest management might hamper its acceptance and implementation, and create dynamics that undermine the instrument. Incoherence between EU- and national instruments, or parallel forest policy systems might threaten acceptance of IFPs.

GAP Analysis

This Gap Analysis[175] tackles a conglomerate of key forestry issues as regards:

- Governance aspects
- Status of forests
- Development goals
- Forest-based economy aspects
- Supply and demand, import and export of goods
- Potential of ecosystem services

An integrated long-term forest plan should serve as an instrument that is able to cover a heterogeneity of different planning aspects. In this exercise, a gap is considered not only an issue that is missing, but also issues that are open, unclear or where new challenges are arising.

While it is difficult to summarise EU-27 countries, some patterns of gap issues can be identified:

- There is no homogeneous approach towards National Forest Programmes (NFP) in the countries. NFP can be seen as a potent starting base for integrated forest plans, as they are designed as major strategic and participatory process on forest topics. It might be an idea to look into good practice examples for NFPs, and how they stand in relation to integrated forest plans. For instance, in Austria has been a continuous process on a dialogue on forests, generating a forest programme and a set of national indicators with target values.
- There have been good efforts in further developing and harmonising monitoring instruments in the past decades, but the status still varies. This has also historical reasons, because e.g. Eastern European countries had to set-up completely new systems. Monitoring efforts by the EC and in numerous research projects are likely to improve this gap.
- A big issue is still lacking cross-sectoral coordination beyond the forestry sector. This might lead to non-harmonised and diverging planning and incentives. Umbrella strategies (e.g. a biodiversity strategy) need more specific implementation strategies for the forestry sector.
- Creating planning instruments while having to reach out to forest owners depends a lot on the forest governance regime in countries. For instance, in Eastern European countries forest management planning is strongly tied to state administration, while in most Western European countries state administration is mostly checking legality of management and providing advisory services.

[175] Based on the Study on Member States country fiches on forest monitoring and planning instruments (to be published...).

Integrated forest plans thus have to reflect this dichotomy between strategic elements and practical implementation in different set-ups.

- A variety of new emerging issues in forests (e.g. climate change – large scale disturbances, markets) brought new dynamic and particular new uncertainties into strategic planning of forests. Clearly, many countries are at a stage of responsiveness rather than strategic planning. It will need a balanced consideration in the integrated forest plans on how to deal with uncertainties, risks, and to implement the mid- to long-term political goals for forests in times where there is a lot of concerns about the future of forests and forestry.
- In many country, disturbances are the elemental driver for the future of forests (e.g. forest fires in Southern Europe). So, it requires safeguarding fundamental basics in forest management and planning before enlarging the strategic scope. A first strategic element might be how to maintain the existence of forests in such areas, and support this respectively e.g. via a priority plan.
- Little evidence was found on how the inherent trade-offs are dealt with that origin from the dichotomy between fostering a bio-economy in parallel with conservation and carbon sequestration. Integrated forest plans have the potential to address and guide this, because this remains a major gap so far.
- Ecosystem services and how to make them contribute to a viable forest management is often mentioned by countries, while instruments to do so are mostly not fully developed. Integrated forest plans can hence bring together elements from other EU policy processes that address this issue (e.g. taxonomy).

The table below gives an overview on the major forest-related issues in EU-27 as identified in the analysis of current strategies and instruments[176].

Table 28: Major forest-related issues in EU-27

Country	Major issues identified
Austria	• Resolution of interest conflicts arising out of an increasingly urbanised society with shifting demands on forests • The dialogue between foresters and hunters on minimizing browsing is still ongoing, but didn't solve the problems sufficiently yet • The recent calamities had big impact on forest owners and the value development of their forests, which is particular difficult for small-scale owners to handle. There is the danger that forest owners lose motivation, which would lead larger areas of unmanaged forests
Belgium	• Forest management plans are compulsory in Brussels, but only partially in Flanders and Wallonia

[176] Evidence is strongly built on national planning documents and country reports to different processes e.g. Forest Europe, FAO FRA, Natura 2000 reports.

	• High forest fragmentation • Neither National Forest Programme or Strategy, or similar instrument, could be found
Bulgaria	• Insufficient finance and institutional capacities to implement the new policies
Croatia	• Maintaining stable and sustainable financing for forest ecosystems • Large forested areas are still contaminated by landmines from the Homeland war. This makes the areas inaccessible for SFM • Additional efforts (such as further digitalisation) is needed to improve the traceability of wood/timber • Only a National Forestry Policy and Strategy from 2003, no later version, nor National Forest Programme or similar instrument could be found
Cyprus	• Forest fires (prevention and management of) • 19,54 % of state forests is found in the area of Cyprus beyond the control of the Government • High dependence on fossil fuels (and thus imports thereof). Need and urgency to develop renewable energy sources • Only a Draft Integrated National Energy and Climate Plan for the period 2021-2030 could be found • Neither a National Forest Programme, nor Forest Strategy or similar instrument could be found • Forest certification, since no forests are under third party certification scheme
Czech Republic	• Strategies need to be developed to mitigate the increasing demands on forests from society and climate change pressures • The economic situation of the forest owners needs to be considerably improved
Denmark	• Reliance on imports to satisfy wood and wood-based products demand. Challenge to create the obligation to ensure that such imports are produced sustainably • Grant schemes prioritize only a few services, which might hinder incentives for multifunctional services • A National Forest Programme 2018 and Forest Act 2018 were found, but no Forest Strategy • An Energy Political Agreement 2018 and Promotion of Renewable Energy Act 2018 exist, but no National Bioeconomy Strategy was found
Estonia	• No National Forest Programme/Plan nor forest Strategy could be found More efforts should be made to use wood in construction and for bio-based energy • The continuing fragmentation and loss of characteristic habitat types and populations of important species and their habitats is problematic • Private forest owners need support, also from forest experts
Finland	• Balancing the various aspects of SFM, including climate change mitigation • Work still remains to be done on boosting the production and profitable commercialisation of non-timber forest products. This is emphasized in the revised National Forest Strategy 2025

France	• Easy access to on-line platforms providing mapping data and designing new monitoring indicators is needed • No National Forest Programme could be found, however French National Forest Strategy, Bioeconomy and Biodiversity strategies were found
Germany	• Transformation from coniferous to stable deciduous and mixed forest is needed to make the forests more resilient against climate change and less prone to calamities, such as bark beetle invasions or draughts • There is still high uncertainty about the magnitude of climate change impacts on regional and local scale which is needed for optimizing decisions on active adaptation measures. Efforts are needed to make projections more reliable
Greece	• Certification of forests is not developed • Completion of forest maps
Hungary	• Shared common ownership of forest area is a challenge for management • High proportion of forestry area covered with non-native tree species (36%) requires regulation
Ireland	• Certification of private forests • Increase efforts at biodiversity conservation • Increase the forest area through sustainable afforestation • Improve forest adaptation to climate change
Italy	• Better adaptation of sustainable forest management practices, particularly for the Mediterranean area • Promoting communication actions and awareness of the public opinion on the role of forest and forest products
Latvia	• No National Forest Strategy could be found • No national biodiversity strategy and action plan • Integration of biodiversity targets into the national forest strategy • Increasing competitiveness of Latvian forest industry • Increasing the level of skill among people working in the forest sector
Lithuania	• Improvement of forest management regimes, as the current system does not completely ensure the protection important forest habitats and is not adjusted to the small-scale private forest holdings • Competing needs of society for forests – there is a need to find a new balance • Growing demand for non-timber forest services needs to be accounted for • The conflict between the aspirations of better nature conservation and more rational forest use needs to be addressed
Luxembourg	• Spruce monocultures representing 10% of the forest cover are severely endangered by climate change and need to be restored to mixed forest stands over the next 2-3 decades
Malta	• Safeguard existing habitat areas and explore the possibility of extending the network of green areas through tree planting initiatives
Netherlands	• Transformation from coniferous to stable deciduous and mixed forest is a key action. This has partly been pushed by the major drought damage to Norwegian Spruce and bark beetle attacks on Larch • The trade-offs in values and interests related to forest use need to be addressed. e.g., through zoning • No National Forest Programme could be found, but National Forest strategy 2020 addresses most crucial aspects

Poland	• Enhancing expertise & capacities of private forest owners • Research on expected changes in forests due to climate change & their mitigation through forests • Promotion and support regarding carbon storage in forest products and substitution of non-renewable materials need to be intensified • More detailed regulations and removing legal gaps concerning forests in urban areas in order to promote their protection and maintenance • Drafting and implementation of a future National Forest Programme
Portugal	• Promote forest environmental and social services among the population • Engage stakeholders to contribute to sustainable forest management and participation & prevent forest risks, mainly fire and pests
Romania	• Forest restitution process in Romania is problematic which results in large areas of disputed and mismanaged forestlands • No national forest strategy could be found
Slovakia	• Optimizing legislation on Sustainable Forest Management • Optimizing financing of Sustainable Forest Management • Generally improving Forest Management

Slovenia	• Ownership structure (large number of owners - 431,000 and co-owners) hinders intensification of forest management. Some owners are not interested in income from forests because of small properties, which results in low cutting rates. The level of technology applied in harvesting in private sector is relatively low. Marketing of timber of small quantities is not optimal
	• Difficult regeneration of forests due to an overabundance of wild animals (deer, roe deer) in the forests
	• Increased frequency and intensity of natural disasters:
	  ○ droughts and ice break following by bark beetle gradations;
	  ○ blowdown of trees;
	  ○ forest fires

Spain	• Improve measures to prevent forest fires • Forest abandonment and depopulation of rural areas is a challenge • Promotion of the use of timber and non-wood forest products among the population • Contribute to a rise in the added value of forest products
Sweden	• To maintain and develop a skilled and diverse work force and forest owners in an urbanized society • Developing a better understanding of ecosystem services, as seven ecosystem services have been identified as having an inadequate status. Ecosystem services with an inadequate status were primarily found among the regulating and supporting services, but also among some of the provisioning services.

5.4 Further information on the preferred policy option

Table 29: Problems, drivers, objectives and how these relate to the preferred option

(Interlinked) Problems	Problem drivers	Specific objectives	Preferred policy option

Data quality: Data is incomplete, inconsistent and not comparable across the EU	**Regulatory failure:** Existing rules relating to forests at EU level do not provide for a comprehensive monitoring of biodiversity, carbon storage, health and resilience and accessibility to collected data. **Market failure:** Prices of forestry products do not necessarily reflect the impact of forestry on biodiversity and climate; indicators are historically biased towards timber production. Imperfect information amongst actors involved in forestry undermines the quality and coherence of forest planning.	Ensure common modern, digitalised, consistent, comparable, timely and accessible data on the state of EU forests.	**Reporting obligation** of data collection, based on common definitions and a common set of indicators reflecting the policy needs beyond existing monitoring EU and international frameworks. Harmonization and standardisation
Quality of planning: Lack of policy coherence and integrated planning with a long-term vision.			**Developing an EU monitoring framework** with and "opt-in" EO component and ensure public access to timely and cost-efficient information for land managers and owners, policy makers and stakeholders.
	Regulatory failure of different planning-related instruments to establish a coordinated approach at EU level. **Regulatory failure** due to scattered responsibilities across national ministries with different objectives.	Ensure all Member States deliver high-quality long-term plans for forests based on high-quality monitoring information related to relevant EU policy objectives.	**Common structure**. Commission issues non-binding recommendations