Climate change impacts on forests in the Pan-European region and response options for the forest-based sector

IUFRO-MONDI Partnership Think Tank Meeting, Oct 2021, Vienna

Summary

As part of the IUFRO-MONDI Partnership, the **1st Think Tank Meeting** was held in Vienna, Austria, on the 21st of October 2021 with 27 participants from 12 countries, representing science and forest industry.

The **goal of the meeting** was to provide an improved understanding between science and industry on the impacts of climate change on forests. It also focused on the most critical response options for silvicultural management and along the forest value chain and relevant socio-political frameworks and societal perceptions.

Four scientists delivered **keynote presentations** based on the latest research findings. The discussion that followed covered regional **scientific reflections** and **industry perspectives,** focusing on challenges and risks related to climate change and opportunities for future engagement of various stakeholders.

This document provides an overview of the **most important results** and key messages of the meeting which are based on a compilation of the provided scientific background and notes taken during the meeting, covering the experts' discussions.

Participants of the Think Tank Meeting (non-exhaustive, some participants already left)

The **IUFRO-Mondi partnership** was established in July 2021. The Partnership aims to establish a **science-business platform** to better understand climate change impacts and to identify response measure in line with the Sustainable Development Goals (SDGs). **Central activities** of the partnership include **Think Tank meetings** aiming to provide information on and access to the latest data on climate change and to identify options for response measures to mitigate risks. **Stakeholder Dialogues** will share and discuss findings of scientific studies and Think Tank meetings and aim to engage partners and public, private and civil society stakeholders.

KEY MESSAGES AND DISCUSSION POINTS

Rapid climate change. Disturbances will increase

The latest research shows that the Pan-European region will face further and increasingly **rapid and widespread climate change,** significantly impacting forests and the entire forest sector alike. Projections of climate change scenarios show that **heat and drought extremes will cause increased risk of disturbances**, including widespread bark-beetle outbreaks and forest fires.

- Climate change is happening fast. In Europe, we are on a minimum **3-4°C track** (global average temperature increase by 2100). Temperature **increase is projected to vary across Europe** with the highest level of warming projected across central and south-/eastern Europe, but also for the Nordic countries and the Mediterranean region. Less warming is projected for western Europe. In a global effort, immediate, rapid, and large-scale **reductions of greenhouse gas emissions are required** to keep the 1.5°C or even the 2°C target from the Paris Agreement alive.
- In European forests the current **annual increment** might face substantial impact from climate change. Depending on the species composition, the annual increment might stagnate or even decline in the southeast and southern European regions, while slightly increase in some Nordic/boreal forest regions.
- **Disturbances are increasing in Europe**, and these disturbances interact with and potentially compound each other. For example, in Germany, the 2018-2020 extreme drought, followed by widespread bark-beetle outbreaks in many regions led to 177 Mio m^3 salvage timber and an area of 277.000 ha to be reafforested. The calculated economic damage to forest enterprises is estimated to be 12.8 billion €, not counting the impact on provision of other ecosystem services. In areas affected by damages, forests turn from a carbon store to a carbon source.
- **Older forests** with tall trees are important habitats for biodiversity conservation. However, with increasing age, forests are **more susceptible to disturbances**. Forests where the primary management objective is production of wood are likely to shift to a younger average age in the future because many forest managers tend to decrease the age of harvesting. Therefore, it is important to maintain a balance between conservation and production forests within a particular landscape.
- **The impacts go beyond secondary conifer forests.** For example, in central eastern Germany the dieback of native beech forests is also a major issue. For mixed forests the impact is difficult to predict. However, mixed stands (with at least 3 tree species per stand or hectare) can hedge some of the risks of climate change and consequent disturbances, including fire, insects, and diseases.
- Statistics show that **forest fires** are starting to become a problem in regions of Europe where traditionally it was not a problem. For example, from 2009-2016 the area burnt in Austria has increased from 50 ha to 400 ha per year. There is a **significant difference** for future projected forests fires **under different climate scenarios**. The "business as usual scenario" (RCP 8.5) predicts a burned area of more than 200 Mio hectares per year at the global scale and more than 13 Mio hectares for Europe and Russia, while an ambitious climate change mitigation scenario – in line with the Paris Agreement - (RCP 2.6) predicts approximately 100 Mio hectares at the global scale and 5,3 Mio ha for Europe and Russia.
- Climate change doesn't only impact forests and their ecosystem services. Institutions, enterprises, and particularly **small forest owners are severely impacted economically**. Small forest owners often lack the technical and financial capacity to adapt to climate change.

Forest adaptation measures - challenges, opportunities, and the role of science

Currently, **many forests cannot sufficiently provide the expected ecosystem services**. **Silvicultural adaptation measures** include increasing resistance and resilience through an optimal tree species composition, adapting the rotation length and thinning regimes. Other response options include **appropriate management of ungulates to ensure adequate natural regeneration**, a science-based discussion about the option to **use non-native tree species** and **new business models** rewarding forest owners for providing multiple ecosystem services demanded by society. Science can play a crucial role in the development of future adaptation strategies.

- Presently, many **forests cannot sufficiently provide the expected ecosystem services** due to their simplified structure and composition or degraded health.
- **Silvicultural adaptation measures** to increase resistance and resilience include appropriate thinning regimes to maintain tree vitality (in particular to drought) and reducing rotation length. Replacement of vulnerable tree species with more adapted ones and the development of mixed, structurally and genetically diverse forests can reduce the risks. All adaptation measures require extensive **silvicultural expertise.** In times of climate change, the optimal site-specific tree species composition of mixed forests is subject of **further scientific research** – e.g., forest models can accelerate field trials by suggesting site-specific suitability of tree species.
- In general, **conifers such as Norway Spruce seem to be more affected by climate change** and in the future, broadleaved tree species will cover larger proportions in (southern and central) European forests. In the regeneration layer, the proportion of broadleaved tree species has increased already substantially compared to coniferous.
- **Adequate populations of browsing ungulates**, including red deer, roe deer and moose, are preconditions for the establishment of resilient mixed stands.
- There are no native species that can fully replace the commercially much preferred coniferous trees of Europe. **Douglas fir** of suitable provenances can replace Norway spruce on certain sites under moderate climate change scenarios. However, by the end of the century, Douglas Fir may also be heavily impacted by climate change and the biotic disturbances complemented by it – e.g. in the Alpine Region.
- The promotion of non-native tree species (NNTS) is heavily debated. While the acceptance among many forest managers is rather high, conservation-orientated solutions often reject the use of NNTS, particularly because of the potential invasiveness of some species. **Science-based insights to NNTS** offer an opportunity to raise the societal acceptance of NNTS and identify their potential suitability and ability to maintain ecosystem functioning, not as a monoculture, but rather in future mixed stands.
- Not all forest owners have the capacity, neither economically nor technically, to adapt their forests to climate change. Financial and technical support is needed. **New business models in forestry should reward forest owners** for promoting the resilience and adaptive capacity of their forests. Such a system, ideally applicable in a simple way, could concentrate on resilience and adaptive capacity as the main indicator, being the basis for other ecosystem services such as climate change mitigation, biodiversity conservation, soil and water protection, recreation and health.

Diversified forest genetic resources are part of the solution

The **265 native tree species** in continental Europe with their different gene pools provide the source for creating more diverse forests, thus reducing the risks. **Breeding programmes** and a more systematic and collaboration-based approach to long-term **provenance and progeny trials** is an important suggested way forward.

- There are **265 native tree species** in continental Europe, 454 if expanded to the islands.
- For creating more diverse forests accessing **different gene pools or genetic adaptations within single species through mixing provenances** are key. Data from provenance trials are needed to validate and further develop models.
- For the identification of well adapted mixtures of tree species, **accurate monitoring** is required, including where the seed was collected, how it was raised in a nursery, where it is planted and how the mature tree performs. This is already possible nationally but should be promoted and coordinated across Europe. However, regulations often make transfer of seeds and seed-lots (e.g. provenances from drier (southern) locations towards the north) across national borders difficult.
- Knowledge on **genetic modification** of tree species through the CRISPR[1] technology is not advanced enough in forestry to apply just yet. While some researchers believe that the CRISPR system offers a previously unattainable level of precision and control over genomic modifications, there is lack of public acceptance for genetically modified (GM) trees. The two main certification schemes, FSC and PEFC, do not accept the use of GM trees in the forests under their certification.
- **Breeding programmes** are a pathway towards diverse and resilient forests and they assist to increase forest growth. However, current breeding programmes focus only on a few species, and development of low-input breeding for a larger number of forest trees is needed.
- There are more than **3600 genetic conservation units** in Europe, data on which is available in EUFGIS, hosted by EUFORGEN, an often-untapped source of genetic diversity. These units are monitored and in the process of intensive genetic characterisation.
- Genetic trials are an important source of data. A more systematic and collaborative approach to long-term provenance and progeny trials is needed.

A robust forest value chain needs forest owners with sufficient adaptation capacity

Adaptive forest management practices and **innovation and technology** on the future use of wood are important measures to sustain a robust and efficient forest value chain. However, beyond silvicultural and technological adaptation, the forest-based industry depends on **forest owners** who have the **capacity** (e.g. technical, financial and institutional) to plan for and implement forest restoration and adaptation activities. The forest-based industry may envisage **new partnership models** with science and forest owners to harness this transformative capacity.

- **Forest ownership** and underlying **user rights** are characterised by significantly varied legislative framework, property rights, and legal institutions across the many countries in the Pan-European region. There is little comparative analysis regarding the implications this may have for the future use of wood.
- **Forest ownership in Europe is under major change.** The number of urban and new forest owners, with limited knowledge about forests, forest management, and with non-economic motivations (e.g. biodiversity conservation and recreation) is increasing across Europe.

[1] CRISPR: Clustered Regularly Interspaced Short Palindromic Repeats

- Climate change, forests with new species composition, and ongoing policy developments, such as carbon storage and sequestration (e.g., carbon accounting) and biodiversity conservation (e.g., setting aside unmanaged forest areas) may influence the **future availability of wood.** The forest-based industry is concerned, whether it will be possible to sustainably meet the demand for forest-based materials from domestic and/or European sources.
- **Forest owners** – particularly small-scale forest owners in times of regionally significant forest damages – **need support in planning and implementing forest restoration and adaptation activities.** The role of the industry in the development of new partnership models with science and forest owners should be discussed.

Science can support evidence-based policy

Society and stakeholders have different views on forests and forest management, prioritizing different ecosystem services. The spectrum ranges from (bio-) centred orientation (e.g. prioritizing biodiversity and naturalness), to (human/eco-system-) centred orientation (e.g. climate change mitigation, hazard protection and recreation) to the more traditional forest management orientation (e.g. wood production and employment). **Science can provide and communicate latest scientific evidence and robust data** as a basis for policy makers, aiming to meet and balance different societal perspectives and expectations.

- **EU forest policy addresses only part of the forest-based sector**, concentrating mostly on the environmental dimension of forests (e.g. nature conservation) and climate change adaptation/mitigation. The forest-based sector, which can play a substantial part in the transition to a circular economy and a green recovery from the COVID-19 pandemic, is not addressed sufficiently at the EU level.
- It is not commonly recognised that many **EU policy instruments affect distinct stages of the forest-based value chain** in different ways. These instruments range from affecting forest management, wood processing and transport, timber trade, to air quality and waste management, to sectoral competitiveness. The future development of emerging and innovative sub-sectors (e.g., bioplastics) will be influenced by policy instruments, affecting the forest-based industry.
- The **biggest challenge for policy makers** seems to find a compromise between conservation of biodiversity (e.g., through setting aside unmanaged forest areas) and the sustainable provision of wood and other ecosystem services. While science cannot advocate for specific policies, **science can provide and communicate latest scientific evidence and robust data** as a basis for policy makers aiming to meeting and balance different societal perspectives and expectations.

SUMMARY OF THE FOUR KEYNOTE PRESENTATIONS[2]

1. Climate change scenarios and impact on forests? *Dr. Florian Kraxner, IIASA*

Climate change scenarios depend on mitigation pathways

- Climate Change will impact European forests in all four regions[3], but at different pace and with different intensity – depending on the mitigation pathway (reference scenarios) we will enter as a society in Europe and globally.

Different forest ecosystems and tree species will face different impacts

- It is necessary to look at each species individually, having the forest structure and respective management in mind.
- Natural and man-caused disturbances and (sustainable) managerial reaction will be key in building up future forests which can contribute to climate change mitigation, but also remain multi-purpose ecosystems.
- Modelling forest management will play a major role in identifying possible future pathways – particularly for assessing trade-offs and synergies.

Disturbances such as forest fires will increase

- Forest fires will most likely increase in frequency and size at all levels (regional/Alpine, European, globally) and under all climate scenarios (RCPs)
- Science can provide explicit forecasting of fire risk and related hot spot mapping in order to develop long-term resilience for forests and short-term emergency planning.

2. Options and limitations to increase resilience and adaptive capacity of forests and forestry. *Prof. Dr. Jürgen Bauhus, University of Freiburg*

Future forests will look different, but institutional adaptation is also required

- There are silvicultural options to adapt forests in the short-and long term. This includes appropriate thinning regimes, tree species change, and development of mixed, structurally and genetically diverse forests. However, it's not only about adapting the forests, but also about adapting enterprises and institutions.
- Nearly one third of European forests are monocultures. For the future, we need at least three functionally different tree species in each forest stand.
- With adaptation, forests will likely become younger, more diverse and have a decreasing proportion of conifers.

Adaptation is expensive

- Complexity of forest management will increase while revenues from timber production will likely decrease.
- Increasing the adaptive capacity of forests and forestry will be a very expensive and continuous task.
- To maintain/increase the adaptive capacity of forest owners, new business models are required that provide a reliable income, for example through rewarding the provision of a range of ecosystem services and nature conservation measures.

[2] The full presentations can be viewed on the Partnership Webpage, to be published shortly

[3] The scope of the meeting was the Pan-European region with a focus on the Boreal, Continental, Alpine and Mediterranean regions

3. *The future role of diversified forest genetic resources and alternative tree species for wood production? Opportunities, risks and limitations.* *Dr. Marjana Westergren, Slovenian Forestry Institute*

High diversity in European forests

- There are 265 native tree species in continental Europe with multiple gene-pools and genetic adaptations within a single species. Non-native tree species are an alternative, but some are potentially invasive.
- Provenance and progeny trials are our best tool for figuring out where a particular species and provenance will thrive. We need to plant more of them in different environments with atypical provenances, a wide range of families and include species mixtures.

Opportunities and risks

- Breeding can improve growth, wood and health traits but may decrease genetic diversity.
- Opt for tree provenances that are resistant enough and not necessarily those with the highest growth rates.
- Spread the risks: mix provenances and use alternative species, monitor what happens in these in-situ trials.
- Adapt the policy landscape, involve stakeholders through participatory approaches.
- Invest in science to decipher the genomic drivers of adaptation, growth and resistance to biotic and abiotic threats.

4. *Socio-political frameworks, societal perceptions and acceptance.* *Dr. Filip Aggestam, University of Life Sciences and Natural Resources Vienna (BOKU)*

Different perceptions among different stakeholders

- Culture, history and politics are mediated through the State and translated into rights and responsibilities. Forest ownership is a bundle of rights (e.g., access, harvest rights, management rights, exclusion rights) that are rarely all held by one entity.
- The citizens' environmental orientation is the most significant factor in predicting preferences towards different forest ecosystem services as compared to demographic factors.
- Improving the understanding of societal values and preferences for specific forest ecosystem services among citizens and forest owners should be seen as a pre-condition for tackling and managing value-based trade-offs and synergies in forests effectively.

Large number of sectoral policies and policy instruments

- EU forest policy addresses only part of the forest-relevant policy frameworks, concentrating mostly on policy instruments that relate directly to forests themselves and less on the varied associated industries.
- Large number of sectoral policies and policy instruments affect distinct stages of the forest-based value chain in different ways. These range from forest management, such as wood processing, to those governing other forest-related value chains, such as renewable energy.
- Perspectives on what can be considered as EU forest-relevant policy vary significantly between the respective sub-sector that make up the forest-based industries.
- Additional policy domains would be essential to consider when trying to account for the forest value chain as a whole, in addition to policies that affect individual value chains and sub-sectors.

FACTS ABOUT THE MEETING

ORGANIZERS

- Organized by the IUFRO-Mondi Partnership at Hotel Triest, Vienna 21st Oct. 2021

PARTICIPANTS (see Annex 2)

- 9 scientists from 7 countries (Austria, Germany, Finland, France, Portugal, Slovenia, Sweden), 11 forest industry representatives from 7 countries (Austria, Czech Republic, Germany, Russia, Slovakia, South Africa, United Kingdom) and 7 organizing and moderating participants.

GOALS OF THE MEETING

1. Provide an improved understanding between science and industry by discussing and identifying further research needs in the context of Pan-European forests, with a focus on the Boreal, Continental, Alpine and Mediterranean region, on:
   - impacts of climate change on forests;
   - most critical silvicultural management options and response options along the forest value chain; and
   - socio-political frameworks and societal perceptions which influence (drive and limit) forest management for wood production.
2. Capture key-findings of the meeting, to be used for the compilation of a summary document to be shared with key platforms, processes and stakeholders.

AGENDA OF THE MEETING

- Four scientific key notes: 1. Climate change scenarios and impact on forests. 2. Options and limitations to increase resilience and adaptive capacity of forests and forestry? 3. The future role of diversified forest genetic resources and alternative tree species for wood production? 4. Socio-political frameworks, societal perceptions and acceptance. (Annex 1)
- Regional scientific reflections and industry perspectives followed by a discussion and identification of challenges, opportunities, risks and research gaps.

PARTICIPANTS

Alexander Buck, IUFRO

Andreas Bolte, Thünen Institute

Christophe Orazio, European Institute for Cultivated Forest

Daniel Böhnke, IUFRO-Mondi Partnership

Dennis Popov, Mondi

Dirk Längin, Mondi

Eckart Senitza, Forest Owner, Pro Silva (Europe)

Filip Aggestam, BOKU

Florian Kraxner, IIASA

Gerald Steindlegger, Integrated Sustainability Solutions (ISS)

Gladys Naylor, Mondi

Herbert Pircher, Stora Enso

Ingrid Benčová, Rettenmeier Tatra Timber

Janice Burns, IUFRO

Jürgen Bauhus, University of Freiburg

Leo Arpa, Mondi

Leo Nossol, Mercer

Manfred Schachenmann, Mondi

Marjana Westergren, Slovenian Forestry Institute

Michael Kleine, IUFRO

Mike Wingfield, University of Pretoria

Nelson Grima, IUFRO

Raisa Mäkipää, LUKE

Roland Kautz, Österreichische Bundesforste (ÖBF)

Silvio Schüler, BFW

Teresa Fonseca, University of Tras-Os-Montes and Alto Douro

Tomáš Pařík, Association of Forest Entrepreneus