



Seeing trees and forests for the future

Assess4EST: assessment of trade-offs and potentials to breed and manage forests to meet sustainability goals

Brussels, 14th October 2025

Website: <https://www.luke.fi/en/projects/assess4est>
Project acronym: Assess4EST



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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773324

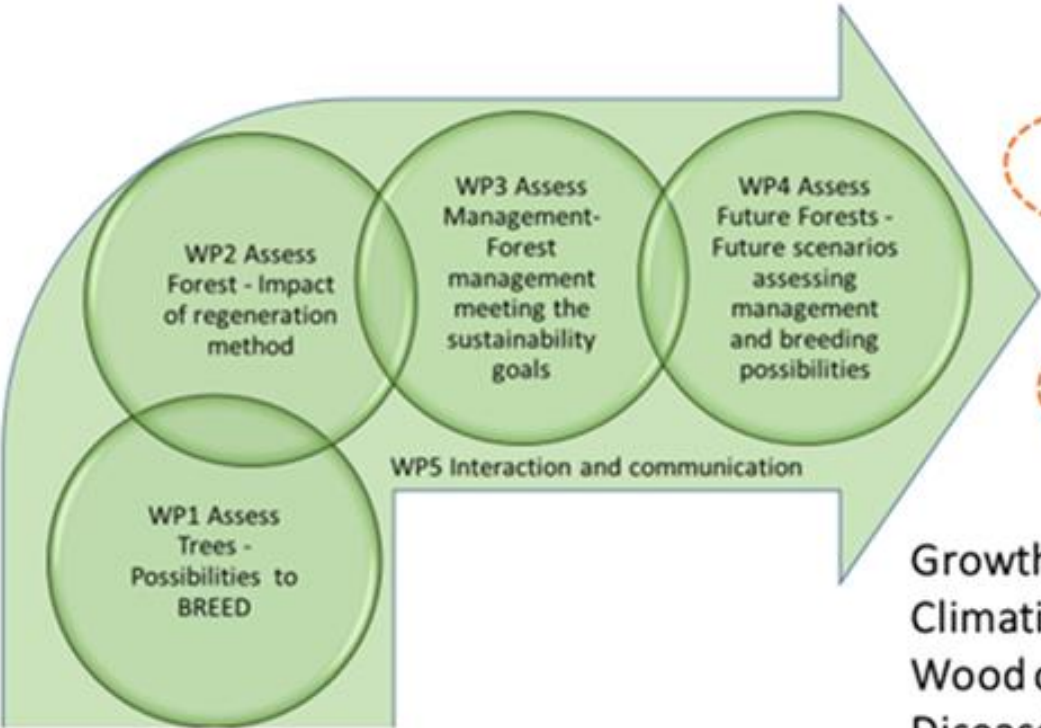


Project idea



Coord.
Katri Kärkkäinen
Luke

Trade-offs at different scales





WPL: Rosario Garcia Gil SLU

WP1 Trade-offs



- Trade-offs among traits varied by population; for example, the negative genetic correlation between growth and wood stiffness was stronger in southern populations than in northern ones. No clear correlation of chemical composition and growth.
- Positive correlation between growth and drought tolerance, at the cost of genetic diversity
- Genetic models that properly account for population structure are more accurate and less biased.
- Across-generation genomic predictions are feasible for wood properties, but challenging for growth and low-heritability traits.

Hayatghaibi et al. *BMC Genomic Data* (2024) 25:60
<https://doi.org/10.1186/s12863-024-01241-x>

RESEARCH **Open Access**

Implications of accounting for marker-based population structure in the quantitative genetic evaluation of genetic parameters related to growth and wood properties in Norway spruce

Haleh Hayatghaibi^{1*}, Henrik R. Hallingbäck², Sven-Olof Lundqvist³, Thomas Grahn⁴, Gerhard Scheepers⁵, Peter Nordström⁶, Zhi-Qiang Chen⁷, Katri Kakkiläinen⁸, Henry X. Wu^{1,9} and M. Rosario Garcia Gil¹

Evolutionary Applications

ORIGINAL ARTICLE | **Open Access** |

Implications of Breeding for Growth on Drought Tolerance in Scots Pine (*Pinus sylvestris* L.)—Insights From Metabolomics and High-Throughput Plant Architecture Analysis

Francisco Gil-Muñoz, Sonali Sachin Ranade, Haleh Hayatghaibi, Juha Niemi, Lars Östlund, Maria Rosario Garcia-Gil

First published: 23 June 2025 | <https://doi.org/10.1111/eva.70122>

Funding: This work was partly funded by the SLU Forest Damage Centre at the Swedish University of Agricultural Sciences (SLU) and the Kempe foundation (Kempestiftelsen), Knut and Alice Wallenberg Foundation and the Swedish Governmental Agency for Innovation Systems (VINNOVA). Francisco Gil-Muñoz and Sonali Sachin Ranade contributed equally to this work.

Research | **Open access** | Published: 21 July 2025

Cross-generational genomic prediction of Norway spruce (*Picea abies*) wood properties: an evaluation using independent validation

Haleh Hayatghaibi¹, Henrik R. Hallingbäck, Salvador A. Gezan, Sven-Olof Lundqvist, Thomas Grahn, Gerhard Scheepers, Sonali Sachin Ranade, Katri Kakkiläinen & M. Rosario Garcia Gil

BMC Genomics **26**, Article number: 680 (2025) | [Cite this article](#)

671 Accesses | 1 Altmetric | [Metrics](#)

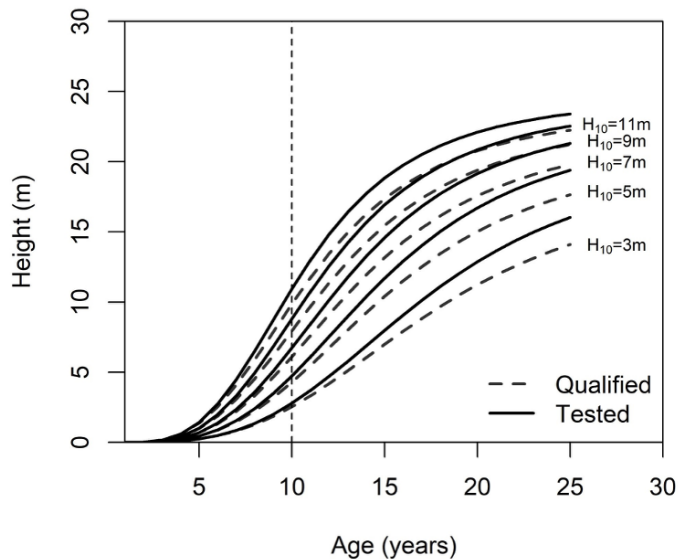


WPL Aris Jansons SILAVA

WP2



GADA - generalized algebraic
difference approach



Objective → new growth functions for silver birch (*Betula pendula*) improved forest reproductive material (FRM) categories 'qualified' and 'tested' up to the midrotation (~25 years)



Volume 97, Issue 3
July 2024

JOURNAL ARTICLE

Height growth patterns of genetically improved Scots pine and silver birch [Get access >](#)

Pauls Zelčiņš ✉, Āris Jansons, Virgilijus Baliuckas, Ahto Kangur

Forestry: An International Journal of Forest Research, Volume 97, Issue 3, July 2024, Pages 458–468, <https://doi.org/10.1093/forestry/cpad057>

Published: 20 November 2023 [Article history](#) ▼



WPL Jari Hynynen
Luke

WP3

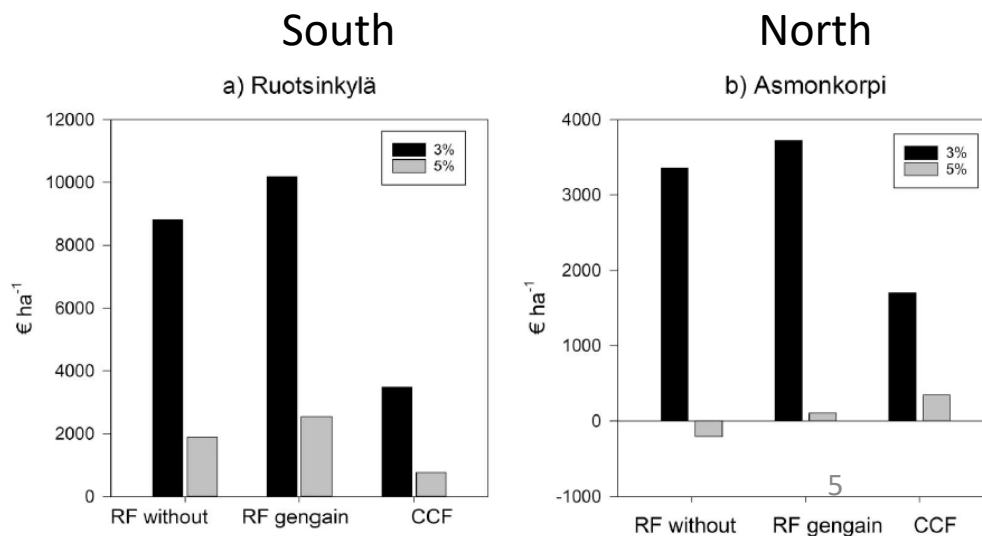


Figure 4. Maximum Bare land values associated with RF and CCF in Ruotsinkylä (a) and Asmonkorpi (b). Interest rate 3% and 5%.



Scandinavian Journal of Forest Research

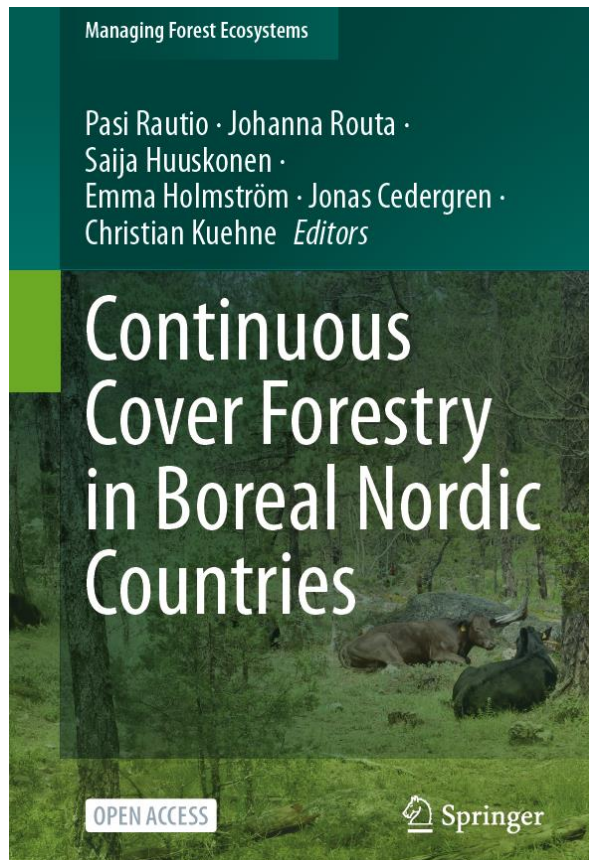


ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/sfor20

Financial comparison between rotation forestry (RF) and continuous cover forestry (CCF) on spruce-dominated peatlands

Anssi Ahtikoski, Jouni Siipilehto, Jaakko Repola, Hannu Hökkä, Mika Lehtonen, Katri Kärkkäinen & Jari Hynynen

WP1, 2, 3



Managing Forest Ecosystems

Pasi Rautio · Johanna Routa ·
Saija Huuskonen ·
Emma Holmström · Jonas Cedergren ·
Christian Kuehne *Editors*

Continuous Cover Forestry in Boreal Nordic Countries

OPEN ACCESS

 Springer

Chapter 7 Genetic Effects



Katri Kärkkäinen, Sonja T. Kujala, Rosario Garcia-Gil, Arne Steffenrem,
Johan Sonesson, Liina Hoikkala, Harri Mäkinen, and Sauli Valkonen

Abstract

- Genetic effects of continuous cover forestry (CCF) are not well known. We need more research, especially on the genetics of spruce-dominated CCF sites. Levels of relatedness are of interest, as are estimates of safe limits for the intensity and duration of CCF practices that secure genetic potential for good growth and quality.
- With even-aged forestry, genetically improved regeneration material can be used to mitigate climate change-related risks through breeding and deployment recommendations. In CCF, currently based on natural regeneration, we assume that enough seedlings establish, and that sites contain enough genetic variation to enable natural selection and evolutionary processes.
- Based on research in other regions, the number of reproducing trees must be kept large to avoid excessive levels of relatedness and inbreeding and to maintain sufficient levels of genetic diversity.



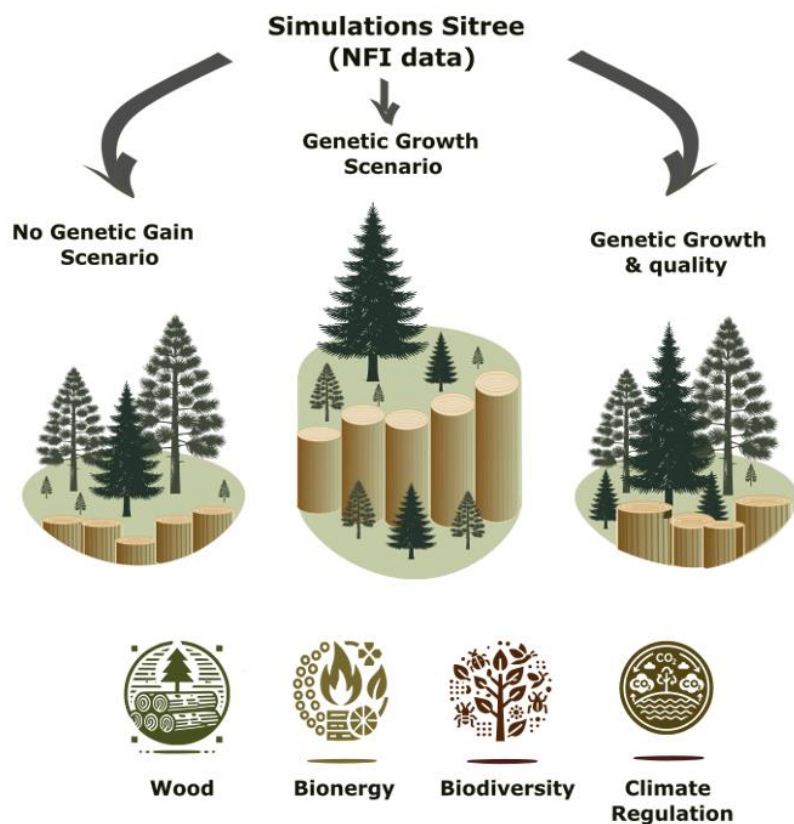
WPL Clara Anton-Fernandez
NIBIO

WP4



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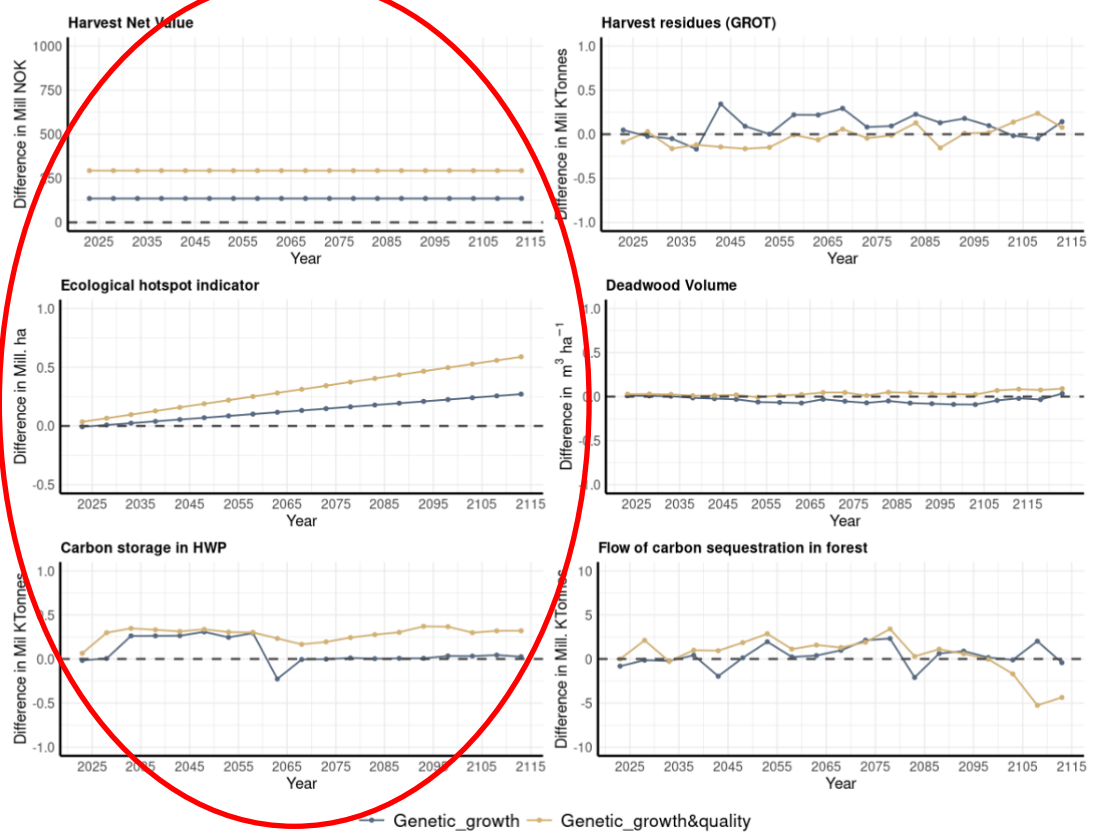


Could the integration of management strategies with genetic gain help mitigate the trade-offs among variuos ecosystem services ???



WP4

Simulation Results: A Comparison of Baseline (scenario without genetic gain) and Two Genetic Gain Scenarios



↑ Harvest net value
MiS area*

Other indicators (GROT, deadwood volume, carbon sink flow) show smaller or fluctuating differences.

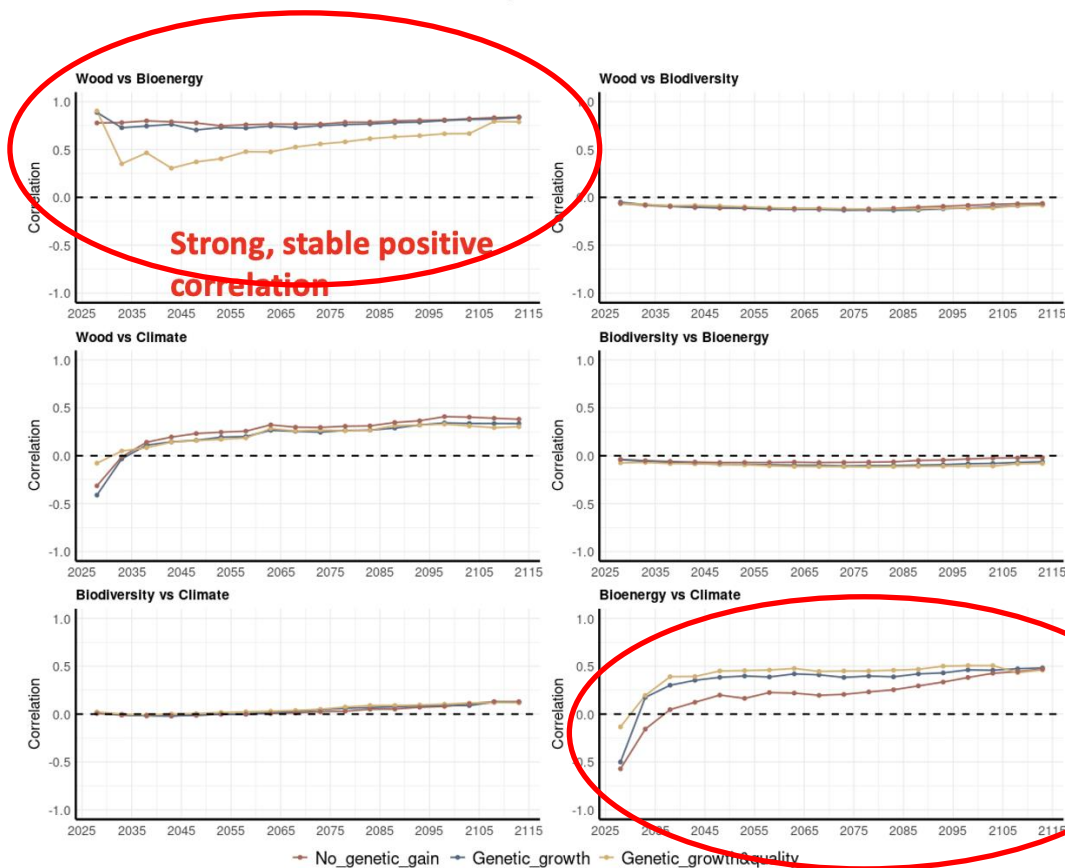
Benefits appear **early** in the planning horizon, despite delayed harvest of improved trees—due to **long-term optimization** anticipating future value.

The **increase in ecological hotspot area** suggests that genetic improvement can promote stands with larger or older trees, enhancing biodiversity without compromising productivity.



WP4

Correlations between ecosystem services across scenarios:



Genetic improvement doesn't fundamentally change the direction of FES interactions, but it can influence the *strength* of certain relationships

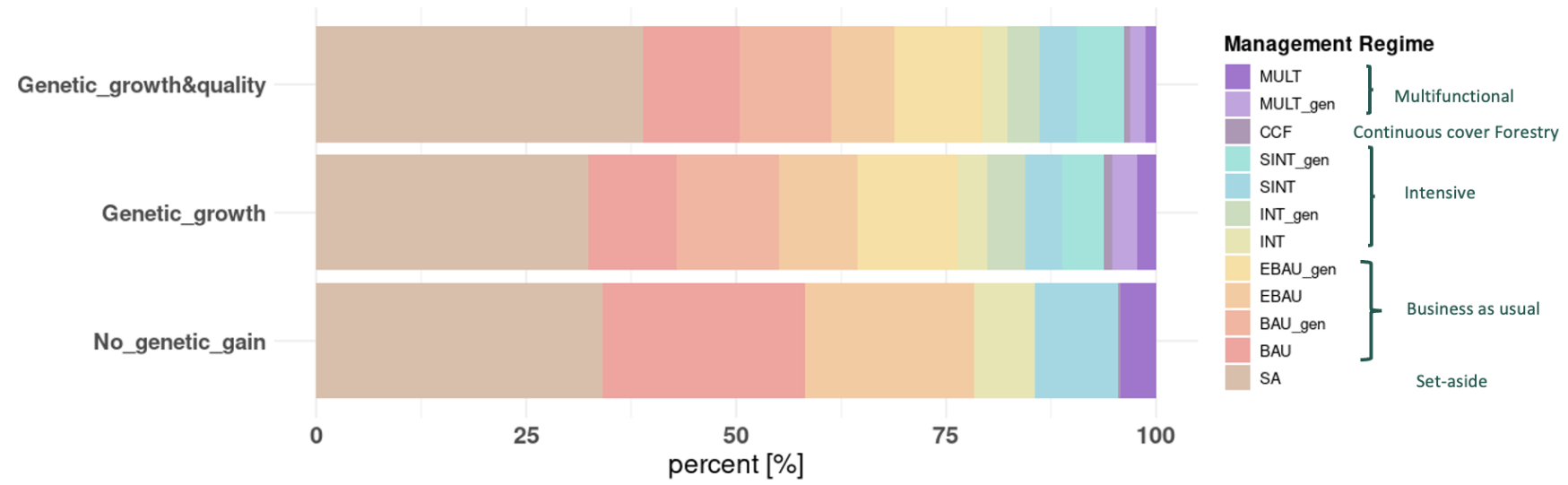


But it can **moderate the strength** of some relationships, where improved productivity enhances their compatibility.



WP4

What changes with genetic gain?



leads to **more set-aside areas** and a **more diverse mix of management regimes**.



supports EU biodiversity targets (e.g. 30% protected areas) **without major harvest reductions**.

avoid pressure on less-utilized or sensitive areas

Regional benefits beyond Norway???



WPL
Arne Steffenrem
Nibio

WP5



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Main results from the stakeholder forums

Industrial needs

- CO₂-neutral resource
- Limited resources today – more volume!
- Construction use of wood: will increase
 - 🌿 Experiences: managed plantation forests are good
 - 🌿 Preferred: Conifers of high stiffness and low weight
 - 🌿 Explore: increased use of hardwoods
 - 🌿 Limitations: Juvenile wood under shorter rotations
- Fiber use is under development, innovations!
 - 🌿 High interest in birch fibre
 - 🌿 Softwood from spruce will be more important
- Innovation and flexibility: The most adaptable industry will survive

Forest management scenarios

- Adaptation and risks – climate change
 - 🌿 Adapted and healthy forests are most important!
- Differentiate forest production more to achieve
 - 🌿 High volumes under intensive short rotation production
 - 🌿 Mixed species forests
 - 🌿 Longer rotations and CCF
 - 🌿 Varied and site specific: the best use of species
- Silviculture and tree breeding important to increase productivity and reduce risks from climate change
- Wood of good quality will always be most useful in competition with steel and concrete
 - 🌿 Strength - weight ratio, knot size, long fibres, reduced fiber angle, improve juvenile wood properties
- In the long run: No need to tailor the timber resource to a specific industry – industry will adapt



Beyond Assess4EST

- Importance of stresses with changing climate
 - Drought
- Importance to assess several options for future forests
 - Closer to nature solutions vs. adapting forests with breeding, assisted migration, widening the selection species used, combining different methods
 - Acceptance of different methods

Thank you!



<https://www.luke.fi/en/projects/assess4est>

ForestValue

Website: <https://forestvalue.org/>

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