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A just transition

Conversations with foresters

on the drawbacks of intensive forestry and the solutions offered by close-to-nature practices

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INTRODUCTION

Forests can help solve many of today's environmental and social problems. They sequester carbon dioxide, sustain biodiversity, provide jobs and contribute to our physical and mental health. But all of these benefits are jeopardised by the forest industry's intensive forestry model. Advocates of the model claim that their practices are economically sustainable and benefit forest owners, labourers, the environment and society more widely. **Most of the time, this is not true.**

This discussion paper is based on interviews with over a dozen foresters and practitioners. They explored with us some reasons why intensive forestry is neither fair nor sustainable and put forward a new vision of a diverse and thriving forest-based sector where all actors receive their fair share.

Forestry in the European Green Deal

The main strand of the European Union's (EU) climate policy is the European Green Deal – a cross-sector plan to transition to a low-carbon economy that is kind to the environment and benefits people. Forests and wood-based sectors are expected to play a double role:

- Stabilise the climate and biodiversity
- Provide livelihoods, goods and services

Forests are essential to us all, but the workers and owners, dwellers and visitors who depend on them stand to lose most if the green transition fails to deliver. To inform this paper we therefore spoke to the foresters who should be at the forefront of the EU's pledge to provide assistance to those most affected by the socio-economic impacts of the green transition. There is unprecedented support for efforts to heal Europe's degraded forests, and the forest industry can support this by adapting to new management styles. Instead, it is lobbying for business as usual, presenting intensive forestry as a precondition for prosperity and employment.

This document opens up the discussion about how the economy, environment and society can be allies in the just transition in forestry. Europe is a global player in the trade, investment and consumption that drives deforestation and the United Kingdom (UK) and the European Union (EU) have promised to protect and restore forests. In Europe, such restoration must tackle the drivers of deforestation and forest degradation, but also reinforce human rights, forest governance, inclusion of communities in restoring degraded forests and promoting less intensive management. If restoration is implemented with these objectives, it will protect and enrich both the remaining forest ecosystems and the lives of the people within them.

DISCUSSION TOPIC #1

Is only intensive forestry economically worthwhile?

THE INDUSTRY ARGUMENT

'[Non-intensive forestry] does not work if you are an investment company, which has bought 200,000 hectares of forest that is seen as part of asset management—it is not the most efficient way to manage forests.' **Tomas Lundmark, Professor of Forest Management, Swedish University of Agricultural Sciences (SLU)**[1]

THE COUNTERARGUMENT

Close-to-nature forestry often offers more profit to forest owners than intensive practices.

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1 Lisa Röstlund and Alexandra Urisman Otto, 'Therefore, Forests without Clear-Cutting Can Benefit the Environment and Economy (Därför Kan Skog Utan Kalhyggen Gynna Miljö Och Ekonomi)', Dagens Nyheter, 14 March 2021.

A striking misconception in the forestry debate is the alleged economic trade-off in undertaking environment-friendly practices. This assumption is reinforced by caricaturing critics of intensive forestry as opponents of all economic activity in the forest. The debate is much more nuanced.

Many forest experts are calling for a shift from intensive forestry (also called conventional, rotational or clear-cut) to close-to-nature forestry (sometimes used synonymously with continuous cover forestry), which preserves the integrity of ecosystems whilst generating profit. In intensive forestry, tree seedlings—generally of a single species—are planted at the same time, followed by periodical pre-commercial and commercial thinnings. At the end of the cycle, the area is clear-cut and prepared for new seedlings. The final harvest is cheap but followed by costly operations with little financial return for decades.

Close-to-nature forestry tends to follow naturally occurring forest growth patterns. Harvesting is partial, leaving younger and ecologically significant trees to grow and gaps to fill by natural propagation. Selective harvesting is typically more expensive than clear-cutting per cubic metre (m3) of similar sized trees, but over time, an established close-to-nature forest produces diverse, high-quality wood—usually in larger volumes. Between cuts, the forest regulates and regenerates itself, with little or no input from the forester.

TABLE – COMMON CHARACTERISTICS OF INTENSIVE AND CLOSE-TO-NATURE FORESTRY

CHARACTERISTICS	INTENSIVE FORESTRY	CLOSE-TO-NATURE FORESTY
HARVESTING METHOD	Clear-cuts.	Selective logging.
REGENERATION	Soil preparation, seedling cultivation, planting and clearing the undergrowth for reforestation.	Natural regeneration.
MAINTENANCE	Use of intensive operations, such as tilling, fertilisation, weed control and ditch networks.	Avoidance of intensive operations. Reliance on natural processes, such as self-thinning of seedlings.
STAND STRUCTURE	Even-aged, homogenous stands. Monoculture plantations.	Structural diversity and spatial variability. Mixed species stands.
COST AND INCOME	High cultivation and thinning costs. Low final felling costs. High financial payoffs at long intervals	Low cultivation costs and variable harvest costs (harvesting cost per m3 decreases with increasing tree size). Steady income in smaller increments.

As a result, there is growing evidence that close-to-nature forestry is economically similar or superior to intensive practices. For example, calculations of financial inputs versus timber yields in boreal forests concluded that intensive forestry is either inferior to close-to-nature forestry[2] or achieves a slight economic advantage at a high cost to forest resilience and biodiversity.[3] Similarly, in Southern-European countries, close-to-nature forests achieve a higher yield and value due to the larger tree diameters.[4] Such results are supported by the long-term experience of Central-European foresters who have trialled close-to-nature forestry and scientists who have been studying it for decades. They confirm that the practice achieves at least the same economic efficiency as rotational management[5] without the latter's ecological trade-offs. Additional benefits stem from the fact that different tree species and ages in structurally diverse forests act as a buffer against diseases, weather and fire.

CASE STUDY – CLOSE TO NATURE FORESTRY IN FINLAND

Professor Timo Pukkala has used his forest as the laboratory for management experiments. He started with an even-aged conifer forest and is gradually turning it into a mixed species, continuous cover stand. While thinning is not always economically the best way to transition from intensive to close-to-nature forestry, he's happy with the results. By only cutting the largest stems, he made a premium profit from most of the cut trees. Even his harvesting costs–which can sometimes be higher in close-to-nature forestry–were relatively cheap per cubic metre because of the large diameter of the trees. Timo checked back after few years to measure the remaining stand and calculated that the remaining individual trees' value had increased by 35-414 per cent in just five years. The thin pulpwood timber had turned into valuable sawlogs. Waiting longer can increase an individual tree's price by as much as 15-20 times.

Timo Pukkala's forest after the first harvest since the decision to transition to continuous cover forestry.

The harvest consists almost entirely of valuable saw logs, as the younger trees were left growing.

The spring after harvest. The remaining forest has maintained much of its visual and ecological qualities. © Timo Pukkala

2 Olli Tahvonen et al., 'Optimal Management of Uneven-Aged Norway Spruce Stands', Forest Ecology and Management 260, no. 1 (2010): 106–15.
3 Timo Pukkala, 'Effect of Species Composition on Ecosystem Services in European Boreal Forest', Journal of Forestry Research 29, no. 2 (2018): 261–72.
4 María Larrañeta Oyarzun, Comparative Economic Analysis of Two Forest Management Systems. Application in the Iratí Forest (Análisis Económico Comparativo de Dos Sistemas de Gestión Forestal. Aplicación En La Selva Del Iratí) (Univ Pub. Navarra, Pamplona., 1999); João P. F. Carvalho, José A. Santos, and Joana Santos, 'Sustainable Management and Valorisation of Oak Forests (Gestão Sustentada e Valorização Das Florestas de Carvalho)', Agronegocios, 2014, 32–35.
5 Brice de Turckheim, 'Economic Aspects of Irregular, Continuous and Close to Nature Silviculture (SICPN)', in Nature Based Forestry in Central Europe, 2006, 61–78 ; P. Csépányi and A. Csór, 'Economic Assessment of European Beech and Turkey Oak Stands with Close-to-Nature Forest Management', Acta Silvatica et Lignaria Hungarica 13, no. 1 (2017): 9–24.

DISCUSSION TOPIC #2

Does intensive forestry keep forests healthy and save trees from going to waste?

THE INDUSTRY ARGUMENT

'When forests grow freely, some trees succumb to competition between [other] trees. Such trees easily become hotbeds for insect attack […] In cultivated forests, such trees are harvested before they die themselves.' **Rolf Björheden, Professor of Forest Technology at Skogforsk**[6]

THE COUNTERARGUMENT

Europe's forest health is rapidly deteriorating– largely due to intensive forestry.

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6 Swedish Forest campaign ad, 'This Is What the Growing Forest Does for the Climate/Det Här Gör Skogen För Klimatet När Den Växer', Dagens Nyheter, 23 October 2019.

Advocates of intensive forestry present it as saving forests from rotting and dying, but while extensive infestations can be devastating, most 'rotting' is essential to keep the forests' nutrient cycle giving and ecosystems healthy. It takes a long time for biodiversity to evolve, so older forests have the most complex ecosystems. Intensive forestry, with its short-rotation harvest cycles, undermines this diversity.

But industry advocates focus on forest area over forest health and tree cover over forest diversity. This allows them to state that 'European forests have been growing by 1,500 football pitches every day'[7] without disclosing that their definition of forest includes treeless areas designated for reforestation. Indeed, in policy design, forest area is an indicator to assess afforestation, reforestation and deforestation activities. It does not reflect the size of the area covered with trees, let alone the condition of forests.

Forest cover change — the balance between forest gain and loss —actually shows a net loss between 2012 and 2018. But when you consider gross tree cover loss, the picture is even worse because when you replace old forest with new saplings it has a negative effect on biodiversity, climate regulation, carbon storage and water supplies. In Europe, tree cover loss worsened by 74 per cent from 2009-2018, amounting to 1.5 million hectares in 2017—about half of the size of Belgium.[8] Overall forest health has been deteriorating due to pests, diseases and wind damage.[9] As a result, ecosystem resilience has been compromised, and a vast majority of habitats and species listed in the Habitats Directive are in an unfavourable conservation status.[10] The increasing frequency of fires and destructive weather events is likely to degrade forests even further.

To improve forest health, foresters must stop measuring economic success according to the short-term efficiency of timber production. Mechanised clear-cuts are simple and cost-effective for the service providers and offer a quick payment to the forest owner, but they fragment the forest landscape and damage the forest floor and water cycles, thereby reducing biodiversity and forests' resilience to weather, fire and diseases.[11] Extending areas of close-to-nature forestry could mitigate these effects.[12]

Close-to-nature forestry can also assist in solving problems associated with land abandonment. While it is important to keep a proportion of forests under strict protection from the biodiversity point of view, large areas of unmanaged forests can become a fire hazard in hotter climates. The depopulation of Mediterranean rural areas has led to significant forest expansion.[13] These secondary new forests grown on former agricultural lands have a poor age structure and inadequate diversity, density and maturity, making them prone to wildfires.[14] Combining various strategies along the continuum between clear-cutting and total land abandonment would bring much-needed diversity into these dense, fire-prone landscapes.[15] A well-planned integrated approach could simultaneously lower wildfire risks and tap into new revenues.

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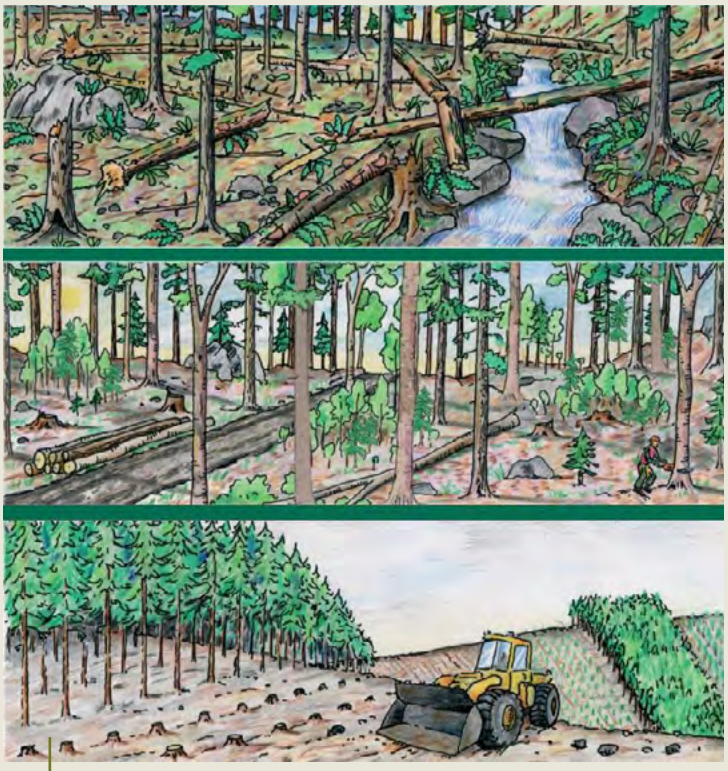
7 *Two Sides, 'European Forests Have Been Growing by 1,500 Football Pitches Every Day!', n.d.*
8 *Joint Research Centre (JCR), 'Mapping and Assessment of Ecosystems and Their Services: An EU Ecosystem Assessment' (Publications Office of the European Union, 2020).*
9 *Forest Europe, 'State of Europe's Forests 2020', 17 December 2020.*
10 *European Environment Agency (EEA), 'European Forest Ecosystems: State and Trends', 2016.*
11 *Puettmann, Klaus J., K. David Coates, and Christian C. Messier, 'A Critique of Silviculture: Managing for Complexity', Ebook Central (Washington, D.C.: Island Press, 2009) ; Anne Siira-Pietikäinen and Jari Haimi, 'Changes in Soil Fauna 10 Years after Forest Harvestings: Comparison between Clear Felling and Green-Tree Retention Methods', Forest Ecology and Management 258, no. 3 (2009): 332–38 ; Hervé Jactel et al., 'Tree Diversity Drives Forest Stand Resistance to Natural Disturbances', Current Forestry Reports 3, no. 3 (2017): 223–43 ; Gabriel Michanek et al., 'Landscape Planning-Paving the Way for Effective Conservation of Forest Biodiversity and a Diverse Forestry?', Forests 9, no. 9 (2018).*
12 *Jeannette Eggers et al., 'How Well Do Stakeholder-Defined Forest Management Scenarios Balance Economic and Ecological Forest Values?', Forests 11, no. 1 (2020).*
13 *Teresa Cervera et al., 'Understanding the Long-Term Dynamics of Forest Transition: From Deforestation to Afforestation in a Mediterranean Landscape' (Catalonia, 1868–2005)', Land Use Policy 80 (2019): 318–31.*
14 *Josep Peñuelas and Jordi Sardans, 'Global Change and Forest Disturbances in the Mediterranean Basin: Breakthroughs, Knowledge Gaps, and Recommendations', Forests 12, no. 5 (2021): 603.*
15 *Peñuelas and Sardans.*

CASE STUDY : ECONOMY AND ECOLOGY WORK HAND IN GLOVE

The 2018 bark-beetle outbreak across European conifer forests is a painful reminder of the growing vulnerability of conventionally managed forests in the changing climate. In Czechia alone, an area of 100,000 football fields was lost due to drought and bark beetle damage. The economic loss was €1.6 billion in just one year.[16] Three centuries of intensive management had increased spruce's share of the country's forest composition from 11 per cent to over a half, most of it in monocultural stands.[17] This practice opened the door to several environmental disturbances—including a bark beetle outbreak, which has seen an alarming increase in negative impacts on conifer.[18]

Minor adjustments to forest management may briefly alleviate the symptoms, but will fail to address the underlying causes. Shortening harvest rotation periods, for example, can temporarily repel bark beetles but may lead to the opposite effect in the long run. Hence, risk management should be balanced with long-term management strategies to foster forest resilience[19]—such as increasing tree diversity to protect against insect damage and other disturbances.[20]

Increasing diversity would have limited the bark beetle spread and, even in infected areas, left the deciduous trees standing. If owners had opted for multispecies management, they would still be receiving an income in the years following the conifer infestation. Instead, they are left to wait for the next harvest in 70-100 years, having sold their timber at the sunk market prices that followed mass salvage logging.[21]



Close-to-nature forestry as a middle-ground between industrial forestry and strict protection. Book cover for Ed. Jurij Diaci, 2006. Nature-Based Forestry in Central Europe: Alternatives to Industrial Forestry and Strict Preservation.

16 Czech Forest Think Tank, 'Damage to Forests in 2019: 40 Billion Crowns', 3 October 2019 ; Czech Forest Think Tank, 'Further Underestimation of the Consequences of Drought and Bark Beetle Calamity in Forests Will Have Negative Effects on Society as a Whole! (České Lesy Jsou v Bezprostředním Ohrožení Další Podceňování Následků Sucha a Kůrovcové Kalamity Bude Mít Negativní Dopady Na Celou Společnost!)', 28 February 2019.

17 Hlásny, T., Zimová, S., Merganičová, K., Štěpánek, P., Modlinger, R., Turčáni, M., 2021. Devastating outbreak of bark beetles in the Czech Republic: Drivers, impacts, and management implications. Forest ecology and management 490, 119075. Klimo, Emil, and Jiří Kulhavý. 'Norway Spruce Monocultures and Their Transformation to Close-to-Nature Forests from the Point of View of Soil Changes in the Czech Republic.' Ekológia Bratislava 25, no. 1 (2006): 27–43.

18 Hlásny et al. Devastating outbreak of bark beetles https://efi.int/sites/default/files/files/publication-bank/2019/efi_fstp_8_2019.pdf

19 Tomás Hlásny et al., 'Living with Bark Beetles: Impacts, Outlook and Management Options', 2019.

20 Jactel et al., 'Tree Diversity Drives Forest Stand Resistance to Natural Disturbances'.

21 Hlásny et al., 'Living with Bark Beetles'.

DISCUSSION TOPIC #3

How does close-to-nature forestry diversify forest owners' income?

Another advantage of close-to-nature forestry is its economic multifunctionality. In addition to securing regular earnings from selective logging, continuous tree cover and higher biodiversity preserve forests' non-timber revenues.[22] Most profitability calculations don't include non-timber goods; yet, due to growing demand for natural food,[23] the largely untapped revenues from wild produce hold tremendous economic potential.

Anything from mushrooms and berries to lucrative trades like truffles, medicinal plants and nature tourism can provide a constant income stream alongside selective logging. The potential financial benefits from Natura 2000—a European network of key wildlife habitats—is estimated to be €200-300 billion per year upon an annual investment of €5.8 billion.[24] Birdwatchers visiting Białowieża Forest in Poland alone spent €1.8 million in 2016 visiting the old-growth habitats of European woodpeckers. At the same time, the sale of Białowieża wood has lost money since 2005.[25]

These numbers illustrate that timber production should not be considered the only or primary forest activity capable of creating profit. While timber and non-timber goods production does not always lead to synergies, valuing non-timber forest products increases the forest's overall profitability.[26] With growing demand for non-timber forest products, this trend is likely to continue upwards. On balance, biological, structural and economic diversification reduces risks, increases income stability and, in the long-term, offers higher profits compared to intensive forest management.

22 Thomas Knoke, Katharina Messerer and Carola Paul, 'The Role of Economic Diversification in Forest Ecosystem Management', Current Forestry Reports 3, no. 2 (2017): 93–106.
23 Forest Europe, 'State of Europe's Forests 2020'.
24 The Economic Benefits of the Natura 2000 Network: Synthesis Report (Luxembourg: Publications Office, 2013).
25 Dorota Czeszczewik et al., 'Birdwatching, Logging and the Local Economy in the Białowieża Forest, Poland', Biodiversity and Conservation 28, no. 11 (2019): 2967–75.
26 Mikko Kurttila, Timo Pukkala, and Jari Miina, 'Synergies and Trade-Offs in the Production of NWFPs Predicted in Boreal Forests', Forests 9, no. 7 (2018).

DISCUSSION TOPIC #4

If intensive forestry misses so many tricks, why is it still so popular?

Intensive forestry began in 18th century Prussia when government officials dealt with increased demand by quantifying forest resource management. Having same-aged trees of the same species on forest plots made them easier to monitor and offered predictable uniform harvests. The outcomes of their experimentation, however, took several human generations to appear, so problems only became evident during the second rotation. The nutrient cycle was disrupted, trees became more susceptible to storm breakage and pests, and production began to decline. By the time the devastation caused by monocropping had become apparent, the technique had already spread across the globe.[27] Despite the low-value wood,[28] high cultivation costs and increased vulnerability, using such forestry techniques is a hard habit to kick now that the industry has got used to much faster rotations.[29]

Although close-to-nature forestry creates more profit once it's up and running, its establishment is not always straightforward, and its economic attractiveness depends on the state of the stand to be converted.[30]

In countries with no history of close-to-nature forestry, it can be challenging to determine what a 'natural' stand should look like. It is therefore easier for forest owners to undertake plantation forestry. Landscape-specific needs may pose another barrier. The heavy machinery used in Nordic close-to-nature forestry, for instance, would be unsuitable for softer forest floors. That said, much of close-to-nature forestry doesn't rely on heavy machinery, in which case

27 Henry E. Lowood, 'The Calculating Forester: Quantification, Cameral Science, and the Emergence of Scientific Forestry Management in Germany in Tore Frängsmyr, J. L. Heilbron, and Robin E. Rider, eds., The Quantifying Spirit in the 18th Century, Uppsala Studies in History of Science (Berkeley: University of California Press, 1990) ; James C. Scott, Seeing Like a State : How Certain Schemes to Improve the Human Condition Have Failed, Yale ISPS Series (New Haven: Yale University Press, 1998).
28 JRC, 'Biomass Flows', 2020.
29 João P. F. Carvalho, 'The Basis and Background of Silviculture – the Pursuit of Sustainability (As Bases e o Desenvolvimento Da Silvicultura – Ao Encontro Da Sustentabilidade)', História Da Ciência e Ensino Construindo Interfaces 20 (2019): 222–37.
30 Tahvonen et al., 'Optimal Management of Uneven-Aged Norway Spruce Stands'.

the transition is a question of providing training, safe working conditions and fair wages for manual labourers.

A final reason for the popularity of industrial forestry is that it is unfairly subsidised. Foresters complain that subsidy and tax regimes are primarily designed for rotational silviculture. The majority of EU funding for forestry comes from the Rural Development Fund under the Common Agricultural Policy (CAP), but ultimately it is up to the Member States to apply and co-fund the provisions. There is little to no ecological or social conditionality on how the funds are allocated. CELPA – an association of Portugal's major paper and pulp production companies – has channelled millions of Euro to intensify practices in its non-native, fast-growing eucalypt plantations. Recipients of CELPA's Melhor Eucalipto project's grants can use the funds for 23 different activities, including deep ploughing, uprooting of stumps, use of herbicides, and other intrusive practices[27] associated with acidification, organic carbon and nutrient losses, soil fertility loss and erosion. EU subsidies are also subject to minimum allocations making it harder for small-holders to access the funds, lest they do it through an association such as CELPA.

Although the barriers to setting up close-to-nature forestry are many, it doesn't mean that solutions don't exist. For some owners, it is a matter of gaining knowledge and training; others need integrated structural changes. The positive examples send a clear signal that efforts are worthwhile.

In Professor Timo Pukkala's continuous cover forest five years after a harvest: The ecosystem is intact and the forest is still usable for recreational activities. All the while, the trees are self-regenerating and the standing timber is rising in value. © Timo Pukkala

31 Projecto Melhor Eucalipto, 'Know in which conditions you can take advantage of the RDP support!' ('Saiba em condições pode aproveitar os apoios do PDR 2020!', 2020 ; UNECE, Forest Information Billboard, 2018, https://unece.org/issue-2-2018.

DISCUSSION TOPIC #5

The 'Swedish model': exemplary timber production or a damaging threat to world forests?

Sweden is one of the world's biggest exporters of timber products. They achieve this through rotational planting, whereby every time the land is cleared of trees, it is replanted with new seedlings. The large-scale intensive regeneration method gives the forest industries a continuous wood supply with low final felling costs. As machinery is used to cut down everything in its way, logging is labour-efficient, fast and economical. Production is further economised by shortening rotation periods (cutting trees younger) when the supply is short.

THE COUNTERARGUMENT

Industry suppliers in Sweden and beyond buy logging rights from small-holders who are unaware of feasible alternatives, and thus often end up selling timber at below-market prices. Even large industry is destined to lose in the long run. In Sweden, the revenue from rotational forestry already fails to keep up with rising costs.

'Researchers on the leash - the Mistra way'. An illustration from Mistra's jubilee publication.

About half of Sweden's forest lands are owned by non-industrial private owners[32] who exert little influence on how forests are managed. These small-holders tend to lack information, skills and forestry equipment and rely on forestry contractors' advice and services.[33] But their advice is not necessarily in the interests of the owners. 'It was a big conflict for me as a person,' recalls Martin Jentzen, a forestry consultant who used to source raw material for a paper mill. 'My job was to source output for the industry, while my personal advice to the owner would have been 'Let it grow for a bit. Don't start too early.'

Even if the forest owner sees through a non-optimal offer, they cannot wander far in search of services. It can be difficult to find a subcontractor who's not connected to the industry and would deviate from its management model. Non-industrial forest owners often plan together with a forest owners association or other purchasing organisation.[34] But even forest owners associations have vested interests in the industry. Norra Skog, the second largest forest owners' association in Sweden, recently acquired 30 per cent of the Finnish Metsä Board's Husum paper mill, valued at €350 million. Part of the deal is a long-term wood supply agreement between the parties.[35] 'I find Norra's decision to sell its forest – its primary business model – to buy into a papermill very telling of the asymmetrical dynamics in the forest sector,' comments forest owner and researcher Back Tomas Ersson.

Educational authorities perpetuate the current industry model.[36] The Swedish University of Agricultural Sciences (SLU) is the principal provider of forestry studies, producing foresters for both industrial and public forest management. Its ingrained industry links reach back to the post-war period when the state encouraged intensive, monocultural forestry,[37] and the approach has persisted.

Intensive forestry advocates have used increasing awareness of the climate crisis to sell a new myth: Trees sequester carbon; the more trees we cut, the more we can plant; therefore, short-rotation logging improves the climate. While carbon absorption slows down in old forest stands, the claim that intensified logging will solve the climate crisis is, scientifically, quite extraordinary (see the box Why clear-cutting won't solve the climate crisis). 'The research funds come from big forest companies,' says SLU graduate and close-to-nature forestry entrepreneur Markus Steen. 'You're certainly free to do your own research on close-to-nature forestry, but the possibilities and finances are much smaller.' Researchers who deviate from the intensive industry model are ostracised. 'I have no contact with my former students and colleagues,' notes Martin. 'Sweden is corrupted by friendships that don't leave room for the criticism of the status quo.'

Markus' and Martin's claims are illustrated by a €14 million research programme, Future Forests. Undertaken between 2009 and 2012, it was a collaboration between Mistra (The Swedish

32 Swedish Forest Agency, 'Statistical Yearbook of Forestry (Skogsstatistisk Årsbok)', 2014.
33 Elias Andersson and E. C. H. Keskitalo, 'Adaptation to Climate Change? Why Business-as-Usual Remains the Logical Choice in Swedish Forestry', Global Environmental Change 48 (2018): 76–85.
34 Andersson and Keskitalo.
35 Alan Sherrard, 'Norra Skog to Acquire 30% Stake in Metsä Board Husum', 1 December 2020.
36 Andersson and Keskitalo, 'Adaptation to Climate Change?'
37 Jenny Andersson and Erik Westholm, 'Closing the Future: Environmental Research and the Management of Conflicting Future Value Orders', Science, Technology, & Human Values 44, no. 2 (2019): 237–62.

WHY CLEAR CUTTING WON'T SOLVE THE CLIMATE CRISIS

The oxymoron 'climate-smart clear-cutting' is disconcerting in a number of ways. First, it trades Europe's already troubled biodiversity for alleged carbon savings. Biodiversity loss is recognised as a problem that is at least as urgent as the atmospheric carbon imbalance, threatening our economies, livelihoods, health and resilience to climate change.[38] The biodiversity and climate crises are so intertwined that they cannot be solved in isolation.

Second, the evidence for decreased carbon uptake in older forests does not reflect individual tree growth. Large, old trees actively fix more carbon than young, small ones. At the extreme, a single big tree can add the same amount of carbon to the forest in a year as is contained in an entire mid-sized tree.[39] And crucially, there is a difference between carbon uptake and storage. Even when old forests' uptake decreases compared to middle-aged stands, they already keep vast amounts of carbon out of the atmosphere.[40] It takes decades to centuries for young seedlings to absorb the same amount of carbon as is released through logging in existing forests. To have a chance of staying below 1.5˚C global heating, net emissions will have to decline by 45 per cent before 2030.[41] There is simply no time left to wait for the new trees to grow.

Furthermore, intensive forestry practices have undesired effects on the atmospheric carbon balance, regardless of the biomass volume. Most forest carbon is not stored in vegetation, but soil.[42] Clear-cuts mobilise soil carbon, which continues to leak into the atmosphere for years following the harvest.[43] The effect is exacerbated by tilling the ground in preparation for the next generation of trees.[44]

Finally, considering the wide range of underlying processes, it is incredibly difficult to estimate future forests' sink capacity. Modelling carbon turnover is further complicated by the level of uncertainties associated with ongoing environmental changes.[45] Releasing the carbon stock with no guarantee that we will get it back is a huge gamble.

Foundation for Strategic Environmental Research), SLU and Sweden's major forest companies (LRF, SCA, Holmen, Bergvik, Skoggsällskapet and Sveaskog). In its own words, Mistra invests 'in research aimed at solving key environmental problems and promoting Sweden's future competitiveness.' Its programmes are conducted 'in close dialogue with companies, public agendas and other users, to ensure that research findings are put to practical use.'[46] In Future Forests, however, the 'dialogue with industries, public agendas and other users' took the form of brazen industry Public Relations through the employment of public research institutions and tokenist stakeholder inclusion. 'It is a bit of a rooster fight—we pay for the program and we must influence it... We don't buy certain opinions, but we must steer and influence what aspects will be explored,' explained programme participant Pelle Gemmel, SCA's forestry manager and SLU professor. As part of the programme strategy, non-industry stakeholders were either

38 *The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), 'The Global Assessment Report on Biodiversity and Ecosystem Services', 2019.*
39 *N. L. Stephenson et al., 'Rate of Tree Carbon Accumulation Increases Continuously with Tree Size', Nature (London) 507, no. 7490 (2014): 90–93.*
40 *Tom Pugh, 'Are Young Trees or Old Forests More Important for Slowing Climate Change?', The Conversation, accessed 7 May 2021.*
41 *The Intergovernmental Panel on Climate Change (IPCC), 'Global Warming of 1.5°C. Special Report', 2018.*
42 *'In all forests, tropical, temperate and boreal together, approximately 31 percent of the carbon is stored in the biomass and 69 percent in the soil. In tropical forests, approximately 50 percent of the carbon is stored in the biomass and 50 percent in the soil' (IPCC, 2000).*
43 *Steven P. Hamburg et al., 'Losses of Mineral Soil Carbon Largely Offset Biomass Accumulation 15 Years after Whole-Tree Harvest in a Northern Hardwood Forest', Biogeochemistry 144, no. 1 (2019): 1–14.*
44 *H. Simola, 'Persistent Carbon Loss from the Humus Layer of Tilled Boreal Forest Soil', European Journal of Soil Science 69, no. 2 (2018): 303–14.*
45 *Thomas. A. M. Pugh et al., 'Understanding the Uncertainty in Global Forest Carbon Turnover', Biogeosciences 17, no. 15 (2020): 3961–89.*
46 *Mistra, n.d.*

pushed out of the debate or left of their own accord. Researchers whose studies didn't produce favourable results were marginalised. Industry-legitimising research that communicated climate reasons for intensification of forest production, on the other hand, was broadcast through various outlets.[47]

Future Forests is by no means an exception to otherwise non-partisan forestry research. Several leading forest and climate researchers sit on forestry company boards, and it is a board member's priority to make the company profit.[48] Moreover, industry-defined knowledge is not limited to higher education. The narrative that intensive logging is the 'climate-smart' method of forest management is part of the school curriculum and reaches all the way to national and EU governments.[49] Publications advocate that business as usual is good for the climate, despite the findings of non-industry led science. Over the last four years, the Swedish forestry industry has spent over €15 million on presenting itself as the climate hero through various lobbying channels,[50] approximately 10 per cent of which was spent in Brussels.[51]

While different timber-based sectors work somewhat in tandem in Sweden, the pulp and paper industry is in fierce competition with solid wood sectors in some other countries. The pulp and paper industry relies on cheap, low-quality wood produced by short-rotation monocultures. As close-to-nature forestry would lead to more saw logs and less pulpwood, a broader conversion from intensive to close-to-nature forestry is not in the short-term interests of the pulp and paper industry. Hence, several people we spoke to said that the industry persuades forest owners that intensive forestry is their best option, even though sawmills would pay the forest owner significantly more for the higher quality wood from close-to-nature management. Rapidly growing demand for bioenergy adds further supply pressures. Current EU subsidies enable bioenergy producers to burn premium timber that would otherwise furnish solid wood industries.

So, despite the evidence of the economic advantages of close-to-nature forestry, Swedish industry continues to lobby for the status quo, finding political allies in governments looking for short-term benefits. In a recent letter to European Commissioner Ursula von der Leyen, the Finnish and Swedish Prime Ministers went as far as to ask the EU to delete the concept of close-to-nature forestry from the EU's green taxonomy.[52]

Growing demand for timber means wood-based companies continue to accumulate forest lands. To supplement the raw material from their own property, industry suppliers in Sweden and beyond buy logging rights from small-holders who are unaware of feasible alternatives, and thus often end up selling timber at below-market prices. Even public forests are unprotected from industry interests, as forestry work, particularly harvesting, is increasingly outsourced to contractors,[53] whose management culture guides planning decisions. And unlike

“As long as the industry can continue intensifying and expanding, it has little motivation to optimise its practices—leaving future generations to bear the brunt of its negligence.”

small-holders, large companies can make up for losses from management mistakes by expanding or moving. Family forest owners, on the other hand, are frequently among the losers in the forestry business. Logging firms, paper mills and pellet producers have substantially more to gain than the forest owners—and much less to lose should the forest land become unproductive as a result of extraction. As long as trees are still standing somewhere, demand can simply be met by logging the next allotment—leaving the landowner to repair the damage. While Sweden, which has stretched its timber yield to the limit, is looking for additional supplies from the Baltic States, the Baltic States' forest industry is already exploring new frontiers in the East.[54]

Swedish Forest campaign ad: 'In Sweden, at least two new trees are planted for every felled one. The forest cleans the air as it grows and gives us climate-smart materials when it's done.'

Yet, even the large industry is destined to lose in the long run, unless it reviews its narrowly defined efficiency targets. In Sweden, the revenue from rotational forestry already fails to keep up with rising costs.[55] The planet has its own limits on how far the industry can expand, and economic setbacks will soon become apparent. Until policymakers and educators stop reproducing outdated models based solely on short-term annual timber yields and spurious climate arguments, there is little hope that future foresters and forest owners will do better than today's.

Recent studies have incorporated more sophisticated economic research designs, non-timber revenues, ecosystem services and even social benefits in their forestry optimisation models.[56] However, it is still very much in need of development, geographic proliferation and adaptation into training and awareness programmes. Fundamentally, forestry science and practice need to keep up with environmental change, but industry lobbying hinders efforts to bridge gaps. Increasingly outsourced and distant forest management does not incubate accountability and stewardship. As long as the industry can continue intensifying and expanding, it has little motivation to optimise its practices—leaving future generations to bear the brunt of its negligence.

47 Andersson and Westholm, 'Closing the Future'.
48 Lisa Röstlund, 'Forest Research Manager Paid by Europe's Largest Forestry Company (Skogsforskningschef Avlönad Av Europas Största Skogsbolag)', Dagens Nyheter, 4 February 2021.
49 Lisa Röstlund, 'The Forest Companies' Story about the Forest - Lobby for 150 Million (Skogsbolagens Berättelse Om Skogen – Lobby För 150 Miljoner)', 8 March 2021.
50 Röstlund.
51 'The European Commission Transparency Register', n.d.
52 Pekka Vanttinen, 'Environmentalists 'up in Arms' about Finnish-Swedish Defence of Forest Industry', EURACTIV, 31 May 2021.
53 UNECE/FAO, 'Green Jobs in the Forest Sector', 2018.
54 E.g. Lennart Ruuda, 'One of Estonia's Largest Wood Producers Is Hatching Factory Plans in Belarus (Eesti Üks Suuremaid Puidutööstusi Haub Valgevenes Tehaseplaane)', Postimees, 18 October 2020.
55 Lars Eliasson, 'Forestry Costs and Revenues 2019 (Skogsbrukets Kostnader Och Intäkter 2019)', Skogforsk, 2020.
56 Timo Pukkala, 'Measuring the Social Performance of Forest Management', Journal of Forestry Research, 3 April 2021.

DISCUSSION TOPIC #6

Does more logging mean more jobs in the countryside?

THE INDUSTRY ARGUMENT

'Forestry companies are today's salt of the earth, enabling people to live and work in the countryside.'
Raul Kirjanen, the Chief Executive Officer (CEO) of Europe's largest wood pellet producer Graanul Invest [57]

THE COUNTERARGUMENT

Despite increased logging, employment in forestry is diminishing.

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57 Kristiina Viiron, 'Raul Kirjanen: Forestry Is Today's Salt of the Earth', Maaleht, 27 November 2019.

Employment in European forestry dropped by a third between 2000 and 2015–primarily due to increased mechanisation in the wood and paper industry.[58] Sveaskog–the Swedish state forest company–provides as few as 846 jobs to manage four million hectares of forest land[59] (nearly a fifth of all managed forest land in Sweden).[60] Employment figures are more encouraging in countries with traditions and legislation favouring close-to-nature forestry, as selective harvesting is more labour-intensive. The state forest company SIGD in Slovenia, where clear-cutting is outlawed, provides five times more jobs per hectare of managed forest land than its equivalent Sveaskog, where rotational forestry is the norm.[61] Additional labour costs during the harvest are compensated by savings from the self-regeneration and maintenance of the forest stand.

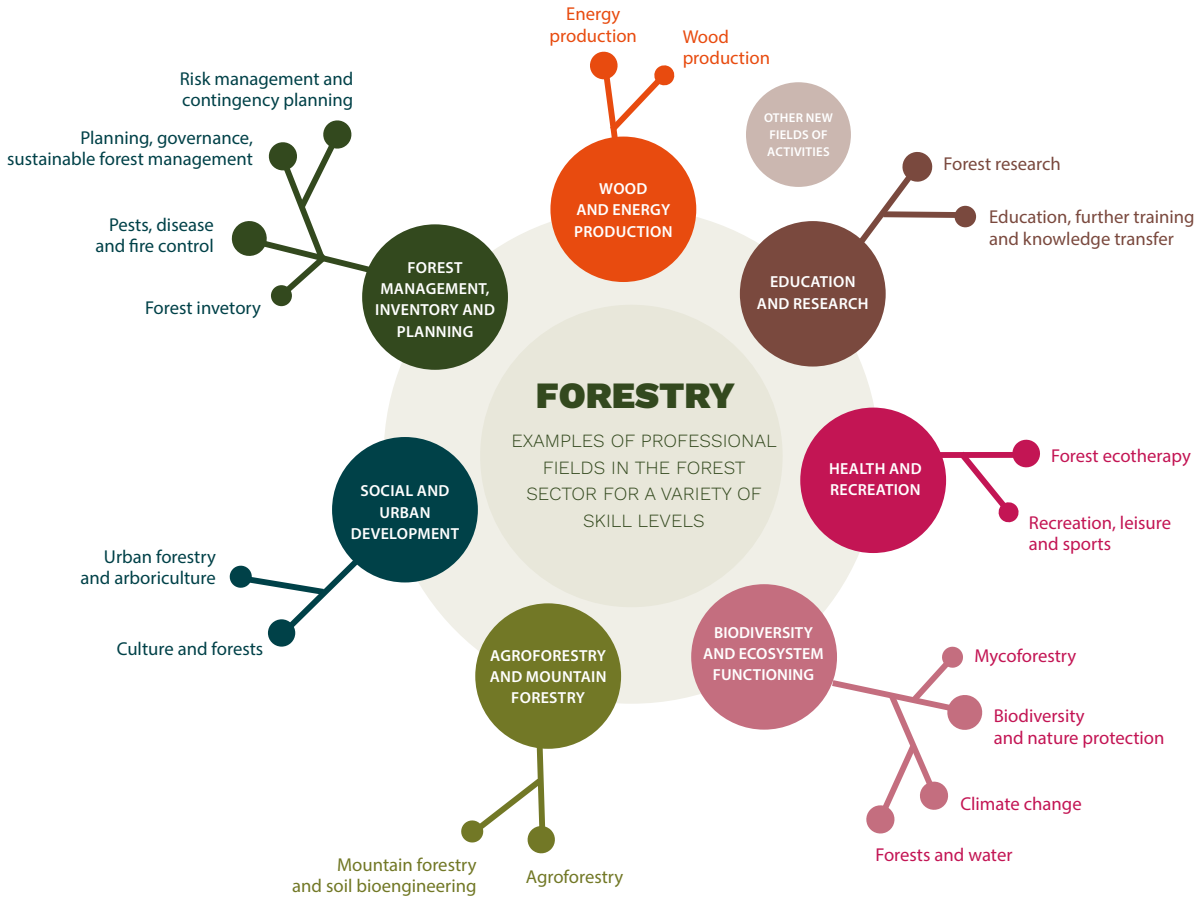
Globally, new jobs in bioenergy and biochemical production slightly mitigate the downward employment trend across subsectors.[62] But these and many other timber-based jobs are often concentrated in large production centres rather than rural areas. According to trade unions, rural depopulation means that forestry workers' main problem isn't the shortage of jobs but poor working conditions.[63] Businesses often struggle to find a sufficient and stable workforce, as the meagre pay and dangerous working conditions don't make forestry an attractive career choice—particularly amongst women and the younger generation.[64] The gap in the workforce is filled with informal and migrant labourers,[65] often trapped under precarious contracts.[66] Unions don't have enough influence to offer the sort of security they once did.[67] Hence, increased intensive logging does not solve rural employment problems. In fact, as most of the EU's wood-based jobs are in downstream parts of the value chains,[68] basing claims about rural employment rates solely on the volume of logged timber is misleading.

In light of escalating environmental uncertainties, rural development has to put economic diversification at its heart. Yet, non-timber enterprises and restoration work are rarely included in the forest sector's economic and employment statistics. Natura 2000 is estimated to directly support eight million jobs in tourism and recreation[69]–triple the equivalent figure for forestry and wood-based sectors.[70] Non-timber forest products and services are not only potential income boosters for the forest owners,[71] they can also considerably broaden the variety of work in the forest. In the view of forest engineer Anton Lesnik, Europe's forests' economic and employment opportunities are largely untapped: 'Forest owners and governments need to see that bioeconomy's potential goes way beyond timber. There is a need to link up the different parts in the value chain; create partnerships between timber and non-timber goods production; between extraction and recreation in forests.' Replacing clear-cutting with close-to-nature forestry practices would markedly increase forest areas suitable for tourism, recreation

58 Forest Europe, 'State of Europe's Forests 2020'.
59 Eustafor, n.d.
60 Swedish Wood, The forest and sustainable forestry, n.d.
61 Eustafor.
62 Forest Europe, 'State of Europe's Forests 2020'.
63 Forest Europe.
64 UNECE/FAO, 'Forest Sector Workforce in the UNECE Region: Overview of the Social and Economic Trends with Impact on the Forest Sector', 2021.
65 UNECE/FAO.
66 EFBWW and BWI, 'Joint Paper on Migration from Third Country Nationals to Europe', 9 June 2021.
67 UNECE/FAO, 'Green Jobs in the Forest Sector'.
68 Nicolas Robert et al., 'The EU Bioeconomy: Supporting an Employment Shift Downstream in the Wood-Based Value Chains?', Sustainability (Basel, Switzerland) 12, no. 3 (2020): 758.
69 UNECE/FAO, 'Green Jobs in the Forest Sector'.
70 Forest Europe, 'State of Europe's Forests 2020'.
71 Jari Miina et al., 'Modelling Non-Timber Forest Products for Forest Management Planning in Europe', Current Forestry Reports 2020, no. 6 (n.d.): 309–22.

and non-timber goods. All the while, jobs in timber production would continue alongside the new ventures.

Of course, some forests are unsuited for any intrusive human activities. Most of Europe's biodiversity hotspots—primary and old-growth forests—have either already disappeared or are in urgent need of repair and strict protection. The restoration sector is clearly a better fit than forestry for employment creation. Natura 2000, which covers habitats of various protection levels across 18 per cent of EU land, supports a wide variety of professions. When its investment needs are fully met, the network is expected to provide 278,000 conservation and restoration jobs.[72] Restoring landscapes for the betterment of humanity and wildlife can provide the meaning and creativity that many workers find missing in industrial forest labour. That said, jobs created by biodiversity protection go far beyond the conservation and restoration sectors. Natura 2000 is estimated to support approximately 1.5 million jobs in sustainable production, including 73,000 in forestry.[73] An innovative approach to sectoral research, development, and ecosystem services could tackle the forest sector's disrepute among workers.[74] By favouring low-added-value, low-employment industries, current policy strategies encourage expansion and intensification instead of smart development and green jobs in forest-based sectors.



Source : UNECE/FAO, 'Green Jobs in the Forest Sector.'

72 *Institute for European Environmental Policy (IEEP), 'Natura 2000 and Jobs – Scoping Study', 2017.*
73 *Institute for European Environmental Policy (IEEP).*
74 *UNECE/FAO, 'Forest Sector Workforce in the UNECE Region: Overview of the Social and Economic Trends with Impact on the Forest Sector'; UNECE/FAO, 'Green Jobs in the Forest Sector'.*

DISCUSSION TOPIC #7

Is Europe's forestry sustainable and multifunctional?

THE INDUSTRY ARGUMENT

'Over the last decades, European forests have been managed sustainably, meeting European society's growing demands for climate change mitigation, protection against natural hazards, recreational space, development of the bioeconomy and providing a home for biodiversity, to name just a few.'
Forest-based industries' joint statement with regard to the European Green Deal. [75]

THE COUNTERARGUMENT

Intensive forestry is undermining forests' protective and social functions.

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75 Representatives of European forest-based industries, 'Multifunctional European Forests Are Crucial to Reach the Objectives of a European Green Deal: Joint Statement', 15 October 2019.

There is mounting evidence of forests' contribution to human health and well-being.[76] Forests protect us from noise and air pollution, reduce stress and cardiovascular risks, strengthen immunity, and provide the environment for exercise and recreation. Urban and peri-urban woodlands are particularly significant sources of health and well-being, as they are accessible to the people most lacking contact with nature. It is crucial, therefore, to consider the multiple functions of each forest when planning logging. Hydrological services, aesthetic values and other ecosystem services better provided under alternative silvicultural practices are not adequately monetised or evaluated in timber yield-focused models.[77] The impacts of clear-cuts are sorely felt by people who lose access to forest-based ecosystem services. New trees planted are of little consolation to someone who's lost their only local recreation forest. These unnecessary losses can be avoided through close-to-nature forestry, which maintains part of the tree cover through each harvest.

Forests constitute a vital part of many Europeans' cultural and environmental identities, their way of life and sustenance. Forestry that disregards specific places' cultural significance and the

CASE STUDY – THE SAAMI HERDERS IN NORTHERN FENNOSCANDIA

For the Saami herders in Northern Fennoscandia, the integrity of wilderness is more than an aesthetic treat. Forests provide food for the reindeer, who are part of every aspect of Saami culture—from livelihood and nomadic lifestyle to handicraft and language. Intensive forestry is increasingly pushing into the old-growth forests of the North,[78] but short-rotation forests are unsuitable for herding reindeer, who depend on lichen growing on old trees. Seventy per cent of the most productive lichen pastures in Sweden have been lost to industrial forestry, and the remaining ones are small and far apart.[79] In the past, feed shortages were partially compensated by ground lichen, but the icy grounds resulting from warmer winters are too hard for the reindeer to penetrate. Saamis–whose rights to Free, Prior and Informed Consent (FPIC) is guaranteed under the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)–have no say in clear-cuts, according to reindeer herder Niila Inga from the Saami Council. Forest Stewardship Council (FSC) certified companies are required to negotiate their forest activities with reindeer herding communities, but if they don't reach an agreement, the areas are sold on to other companies or private landowners. Non-certified owners often do not even notify the herders about their logging plans. 'It is striking how Scandinavian countries simultaneously brag about their rich Indigenous culture and then go on to actively destroy it. We would be open to negotiating different forestry styles if anybody actually asked us.'

integrity of the broader landscape cannot be considered socially sustainable. Industrial forestry in its current form contests rather than collaborates with other land uses. Saami reindeer herders' traditional way of life is threatened by forestry expansions (see Case study). Numerous Estonian sacred groves–revered by religious practitioners and agnostics alike–have been eradicated by clear-cuts.[80] Bountiful bilberry woods have been damaged by clear-cuts despite forming an essential part of people's lifestyle, nourishment and income.[81] For many people, intensive forestry around urban settlements has eliminated their only source of fresh air and nature recreation.

The 64 lives lost in the Portugal forest fires in 2017 were another bleak reminder of intensive forestry's high societal costs. Even though fires were spread by combustible bark flakes from eucalypts,[82] new plantations are taking the places of the burnt ones and extending into Galicia, where "eucalyptisation" is allowed to continue, through a loophole in a "moratorium" on new plantations.[83] From the neighbouring landowners' point of view, the impact on adjacent properties is one of the most worrying aspects of intensive forestry. In addition to the fire hazard from badly managed forests and plantations, intensive forestry can aggravate weather and pest damage. For instance, clear-cuts create forest edges, which are susceptible to wind throws; and wind throws open the door for bark beetles.[84] Such adverse externalities beg for more consideration of the effects of forestry practices across plot boundaries.

ECONOMIC ADVANTAGES OF CLOSE-TO-NATURE FORESTRY COMPARED TO CLEAR-CUT MANAGEMENT

1. Harvesting trees at their peak economic value
2. No or low planting and maintenance costs
3. Higher resilience to natural hazards and climate change
4. Flexibility to withstand financial risks from market fluctuation
5. Premium price for products
6. Steady earnings
7. Income diversification

76 Forest Europe, 'Human Health and Sustainable Forest Management', 2019.
77 Puettmann, A Critique of Silviculture.
78 Piera Heaika Muotka, 'Sweden Must Respect Sámi Reindeer Herders' Rights When Conducting Forestry', Saami Council, 11 December 2020.
79 Alessia Uboni, Birgitta Åhman, and Jon Moen, 'Can Management Buffer Pasture Loss and Fragmentation for Sami Reindeer Herding in Sweden?', Pastoralism : Research, Policy and Practice 10, no. 1 (2020): 1–13.
80 Saul Elbein, 'In Tiny Estonia, a Fraught Debate: What Are Forests For?', National Geographic, 19 October 2020.
81 Remm, L., Rünkla, M. and Lõhmus, A. 2018. How Bilberry Pickers Use Estonian Forests: Implications for Sustaining a Non-Timber Value. Baltic Forestry 24(2): 287–295. Lõhmus, A., Remm, L., 2017. Disentangling the effects of seminatural forestry on an ecosystem good: Bilberry (Vaccinium myrtillus) in Estonia. Forest ecology and management 404, 75–83.
82 José Antonio González Díaz et al., 'Dynamics of Rural Landscapes in Marginal Areas of Northern Spain: Past, Present, and Future', Land Degradation & Development 30, no. 2 (2019): 141–50 ; Stefan H. Doerr, António Bento Gonçalves, and Cristina Santin, 'What Links Portugal's Deadliest Wildfire to Grenfell Tower? Economics and Neglect', The Conversation, 22 June 2017. https://www.dw.com/en/portugal-struggles-to-get-forest-fires-under-control/a-55039934
83 Paula Pérez. 'Medio Rural Will Temporarily Ban New Eucalyptus Plantations (Medio Rural Prohibirá de Forma Temporal Las Nuevas Plantaciones de Eucalipto)'. Faro de Vigo, 24 February 2021 and RV. 'The Moratorium on Eucalyptus in Galicia Denounced as "a Gross Deception" (Denuncian Que La Moratoria al Eucalipto En Galicia Es "Un Burdo Engaño")'. Faro de Vigo, 12 April 2021.
84 Branislav Hroššo et al., 'Drivers of Spruce Bark Beetle (Ips Typographus) Infestations on Downed Trees after Severe Windthrow', Forests 11, no. 12 (2020): 1–15.

Just transition in forestry

The lack of public consultation and the dominance of industry lobbying in forest management have led to deep social divisions. Opponents of intensive forestry are discredited as misanthropes, and environmental activists are being pushed to become critical of all forms of forestry, leaving forest owners unaware of, or resistant to, arguments for alternative forestry.

It doesn't have to be like this. Rotational forestry's profitability is falling,[85] and the benefits of intensive practices are short-lived, even for the big and powerful. They can still make profits by expanding to new frontiers, shortening rotation cycles and squeezing workers–but not for much longer. The industry needs to adapt to stakeholder needs and environmental limits. Adaptation may include scaling back–at least temporarily–but this won't be at the expense of long-term profitability. Instead of lobbying to maintain the status quo, the forest industry should spend its energy on sustainable innovation and diversification. First and foremost, it should listen and respond to the science and changes in demand. The forestry industry will benefit from making adjustments now rather than later when environmental changes have already taken their toll on forests' resilience and economic potential.

The EU must stand up to industry pressure and incentivise forestry that benefits the economy, the environment and people. Forest-based industries cannot be defined by the short-term interests of logging companies, and pellet and paper producers. To achieve a just economic transition, the EU must ensure all stakeholders are around the table–including forest workers, dwellers, visitors and owners. The aim should be to provide incentives for forest owners to transition towards economically viable forestry that preserves the harvest potential for their children and grandchildren; that considers the safety of forest workers and the rights of forest users; and that creates opportunities for alternative forestry and non-timber entrepreneurship. Ultimately, a just transition in forestry must respect the rights of forests themselves–their right to persist, flourish and regenerate.

To be introduced to some of the practitioners who are already conducting close-to-nature forestry, read our *EU Forests of Hope report*.

85 *Eliasson, 'Forestry Costs and Revenues 2019 (Skogsbrukets Kostnader Och Intäkter 2019)'.*

“It is striking how Scandinavian countries simultaneously brag about their rich Indigenous culture and then go on to actively destroy it.”

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"We need to combine various strategies along the continuum between clear-cutting and total land abandonment."