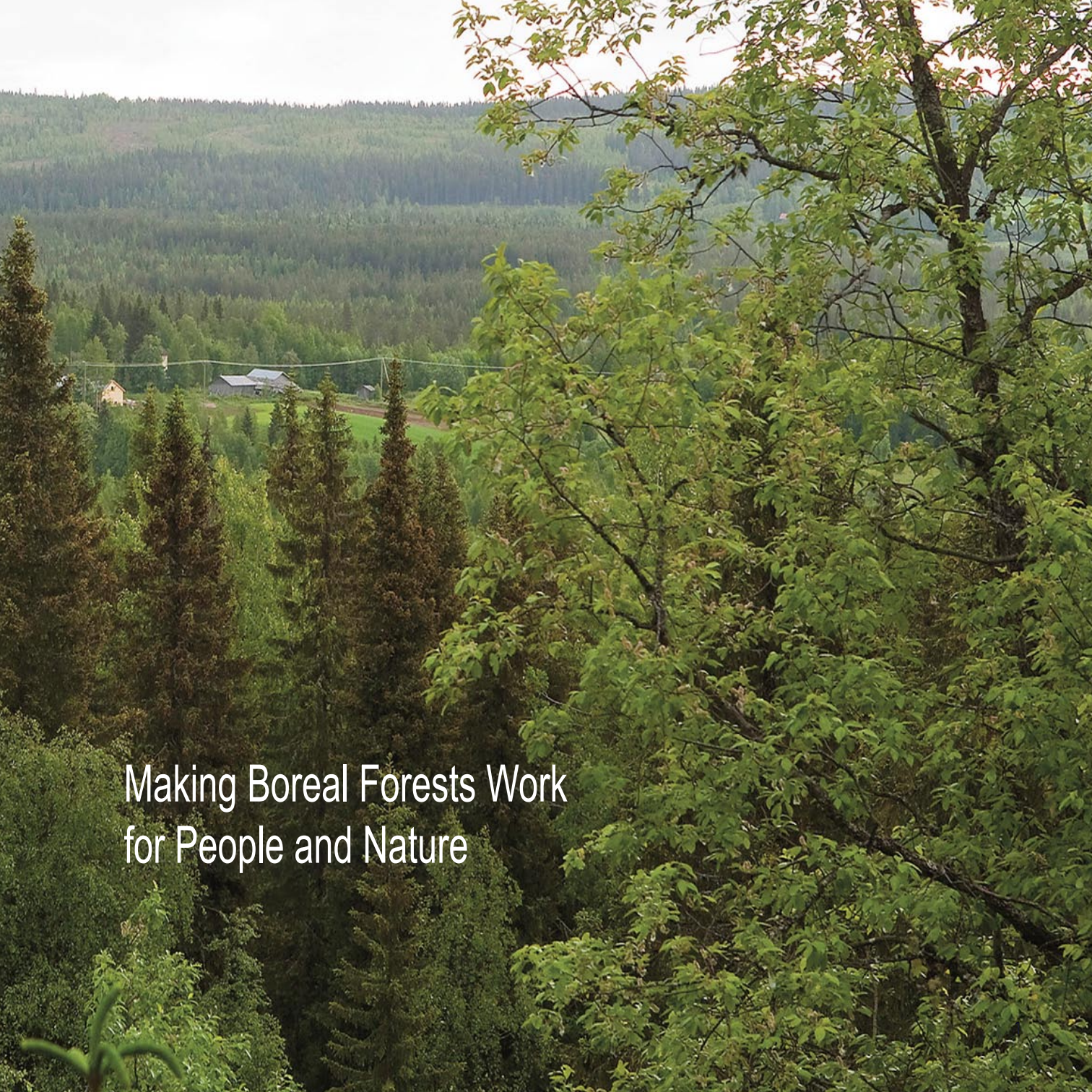

Making Boreal Forests Work for People and Nature

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Key messages

- The forestry sector in boreal forest regions has been drastically affected by multiple meta-drivers. Consequently, there is a strong need to shift focus and support towards renewal and diversification through green economy and forest-related services. This could result in forest-based sector that would be a thriving combination of new and traditional activities in the future.

- It is apparent that services related to wood and non-wood forest products, as well as the many other forest ecosystem services such as climate change mitigation, water provisioning and for recreational and cultural values will play an ever-growing role in the economies and well-being of the boreal region.

- Cross-sectoral policies, coordinated strategies and collaboration among various economic sectors are necessary to secure these services to meet the future demands and to develop practices to support forests in providing economic diversity.

- Closer collaboration among boreal countries, among governments, stakeholders and international organizations, is needed to support the transformation of the forest sector and to enhance adaptation of the boreal forests to future uncertainties.

Tuomo Wallenius

Chapter I – Forests: the backbone of the boreal region

The boreal forests, mainly dominated by conifer species, extend in a band from the Russian Far East across Siberia and Scandinavia to Northern Canada and Alaska, covering an estimated 1.7 billion hectares and over one-quarter of the world's forested area. Boreal region countries, although diverse in history, political systems and forest administration, ownership and management, have all built their economies and cultures on the exploitation of various forest resources to a significant degree.

These forests constitute approximately 45% of the world's stock of growing timber. Today, their growth and yield is larger than ever before. Throughout the region, the net annual increment of timber production is higher than that of annual wood harvesting. This timber is a much-valued global commodity: about one-quarter of global exports of forest industry products derives from boreal forests.

Currently, the share of the forest sector in the Gross Domestic Product (GDP) of each boreal nation has decreased − being now approximately 1% in Russia, 2% in Canada and Sweden and 4% in Finland. Even with this small share in the national accounts, the boreal forests will continue to provide renewable wood and non-wood products and ecosystem services, such as carbon sequestration and storage in forest soils, climate mitigation, various cultural services and sustaining biodiversity, the latter only rarely accounted in GDP.

The fundamental role of the boreal forests is highlighted by growing public awareness of their landscape and recreational values − often based on wilderness attributes and conservation of biodiversity. However, social expectations and valuations of the world's boreal forests differ and are often contradictory as the perception of forests as a resource for industrial use and economic development remains strong.

The remoteness and vast extent of the boreal forests present significant opportunities for maintaining their natural state and ecosystem services. Boreal regions nurture some of the world's last wild rivers and wilderness landscapes and are characterized by large areas of lakes and wetlands with more surface freshwater than any other biome.

Across the boreal zone the intensity of forestry activities varies greatly. It ranges from timber logging with little consideration for forest regeneration, through extensive management with simple silvicultural approaches, to very intensive management with frequent management interventions. Most managed areas are used for multiple purposes.

As national and international policies and public attitude now place increasing emphasis on green economy and biodiversity conservation, boreal forests deserve more attention and comprehensive investigation as a source of various renewable resources and as protection zones.

Historically, all forests in European Nordic countries were exploited for different purposes, leaving scant stocks, but significant portions of old-growth forests remain in other areas of the boreal zone. These forests serve as a critical natural reserve for both biodiversity and carbon storage, but only a fraction is legally protected from logging, mining, urbanization and other development.

The forestry sector in each of the sub-regions within the boreal zone faces both similar and different challenges. Yet future uncertainties arising from changing global markets, political interests and climate change are the shared major challenges.

Significant practical implications for forestry and concomitant policies arise from the strikingly different ownership characteristics of the boreal forests: from mostly public (regional, provincial and federal) ownership of forests in Russia, Alaska and Canada to mainly private (industrial or non-industrial) ownerships in the Nordic countries.

For Canada and the Nordic countries, the main challenge for the forestry sector is maintaining their global competitiveness and profitability with investments outside of the region while balancing with production costs and environmental objectives in the boreal region.

In Alaska the future of timber harvesting on federal lands is uncertain as the conflict between environmental protection and economic development interests continues to shape the forestry thrust.

Russia, on the other hand, is still coping with problems of an ageing forest industry, the low value of marketed roundwood and under-regulated timber harvesting coupled with social problems and lack of coordination between federal and regional authorities. The transition process is ongoing and Russia aims to double its wood production over the next 20 years. There are great concerns about the vulnerability of the boreal forest ecosystem to climate change, as the bulk of productive Russian forest is in permafrost areas.

Tuomo Wallenius

Figure 1. Wide swathes of the boreal forests are inaccessible and beyond commercial use now or in the foreseeable future. According to ECE Timber Committee statistics, areas beyond feasible economic logging and transportation in the context of current technology capacity and prices comprise 19% of closed-canopy forests in Canada, 14% in Norway, 9% in Sweden, 2% in Finland and 32% in Russia. Most Alaskan forests in the boreal zone are excluded from timber production.

Exports as % of production volume in boreal forest of	sawnwood	wood-based panels	paper and paperboard	wood pulp
Canada	67	81	79	44
Finland	61	80	91	19
Norway	22	45	87	26
Russia	59	28	40	27
Sweden	67	27	88	20
Boreal % of global production	16	8	10	16
Boreal % of global exports	33	16	26	21

Source: modified from Burton et al. 2010 (data around 2007)

Table 1. Annual industrial roundwood harvest from the boreal forests is about 17% of the global harvest. All boreal countries are strongly dependent on trading of forest products. Canada exports most of its wood products to the USA, while Sweden, Finland and China rely on Russia for industrial roundwood supply in varying extents.

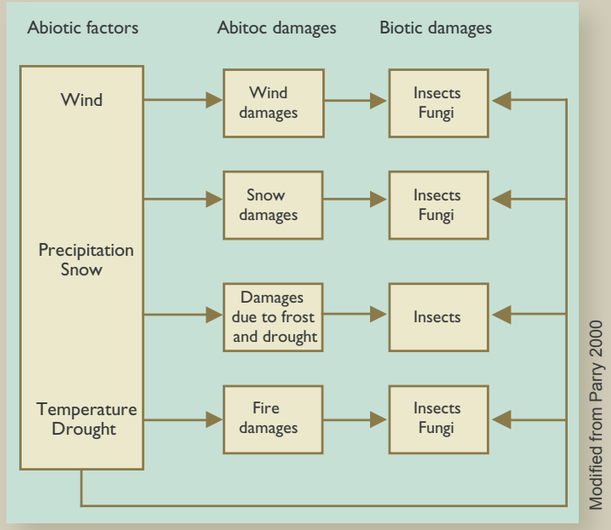


Figure 2. Although boreal forest ecosystems have lower aboveground species diversity than most other biomes, they are intrinsically resilient to natural disturbances that have shaped these forests for millennia. However, many boreal ecosystems are sensitive to climate change, which is likely to increase the risks of abiotic (especially fire, but also wind, snow, frost) and biotic (insects and pests) disturbances and mortality of trees.

Further threats to boreal forests and their biodiversity stem from habitat destruction and continued forest area fragmentation by anthropogenic processes. For example, it has been estimated that about one-fifth of Canada's frontier forests are directly threatened by hydropower development, oil and gas exploration, mining, peat extraction and urban development.

Poor forest governance threatens the quality of forests through inadequate and sub-standard management and planning. Illegal logging and corruption are some reflections of this poor governance, distorting timber markets and reducing public income. For example in northwestern Russia in the early 2000's, the financial loss to Russian authorities and legal logging and transport operators was estimated to be in the range of US$200−270 million as result of lower market prices.

Chapter II – Global trends impacting on boreal forests

Global and regional agreements and policies aimed at global climate change mitigation, biodiversity protection and open trade are increasingly affecting national policies, legislation and forestry sector development in the boreal zone. For example, all countries in the boreal zone are involved in negotiations concerning the Legally Binding Forest Agreement (LBA), where a focus has also emerged at the pan-European level; all are now members of the World Trade Organization (WTO).

Conventional forest product markets have been impacted by globalization and increased plantation forestry, by structural changes in the global demand for traditional forest industry products together with technological changes and ICT developments. Rapid economic growth in Asia is leading to major shifts in global economics and political powers.

Most of pulp and paper production and consumption is growing outside the boreal region and the region is experiencing grave capacity cuts. However, even with the saturated communication paper markets in Western Europe and North America, the boreal forests will remain an important source of many conventional forest products. For example, there is major potential in expanding the solid wood products industry and the new fibre-based products sector in the boreal region.

Climate change and associated elevated atmospheric CO_2 concentrations, rising temperatures and longer growing seasons is expected to increase the global growing stock of timber over the this century. Thus, the global timber harvest could be 6% greater in 2050 than it might have been without warming effects.

However, with exacerbated insect attacks, fires, strong winds and prolonged droughts, future projections of boreal wood supply are highly uncertain and are likely to vary considerably from one region to another.

The boreal region contains more than 35% of the global terrestrial carbon stocks. With proper management the boreal forests can play an important role in mitigating climate change through increased carbon storage. Carbon can be stored in wooden products and wood can also replace material with high embodied energy, such as steel or concrete, in order to reduce global emissions. In addition, wood can replace non-renewable fossil energy sources directly through combustion for energy.

Alternative uses of timber and wood result in substantially different production processes as well as different carbon impacts over product life cycles. Methodologies for quantifying substitution benefits and for accounting for the time-value of carbon − both physical and economic − are still evolving.

Long-term carbon storage in wood-based products, combined with novel forest management that promotes carbon sequestration in forests, is often seen as the most effective way for the forestry sector to contribute to climate change mitigation.

One driver of global change is the burgeoning global population, their sheer numbers and essentially, their behaviour. Consumption patterns and social and political behaviour are critical factors for the future of boreal forests.

Rapid urbanization and increasingly sophisticated communication technology have resulted in fundamental changes in perceptions, attitudes and

Erkki Oksanen

Figure 3. The quality of construction timber from boreal forests is very competitive. However, future demand is mostly dependent upon consumer preferences and building legislation. Plantation forestry in Asia, Latin America and Oceania is focused primarily on pulp wood, releasing some of the market for boreal solid wood.

expectations of forests, sometimes causing local contradictions or conflicts. Forests are increasingly used to symbolize ever-diminishing pristine natural state, so forests are being valued more highly for their non-timber attributes such as scenery, recreation and conservation.

New interests in and uses of boreal forests generate acceptance issues by society of forest use and management. Calls for the social responsibility of all forest users, including forest industries, are likely to rise. With increasing global population pressures and ambivalent social attitudes, conflicts over forest use and land in the boreal region may reach the levels experienced in Latin America, for example.

The global trends are at different stages within boreal region. With high trade dependence, none of the boreal countries can leave these possibly interacting trends unattended.

The uncertainties related to economic, social and political development and power relations will continue in the boreal forest products markets and industry, joined with potential impacts on forests by climate change. It is becoming more difficult and less profitable to continue business as usual.

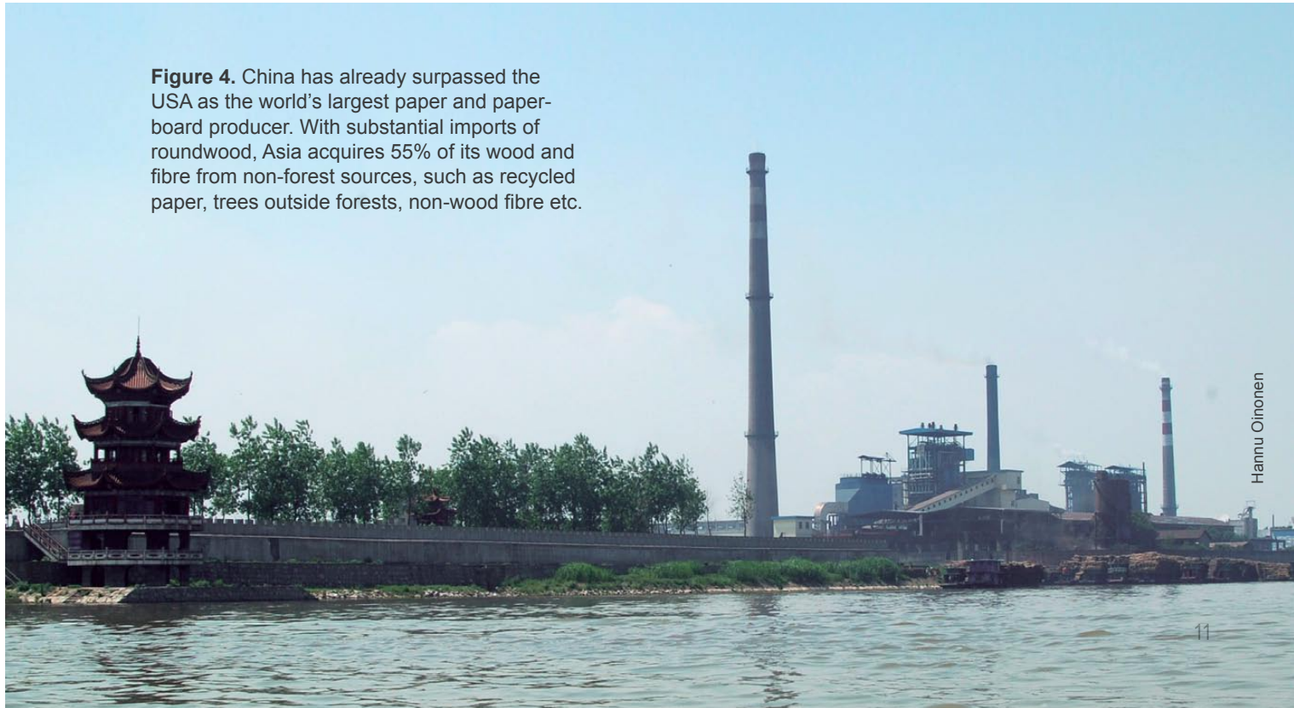
New interests and new players, such as energy companies, recreational and tourism activities, carbon-trading brokers and water-exporting companies will enter the forests; old divisions may subside while new ones emerge. Flexibility to allow for necessary adjustments during development, and first of all, innovative approaches to collaboration are needed. Some of the traditional structures may require remodeling.

The future of the boreal forests will depend on the development of a multi-cluster strategy that includes currently competing industries and new ones that will develop based on new products and forest ecosystem services.

There will be a few larger and many small- and medium-sized operators receiving inputs from the forest. Their success − and hence the future of boreal forests − will depend on the sustainable management of the resource under increasingly uncertain conditions and on the development of novel multi-sectoral policies.

Indeed, the traditional meaning of "forest sector", including that of the wood-processing industry and related forestry activities, is changing. For example, the energy industry is becoming ever more involved with woody biomass derived from forests. On the other hand, the traditional forest industry is partly moving towards renewable energy supply, such as biofuel production. We may even need a new term for the evolving sector of economy based on forests – a name that better reflects this changing pattern.

Figure 4. China has already surpassed the USA as the world's largest paper and paperboard producer. With substantial imports of roundwood, Asia acquires 55% of its wood and fibre from non-forest sources, such as recycled paper, trees outside forests, non-wood fibre etc.



Hannu Ilnonen

Box 1. Scenarios as inspiration for discussion about possible futures of forests in Sweden

One way of approaching the new demands and large-scale challenges and trends in the forestry sector and the potential conflicts between opposing goals, is through scenario analyses. The Future Forests scenarios were developed as qualitative narratives of possible futures. The scenario team consisted of 21 researchers from different disciplines, ranging from natural sciences to social sciences and the humanities. In addition, 15 stakeholders from private and public forest companies, government agencies and NGOs (conservation and reindeer husbandry) were involved in step 1.

Step 1. Extracting external trends and drivers

The process was started by identifying external trends and drivers that the Swedish forestry sector cannot influence itself. Any internal structural changes, such as the relative proportion of different forest products, were seen as a response to these external drivers. Two brainstorming workshops, one with the research team as an expert panel, and one with our group of stakeholders, produced 81 different suggestions on possible trends and drivers, later aggregated into 11 themes by the research team: *climate change, climate change politics, alternative land use, demography and migration patterns, energy and bioenergy, environmental disasters, markets for forest products, geopolitics, forest governance, scientific and technological developments and attitudes and values*. These themes were analysed and developed through literature reviews by the research team.

Step 2. Identifying critical uncertainties

These reviews constituted the empirical basis for the scenarios. Next, critical uncertainties were identified in a workshop with the research team in an iterative process where smaller groups produced suggestions that were discussed in the full team until consensus was reached. This step is by definition a very subjective step, where the uncertainties chosen reflect the interest of a particular group of people at a particular period in time. Our research team agreed on the following two uncertainties, which by themselves are aggregates of several drivers: 1) the role that strong political institutions could have in achieving transnational agreements on forest use, and 2) the role that renewable energy, and bioenergy in particular, could have in society. These two uncertainties constructed our scenario cross (Fig. 5)

Step 3. Constructing scenario narratives

These two uncertainties defined four different possible futures (Fig. 5): the *Balancing Act*, the *Carbon Sink*, the *Carbon Substitution* and the *Free-for-all*. These futures were fleshed out in several ways. First, we extracted relevant information from our literature reviews in step 1. Second, we used the research team as an expert group to comment on, add or change the information to better suit the different futures. Finally, we disaggregated the information into bullet points, and also constructed a fictional letter from the future for each scenario.

Together, the bullet points and the fictional letter serve as a basis for discussions

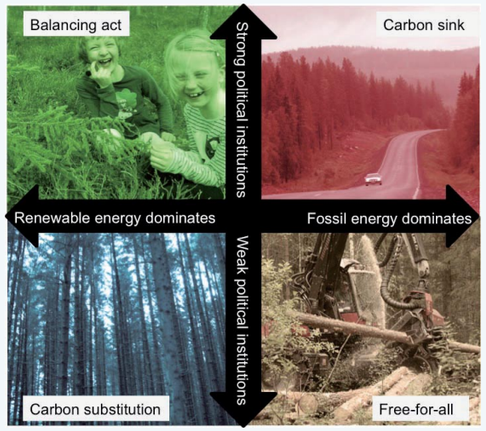


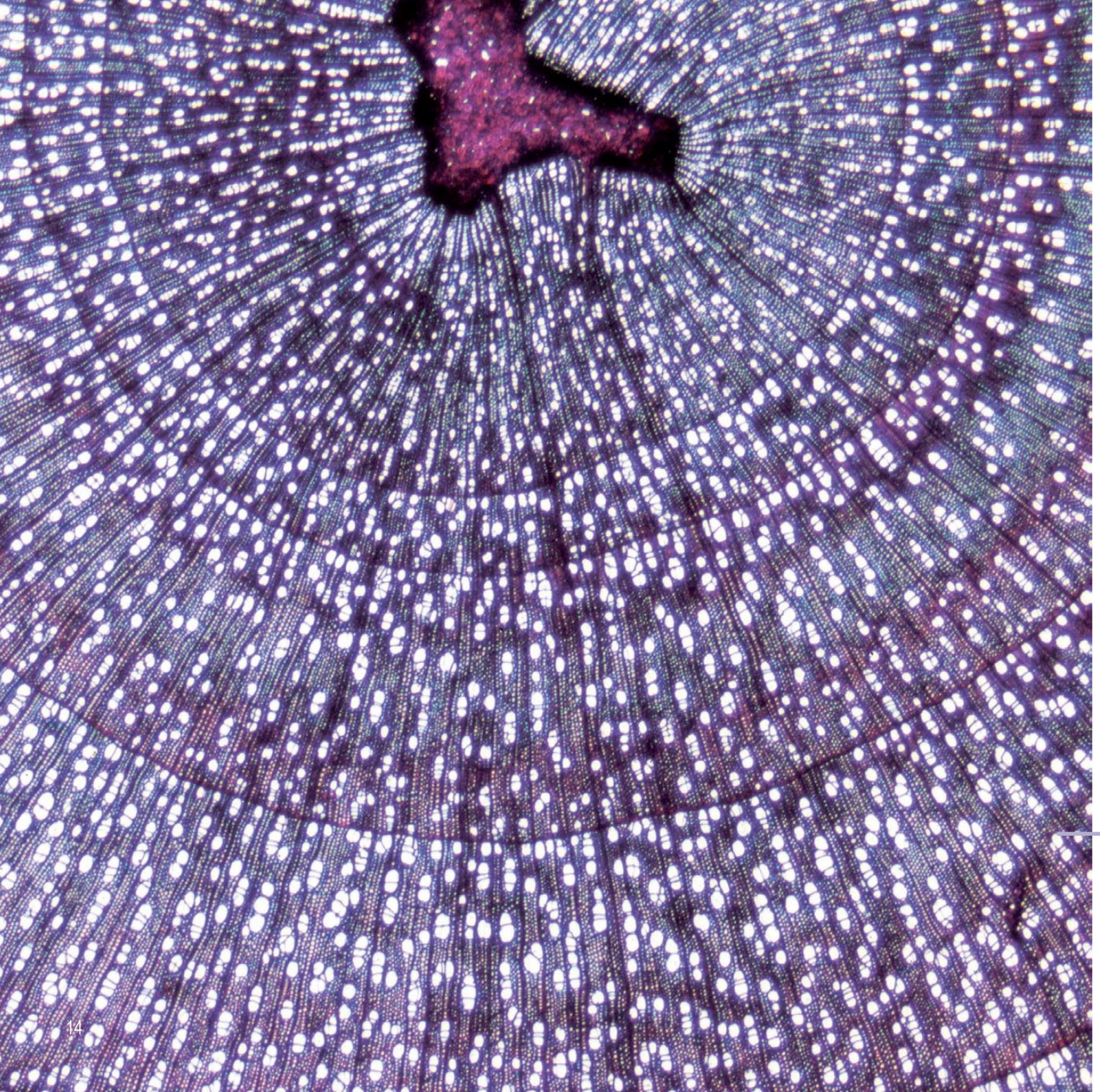
Figure 5.

The Balancing Act describes a stable world with a strong global economy and strong political institutions (such as the United Nations and European Union) that can achieve international agreements on forest use. Breakthrough innovations have led to reduced energy consumption, and renewable sources of energy are important together with nuclear power. The high demand for bioenergy has resulted in significant land conflicts. Rural development in Sweden is good thanks to more job opportunities in the forests. A strong demand for forest products has led to intensive forestry with short rotation periods. As a result of political decisions, efforts are being made to also take into account other considerations in the forests, leading to a mosaic landscape where intensively-cultivated forests are interspersed with protected areas, leading to positive effects on biodiversity.

The Carbon Sink describes a less stable world with a weak global economy. Strong political institutions have some influence, however, and have agreed on mitigating climate change through carbon sequestration. No major innovations have taken place in the energy sector, and fossil fuels dominate. Rural development in Sweden is weak. There is a relatively weak demand for forest products, and forest management focuses on carbon storage. Forests are not managed intensively, but in many cases as closed-canopy forests with long rotation periods. Biodiversity is doing well and the risk of infestations by pests and diseases is relatively low. However, the risk from storm damage has increased.

The Carbon Substitution scenario describes a world with growing tensions between states, and weak political institutions. However, the economy is fairly strong because the green economy has made a breakthrough in step with new innovations focusing on renewable energy and reduced energy consumption. A strong demand for bioenergy has resulted in severe land conflicts. Rural development in Sweden is good. Demand for forest products is strong, with a focus on bioenergy and biomaterials to replace fossil energy sources and materials. Forestry is intensive with short rotation periods. Market-driven certification schemes have resulted in voluntary reserved forests, and these are the only areas where any form of old-growth forests remains. Landowners' rights have been strengthened and the right of public access is weakened. Biodiversity is not developing well, and the risk of pests and diseases has increased.

The Free-for-all scenario describes a highly regionalized world with a high risk of conflicts (such as trade blockades and currency wars). There are weak political institutions and a weak global economy. There have been no major innovations in the energy sector, and nuclear power and coal are the dominant sources of energy. There are serious land conflicts due to a strong demand for traditional forest products for the local market in northwestern Europe. Rural development in Sweden is good in regions with an active forest industry. A high demand for timber and pulpwood creates intensive forestry with short rotation periods. Biodiversity shows very poor development.



Pekka Saranpää

Chapter III – New opportunities in the green economy era – Wealth from forest-based energy?

Boreal forest resources can increase the welfare of societies and well-being of people and nature only when they are combined with appropriate human capital and knowledge. The green economy concept brings together sustainability issues into a comprehensive framework, including resources, skills, people and the environment.

New technologies and innovations are needed for more efficient and diverse use of wood and for biomass-based products, such as for example fibre packages, biodiesel, composites, biopolymers, pharmaceuticals and cosmetic products.

An enabling business environment is essential to put these innovations into practice. Growth strategies need to be flexible enough to take advantage of the unexpected opportunities, and to be able to abandon an approach if a better one becomes available.

Green markets can expand through raised consumer awareness and increased willingness-to-pay for green products and services. Consumers' awareness is beneficial, but awareness is needed at all levels for efficient use of material and in ensuring a level playing field in the markets between different products and/or regions.

Boreal forests can continue to be used for paper and pulp production and for diverse wood products.

At the same time these forests can provide income and employment in forest-based services, when supported by judicious policies and wise forestry practices. Non-wood uses of forests, such as for recreation, health, wildlife, protection of groundwater, landscape and cultural values, are more important than wood in some parts of the boreal region, and their importance will continue to grow.

Forest-based energy is a lucrative and potentially big business activity both for the private and public sectors and for forest owners, with a few major players, many being outside the forestry sector.

Figure 6. The new wood energy processes and products will be based on sophisticated technology that does not exist today on a commercial scale. The biorefinery concept offers some of the most promising emerging options for the transformation of the forest industry.

Box 2. Most bioenergy investments would not be undertaken without some form of government support

The share of fossil fuels in global primary energy consumption is currently at 81%, with an anticipated slight decrease in the dominance of fossil fuels to 75% in 2035. The growth of all renewable energy sources is underpinned by policy measures, particularly subsidies − globally US$64 billion in 2010. However this is much lower than the subsidies for fossil fuels of US$409 billion in 2010. The growth in global subsidies for renewables is expected to rise to US$250 billion in 2035.

There is an urgent need to define the objectives and strategy for the future energy agenda before decisions are made on the policy instruments. In forests this includes valuing the necessary trade-offs among long-term site fertility maintenance and biodiversity protection, carbon emission mitigation and energy security and independence.

In Northern Europe the use of forest-based energy has almost tripled over the last decade. The main feedstock has been side products from sawmills and the logging residues such as branches and tree tops, which are currently gathered from around one-third of the area that is clear cut each year in Northern Europe. In USA and Canada the current low cost of fossil fuels is a barrier to investments in woody biofuel production capacity.

Forests as a source of biomass for energy may allow a win-win situation when wood products and biofuels are jointly produced from the same forest-land. Yet, if decreased clear-cuts or lower sawmilling activities due to environmental or market considerations, less wood-processing by-products and logging residues will be available. Also, a much closer look is warranted, including a critical assessment of high-value products, such as biochemicals.

With the existing technology and wood procurement logistics, the cost of transport often restricts the use of boreal woody biomass to local use only. At the same time there are increasing numbers of players competing for wood fibre, with varying ability to pay for it. There will be competition from other renewable sources as well; the unit costs of many sources of renewable energy, such as wind and solar power, are coming down as is typical in many emerging industries.

There is good biological production potential for woody biomass for energy use, but it needs to be set within the abiotic and biotic limits of the boreal forest ecosystem. When logging residues are used as feedstock for energy, more research and new standards are needed on the impacts of biomass removal on future tree growth, forest productivity, the nutrient cycle, biodiversity and carbon balance during the full cycle of management, wood processing and transport in order to guarantee the sustainability of the operations.

For the next few decades the fastest growth in use of boreal wood may well be for energy, possibly replacing some of the diminished demand for pulpwood, but not endangering the possible expansion of wood products industries.

Under all optional futures, the boreal forests need to be managed and used with due consideration to energy needs; sufficient flexibility is warranted to grasp other uses when the problem of energy supply is solved by new technologies and innovations.

Erkki Oksanen

Figure 7. In Northern Europe the use of forest-based energy has almost tripled over the last decade. Main feedstock has been side products from sawmills and the logging residues such as branches and tree tops, which are currently gathered from around one-third of the area that is clear-cut each year in Northern Europe. In USA and Canada the current low cost of fossil fuels is a barrier to investments in woody biofuel production capacity.

Box 3. Bioenergy development in Russia calls for new technology and expertise

Boreal forests in Russia have large wood energy resources in the form of non-industrial roundwood, logging residues, stumps and roots, small trees and by-products from solid wood processing. However, there are large differences in the potentials to supply wood energy among the boreal regions in Russia due to differences in forest resources and their utilization, as well as the availability of infrastructure and limitations on logging, such as bans and other restrictions on cutting in old-growth forests.

Locally available infrastructure may allow increased use of wood for energy through reconstruction and modernization of the – often aged − residential district heating systems. Support is strong from the regional and federal authorities who expect forest energy to provide many benefits, such as employment and income in the energy supply chain. There are regional energy programmes, for example in the Karelia, Arkhangelsk, Novgorod and Leningrad regions that aim to increase the utilization of local renewable energy sources. In most cases this would be woody biomass.

The development of technology for the supply and utilization of wood for energy production in Russia would thus provide new markets for technology and expertise. The conversion of boilers currently using oil and coal, to biomass from wood, would also reduce the region's net greenhouse gas emissions. The current policy of subsidizing prices for oil, coal, and natural gas may change, and would make energy wood more competitive.

Chapter IV – Welfare and human well-being from forests

Even if most of the boreal population is concentrated in cities and towns, forests are still a very important part of landscapes and lifestyles with strong cultural and spiritual meaning and values. Urban forests and natural forests within reach of the major population centres are being used to combine recreational, health, environmental and productive functions in the integrated and changing land-use mosaic.

Jobs and work should distribute prosperity to all members of an equitable society. In an evolving post-industrial society many jobs are disappearing from industrial sectors and an increasing share of those employed is found in the services sector, in both private and public businesses and diverse services. With new investments generally directed outside of the boreal region and with increased labour productivity in the remaining units, fewer jobs remain in "old" forest industries within the boreal zone.

New, perhaps more intense forestry activities in some locations and possibly increased use of wood − for energy − and non-wood forest products (NWFPs) could provide more jobs, if and when the opportunities for the new openings are fully seized.

Potential new markets are arising in forest-based services, in health, in various activities related to recreation and tourism, in nature and landscape services, in maintenance and in value trading − maybe in carbon trade.

Many new jobs in services sectors are associated with low labour productivity and low pay. New skills are needed in forest-related research, consulting and educational services, and in developing incentives for producing and maintaining the many non-wood products and services of the forests.

Nature tourism is the fastest growing sector in the thriving global tourism industry and the boreal forests are increasingly being seen as an exotic destination, possibly furnished with local cultures, both for local and foreign visitors. However, success in promoting this activity often depends not on what the forests have to offer but on entrepreneurial skills and an enabling business environment.

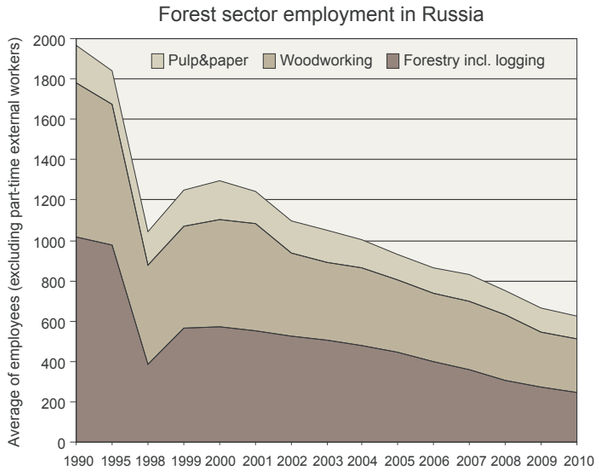


Figure 8. Today forest sector employment has radically decreased in most of the boreal region, and more specifically, in the forest industry. In Canada and Finland, one-third reduction was experienced in direct forestry sector employment between 2000 and 2010, and over 50% in Russia during the same period. However, at least in British Columbia, Canada, employment in forestry is projected to continue more or less at the present level in the near future mainly due to needs in maintenance and landscape services, also included under "forestry" together with logging, hauling and silviculture.

Box 4. The roles of forest berries and mushrooms in providing income, food and recreation in the Nordic countries

Multiple forest use is reflected in the Nordic common rights of access for picking berries and mushrooms and other NWFPs, even from private forests. This free access, facilitated further by the dense network of forest roads, makes berry and mushroom picking an essential part of the way of life Nordic countries.

According to an extensive national field inventory, Swedish forests produced 255 million kilograms of bilberries (*Vaccinum myrtillus*) and 155 million kilograms of lingonberries (*V. vitis-idaea*) in 1975 to 1977. As estimated in Finland, only 5–6% of the annual bilberry resources and 8–10% of lingonberries are collected.

Opportunities in the sale and processing of NWFPs to provide additional income vary widely between products, regions and seasons. Earlier interventions to promote NWFP utilization have included training in identification, picking, processing and marketing of natural products. For example, since the early 1970s in Finland 55,000 commercial mushroom pickers have been trained. A recent boom in increased commercial picking of ceps (Boletus edulis) has, however, been more driven by the higher picker prices caused by an effective purchase organization, largely created by a company belonging to an Italian immigrant.

Sales tax and income tax exemptions on selling berries and mushrooms picked by an individual continue to be key incentives for commercial picking.

Approximately one-third of berries and some one-tenth of mushrooms picked in the Nordic countries enter the market for sale. Lately engagement in picking berries for sale has decreased, due to urbanization and aging of rural people as well as low berry prices. That is why in the Nordic countries, commercial berry picking has during the past decade relied largely on migrant pickers, first from neighbouring countries but nowadays largely from Thailand. For example in Sweden foreign pickers have picked some 95% of forest berries entering the market. As a consequence, in the last few years conflicts have arisen in picking areas with local people who consider certain areas as their traditional land right. There is high public sensitivity to any changes in traditional, possibly unwritten or even official usufruct, tenure and ownership rights.

Any successful policy towards enhancing the supply of multifaceted NWFPs calls for a better clarification of rights and duties of organized foreign pickers, and coordinating spatially their picking activities. Also innovations to better organize the participation of urban people in commercial picking are needed; hopefully in future better picking prices of common but currently underutilized crops of wild berries and mushrooms will serve as further encouragement.

Erkki Oksanen

Figure 9. Many forest-based industrial products in the future may be highly capital-intensive and their development, research and marketing require advanced skills and training and less wood. Wood harvesting operations will become even more demanding due to advanced technology and possibly with integrated harvesting for forest-based energy. In other rural forestry activities, labour productivity, even with mechanization of some operations, such as planting, will remain low. For rural development, new professional, skilled jobs are badly needed, with higher pay as opposed to generally low-paid jobs in many services. As to the future, this urban-rural divide may slowly get more blurred with commuting and telework in knowledge professions enabling increasing residence in rural areas.

Box 5. Building up markets for recreational or scenic value trading

In the Nordic countries, based on the common rights of access to nature, all citizens have equal rights to relax and enjoy nature in undeveloped areas whether or not they are owners of the area. Consequently, private landowners usually have no incentive to provide recreational facilities or to take recreational needs and scenic values into account in forest management decisions. As a result, a scheme for creating new markets for recreation benefits has been developed in the EU-project "NEWFOREX".

In this scheme, in a jointly agreed compensation or payment, the landowner gives up rights of use to his/her property, and grants certain recreational use rights to the buyer, such as for commercial use of tourism, beyond the common rights of access. The contract is made for a fixed period of time, and the payment is freely negotiable.

The main aim is to create new economic incentives by introducing a contractual mechanism to provide improved recreational environments and to maintain or improve scenic quality. Examples include delaying of final felling or avoiding clear cutting; maintaining certain tree species or mixed forest in a specified area; keeping a certain area open; maintaining within-stand visibility and accessibility; opening remote distance views; preserving buffer zones along walking or skiing paths and tracks; and establishing and managing facilities such as campfire sites.

Funds for compensation payments would be collected from tourists as a part of their accommodation payments, from the owners of holiday homes or from local people as taxes on real property.

Practical experiments to prove the viability of the scheme will be the next step.

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Figure 10. The value of biodiversity extends to indirect but essential life-supporting functions, such as nutrient cycling, soil formation, erosion regulation and insect pollination of forest flora or nearby crops. Even if no exact value can be estimated, degradation of biodiversity in the boreal ecosystem could represent enormous social and economic losses.

Chapter V – Maintaining healthy and functional boreal forests

Clear-cutting, often followed by planting, brushing, pre-commercial and commercial thinning, has been the main silvicultural system used in many parts of the boreal forest. The end result has been to greatly increase the productivity of the boreal forests in terms of timber, but at the cost of biodiversity and other ecosystem services.

Systematically conducted over large tracts of Sweden and Finland's boreal forests, this approach has resulted in a simplification of the structure and composition of the forests and thinning of dead woody debris. Similar practices have been used in Canada and more recently in Russia, but with much less efficiency so that the forest has not been as simplified.

Integrating environmental considerations within the mainstream of economic decision-making is at the heart of green economy. Recent studies have shown that there is a link between forest productivity and tree diversity and resilience.

Halting the loss of biodiversity and degradation of ecosystem services requires a re-evaluation of the forestry practices used. Based on the understanding that the extant biodiversity in the virgin boreal forest is the direct consequence of the frequency, intensity and extent of the natural disturbances that have occurred in this biome, various natural disturbance-based approaches have been developed and implemented in boreal forests.

New management approaches are evolving aiming at maintaining as far as possible the diversity of forest structure, the number of species, connectivity and function to facilitate the forest to reorganize itself to better adapt to change at both stand and landscape levels. For example:

At the stand level forest management systems can emulate the long-term retention of structures and organisms following natural wild fire or selection cutting emulating the partial natural mortality of trees in boreal stands.

At the landscape level, the management approach used can reproduce over a certain region the natural proportion of forest stands at different successional stages or possibly divide the landscape into different zones with different but complementary management objectives, such as a conservation zone, an extensive management zone and an intensive management zone.

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Figure 11. Old forests in the boreal zone possess unique characteristics, such as a more varied structure, greater compositional diversity and multiple dynamics not observed in younger even-aged stands. Current forest management practices that use short even-aged rotations do not reproduce the historical age structure, potentially affecting biodiversity.

Natural disturbances such as fire, wind, insects and pests have played, and continue to play, a major role in the boreal forest's development and renewal. Fire is still today an important driver of the natural dynamics of boreal forests in the continental parts of Eurasia and North America. Historical fire cycles for example in Canada range between less than 100 years up to more than 500 years, depending on the ecozone. Due to the longer natural fire intervals, a significant proportion of the Canadian land base is occupied by old-growth forest. This holds true also for large areas in Siberia and the Russian Far-East.

There is an urgent need for novel adaptive forests strategies, which could respond rapidly to risks and uncertainties arising from changes in economies, society and the environment. The strategies would also enable identifying the best market compromises among wood harvesting, biomass capture, ecosystem functions and ecological reserves.

With wise management, the extensive boreal biome can meet multiple demands, such as wood production, maintenance of biodiversity and other ecosystem services, and various social demands. The boreal forests are a vast renewable resource for green economy, where economic prosperity can be juxtaposed by ecological sustainability.

With the recent move in many regions of the boreal forests towards meaningful multi-stakeholder strategies, better emulation of natural disturbances and with new emphasis on maintaining forest complexity and ecological resilience, the boreal forest might be the biome in which forestry is near true sustainability.

Box 6. An integrated approach for maintaining the biological diversity – The case of Finland

The current forestry sector approach in Finland suggests that biodiversity conservation targets can best be reached via the integration of segregated protection areas with “close-to-nature” forest management. The main methods for safeguarding biological diversity in commercial forests are the protection of valuable habitats and biotopes, nature management practices to enhance the biological values of the forest and increasing the amount of decaying wood.

The new forest management policy has brought measurably positive changes to commercial forests. The rate of decline of certain forest species has slowed down, or in some cases even stopped since the 1990s, although it has not been possible to halt the decline in forest species overall. An evaluation of threatened species conducted in 1990, 2000 and 2010 by the IUCN’s Red List Species classification showed that decline had decelerated or stopped for 81 forest species but continued for 108 species. Retention trees and dead wood at felling sites have been particularly important in curbing the declining trends.

The challenges for protection are most pressing in southern Finland due to prolonged human influence on forests, fragmented landscapes with other land uses, forest management practices in the past and forest ownership structure more than 80% of forests in Southern Finland are privately owned. The Forest Biodiversity Programme (METSO), initiated in 2008 and running until 2020, enhances southern Finland’s network of protected areas and safeguards forest biodiversity in privately and state owned forests across the whole country, focusing on southern Finland.

The METSO programme offers an innovative and bottom-up approach where the private forest owners can voluntarily propose biodiversity oriented management practices and temporarily or permanently based protection of the forest biodiversity. If a site is approved as a METSO target, the forest owner will be compensated for the costs of nature management on the site and for loss of income in conservation. The voluntary approach has raised the interest of private forest owners and increased the social acceptability of forest biodiversity conservation.

Tuomo Wallenius

Afterword

The forests of the boreal region have supported the livelihoods and well-being of local people for thousands of years. People have lived in wooden houses, used wood for heating and energy and uncounted other purposes, picked berries and hunted for furs and meat. Industrial forestry has provided work and income and through trade the economic importance of boreal forests now extends well beyond the region. In today's national and international policies and public attitudes there is greater than ever emphasis on nature protection and the promotion of biodiversity, highlighting the non-wood ecosystem values and services provided by the boreal forests. Yet wood products can continue to be an inherent part of the same values and services.

This brief highlights some of the key issues in securing the continued function of the boreal forests to work for people and nature. Future uncertainties certainly increase the demands for their innovative use and sustainable management.

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