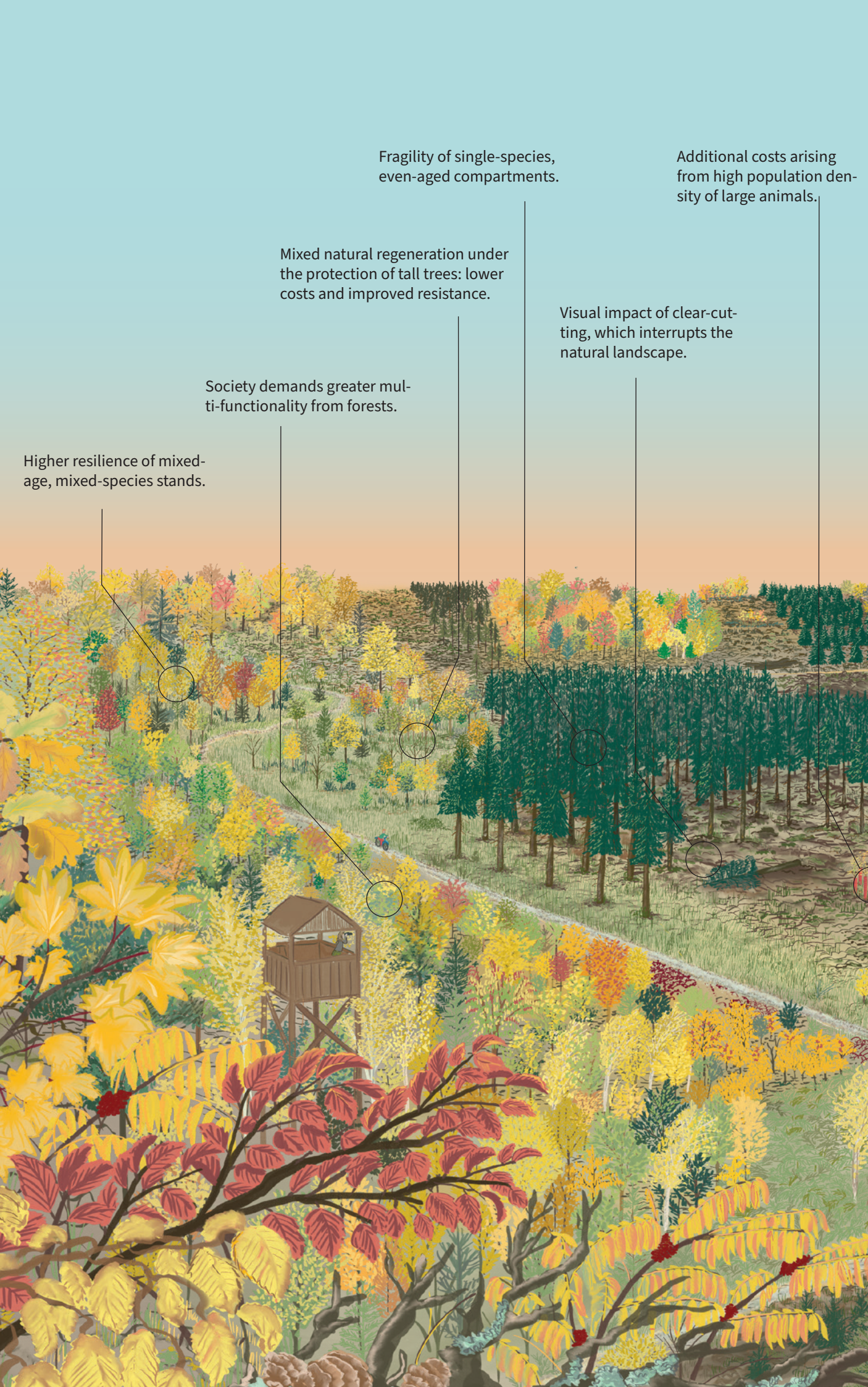
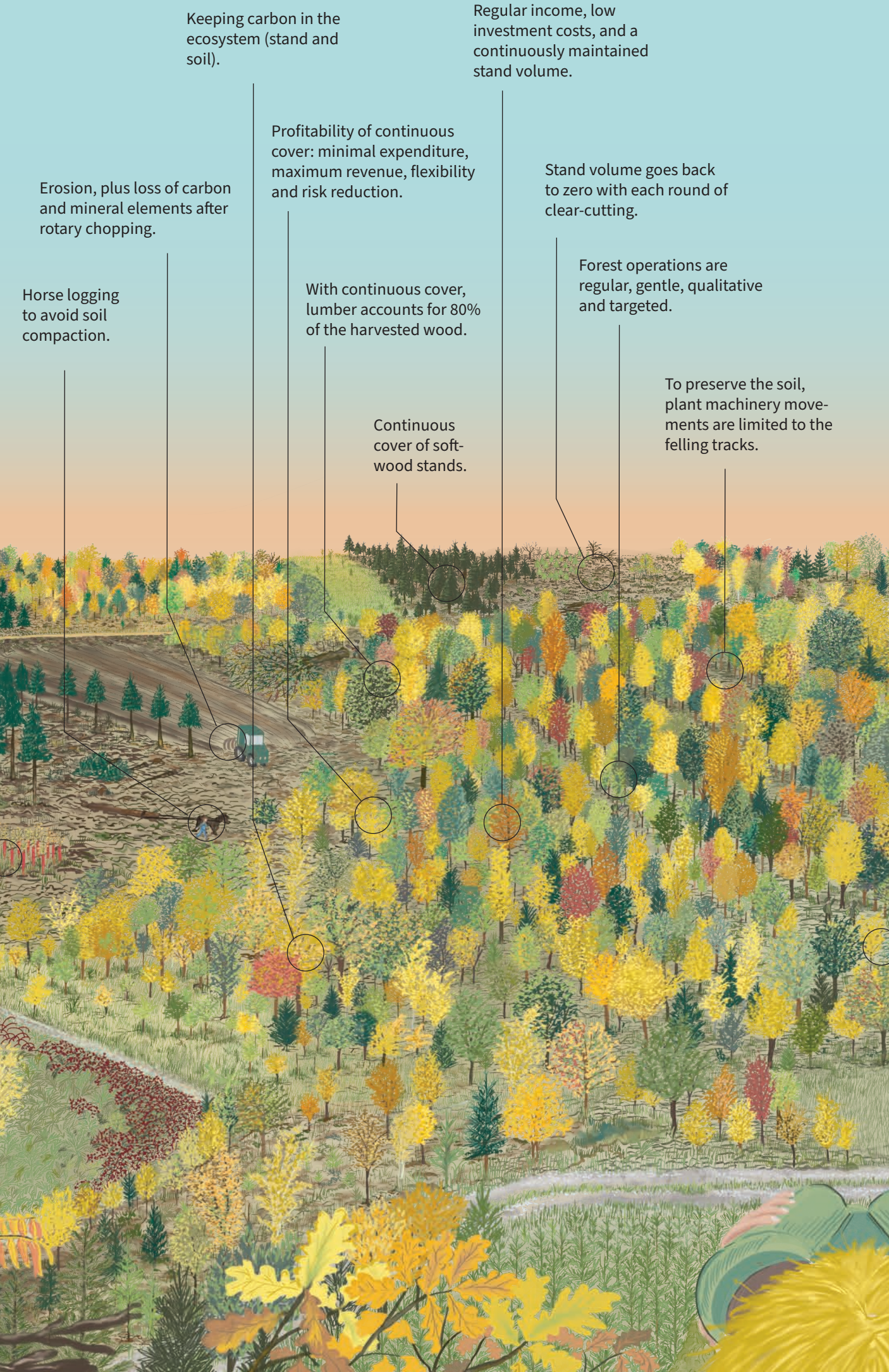
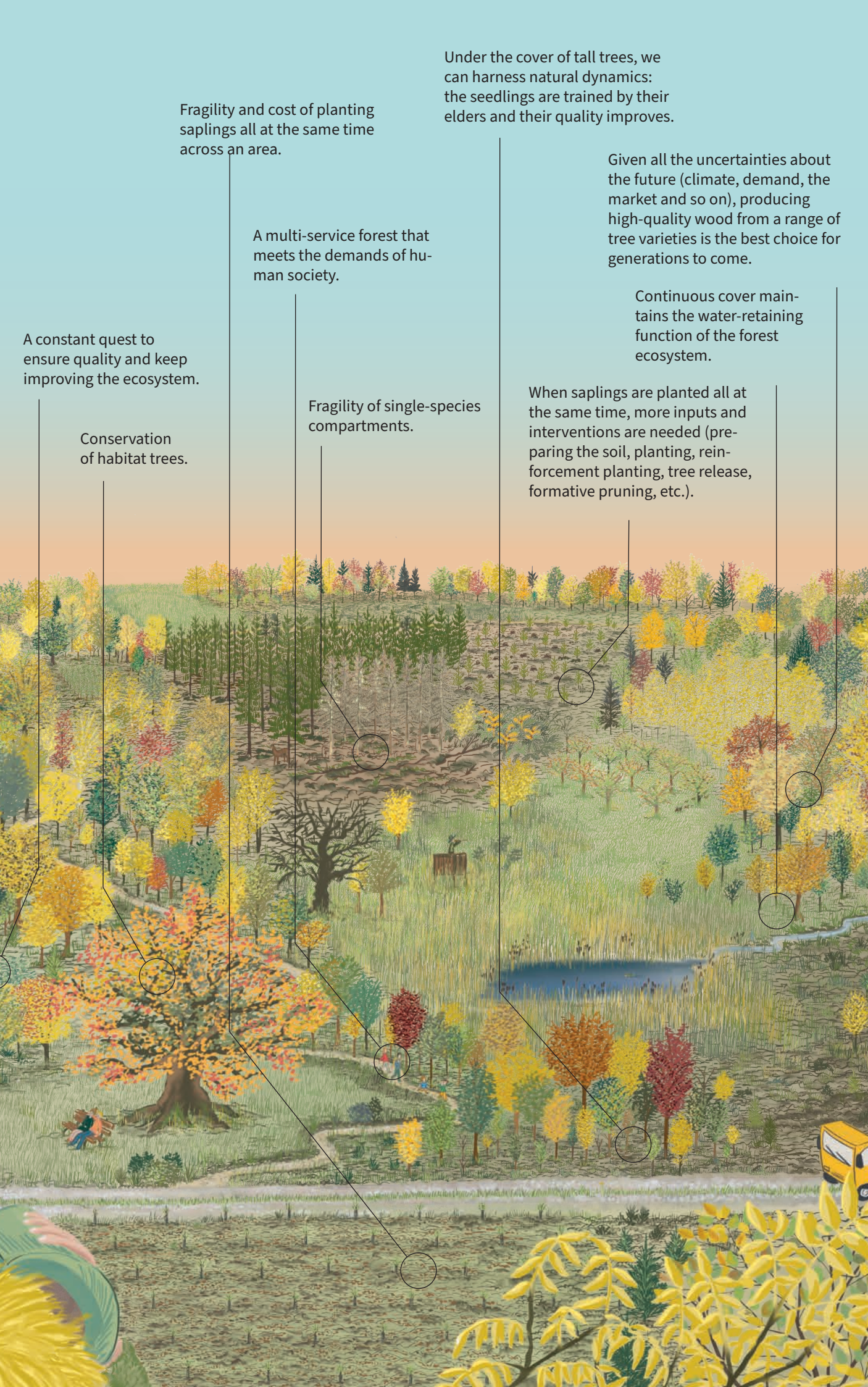
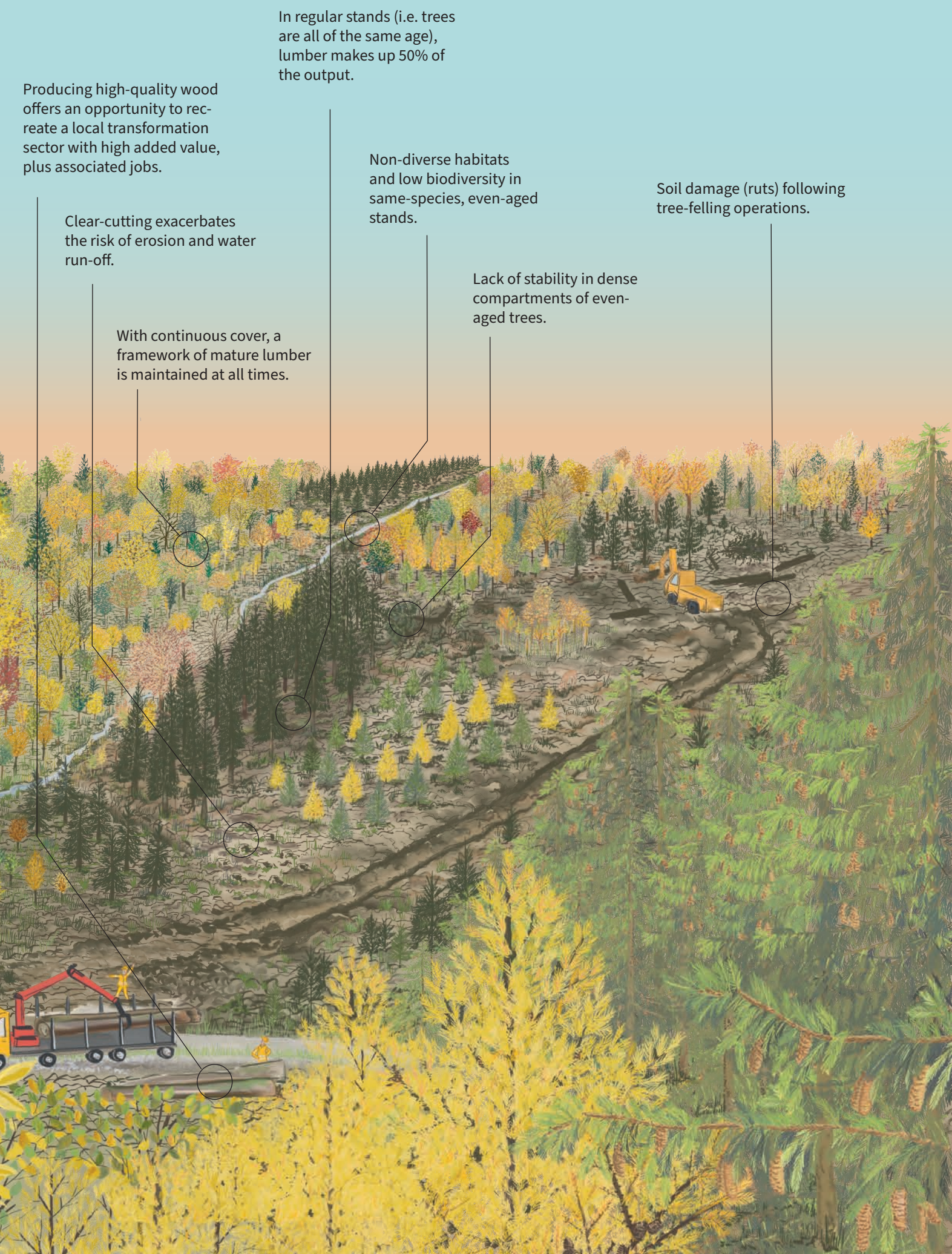
Why get into Continuous Cover Forestry?

For forestry owners


Higher resilience of mixed-age, mixed-species stands.
Society demands greater multi-functionality from forests.
Mixed natural regeneration under the protection of tall trees: lower costs and improved resistance.
Fragility of single-species, even-aged compartments.
Visual impact of clear-cutting, which interrupts the natural landscape.
Additional costs arising from high population density of large animals.


Keeping carbon in the ecosystem (stand and soil).
Regular income, low investment costs, and a continuously maintained stand volume.
Profitability of continuous cover: minimal expenditure, maximum revenue, flexibility and risk reduction.
Erosion, plus loss of carbon and mineral elements after rotary chopping.
Stand volume goes back to zero with each round of clear-cutting.
Forest operations are regular, gentle, qualitative and targeted.
Horse logging to avoid soil compaction.
With continuous cover, lumber accounts for 80% of the harvested wood.
To preserve the soil, plant machinery movements are limited to the felling tracks.
Continuous cover of soft-wood stands.


Under the cover of tall trees, we can harness natural dynamics: the seedlings are trained by their elders and their quality improves.
Fragility and cost of planting saplings all at the same time across an area.
Given all the uncertainties about the future (climate, demand, the market and so on), producing high-quality wood from a range of tree varieties is the best choice for generations to come.
A multi-service forest that meets the demands of human society.
Continuous cover maintains the water-retaining function of the forest ecosystem.
A constant quest to ensure quality and keep improving the ecosystem.
When saplings are planted all at the same time, more inputs and interventions are needed (preparing the soil, planting, reinforcement planting, tree release, formative pruning, etc.).
Fragility of single-species compartments.
Conservation of habitat trees.


In regular stands (i.e. trees are all of the same age), lumber makes up 50% of the output.
Producing high-quality wood offers an opportunity to re-create a local transformation sector with high added value, plus associated jobs.
Non-diverse habitats and low biodiversity in same-species, even-aged stands.
Soil damage (ruts) following tree-felling operations.
Clear-cutting exacerbates the risk of erosion and water run-off.
Lack of stability in dense compartments of even-aged trees.
With continuous cover, a framework of mature lumber is maintained at all times.

Preface

For more than a century, all over Europe, enthusiastic public and private forestry managers have been implementing Continuous Cover Forestry (CCF) as their day-to-day activity on the land.

Thanks to the accumulation of countless findings they have fed back, plus advances in European scientific research on mixed forestry, everyone can now access the «CCF» toolbox they need in order to adapt their practices, little by little, to the challenges of managing a forest threatened by global heating and associated climate hazards. At the end of this document you will also find the main bibliographic references, to help you explore the subject further if you wish.

This summary seeks to provide the most important information to help remove the barriers to changing your practices, and make it easier for you to adopt this discerning, profitable and close-to-nature management style. After that, it's over to you to decide when and how to give it a try, at your own pace, in line with your wishes and skills. What an exciting challenge!

We hope you enjoy reading this brochure, and that it will answer some of your entirely reasonable concerns during this uncertain period.

The ASKAFOR teams

ASKAFOR

This document has been created from countless feedback reports and the results of European scientific research. If you wish to explore the subject further, you will find a selection of bibliographic references at the end of this document, and at **askafor.eu**

Contents

The forest: a fragile ecosystem

In our forests, **single-species** and **regular** stands represent the majority. Recent events and episodes (such as storms, drought and bark beetles) have shown us the forests' fragility and lack of **resilience**.

Yet, experience and science have taught us that forests with greater diversity of **tree varieties** and ages are more resilient and able to withstand disturbances:

- More stable in strong winds
- More resistant to pathogens (insects, fungi, etc.)
- Resources (e.g. water, light, nutrients) are shared
- Greater protection for biodiversity
- Production of higher-quality humus (forest soil)
- More adaptable

In light of increasing numbers of attacks on tree health, and extreme climate events in forests, management that nurtures diversity in tree varieties and ages would be a major asset in reducing the risks that weigh on the forests' economic value.

Single-species, regular stands

Uprooted trees

Vulnerable to drought

Bark beetle attacks

Mixed-variety, multi-age forest

Single-species. Comprised of one tree variety only.

Regular. All the trees are of the same age (even-age).

Resilience. An ecosystem's capacity to overcome the changes caused by disturbances, and return to its initial state or normal functioning.

Variety. Species of tree.

Capital. Collection of trees that provide an output. Often corresponds to the volume of wood on a stand.

CCF, an opportunity to square up to tomorrow's expectations and uncertainties

In a changing ecological, economical and social context, new demands and functions are emerging. Nowadays we need to go beyond the production of high-quality wood and also: protect, nurture and restore biodiversity; preserve the forest's protective actions (against excesses of sunlight, water, temperature, etc.); store carbon; preserve our landscapes and offer peaceful, relaxing spaces for people.

Given the climate emergency, the frequency of climate disturbances, the decline of biodiversity, and changes in the economic context, it is time for us to review our forest management methods. Approaches that used to work (single-species softwood stands) are no longer appropriate; new issues have arisen, and the risks weighing on the forest ecosystem and heritage must be taken into account, including (perhaps especially) in our economic calculations. The current crisis level compels us to prioritise the resilience of our forests.

The impacts of our management choices on biodiversity, soil preservation, water and carbon storage are now better known, and must guide our decisions. In a domain where time is measured in units longer than a century, it is important that these choices – binding on future generations – are not made lightly. We can no longer think about forest management the way we used to.

More than ever, we have to adapt our practices and find new solutions, but also stay agile enough to adjust successfully to the conditions that lie ahead.

Several terms for the same concept

Continuous Cover Forestry (CCF)
Irregular forestry
Close-to-nature forestry
Pro Silva

Continuous-Cover Forestry (or CCF) aligns with the principle of forests fulfilling multiple functions ("European Union Forest Strategy", 2021) and responds to current changes and demands by proposing solutions based on:

- Improved resistance of forests in the event of climate-related hazards or parasite attacks.
- Demand for greater multi-functionality from forests.
- Preservation of the "forest atmosphere" and species that rely on it (important for forest-specific biodiversity).
- Preservation of "productive capital" (i.e. optimisation of the functioning of the forest ecosystem as a whole, first and foremost by preserving its soils).

CCF also seeks the best compromise between the varying expectations of society. By drawing first and foremost on the natural dynamics of forest ecosystems, CCF guides these natural forces towards long-term maintenance of a forest that can yield a profit as well as a range of ecosystem services and support for these services: wood production, preservation of biodiversity, protection of the soil, wetlands and water resources, carbon storage, provision of a welcoming space for people, and more.

CCF offers forestry at individual tree scale that can optimise the way each tree functions. The forest ecosystem as a whole is managed using a systemic approach that is simultaneously technical, economical, ecological and socially integrated.

It is a "baby steps" method, adaptive by nature. It gives the forestry manager all the agility and tools they need in order to adapt their approach flexibly to changes in the conditions. With CCF, interventions are light and frequent; we observe closely, we check, we adjust.

The forest: a shared space to meet a multitude of demands

Economic requirements

Societal expectations

Ecological necessities

A space for tourism and leisure activities

Soil protection

Quality and variety of landscapes

Increases in biodiversity

Wood and humankind, together throughout history

Since time immemorial, humans and wood have been closely connected. Given humans' many uses for wood, it is a dependent relationship, but also an affectionate one.

Even though wood production can no longer disregard the other services rendered by the forest ecosystem, wood still occupies a prominent place in our societies. Warm, natural and healthy, wood is something people want in houses and objects, and there is an increasing preference for wood of local origin and native varieties.

Whoever can do the maximum can also do less

The best choice we can make in our forests is to produce high-quality wood, in light of our production costs and market competition from mass-produced goods that come from northern and eastern European nations. Producing high quality is our best option!

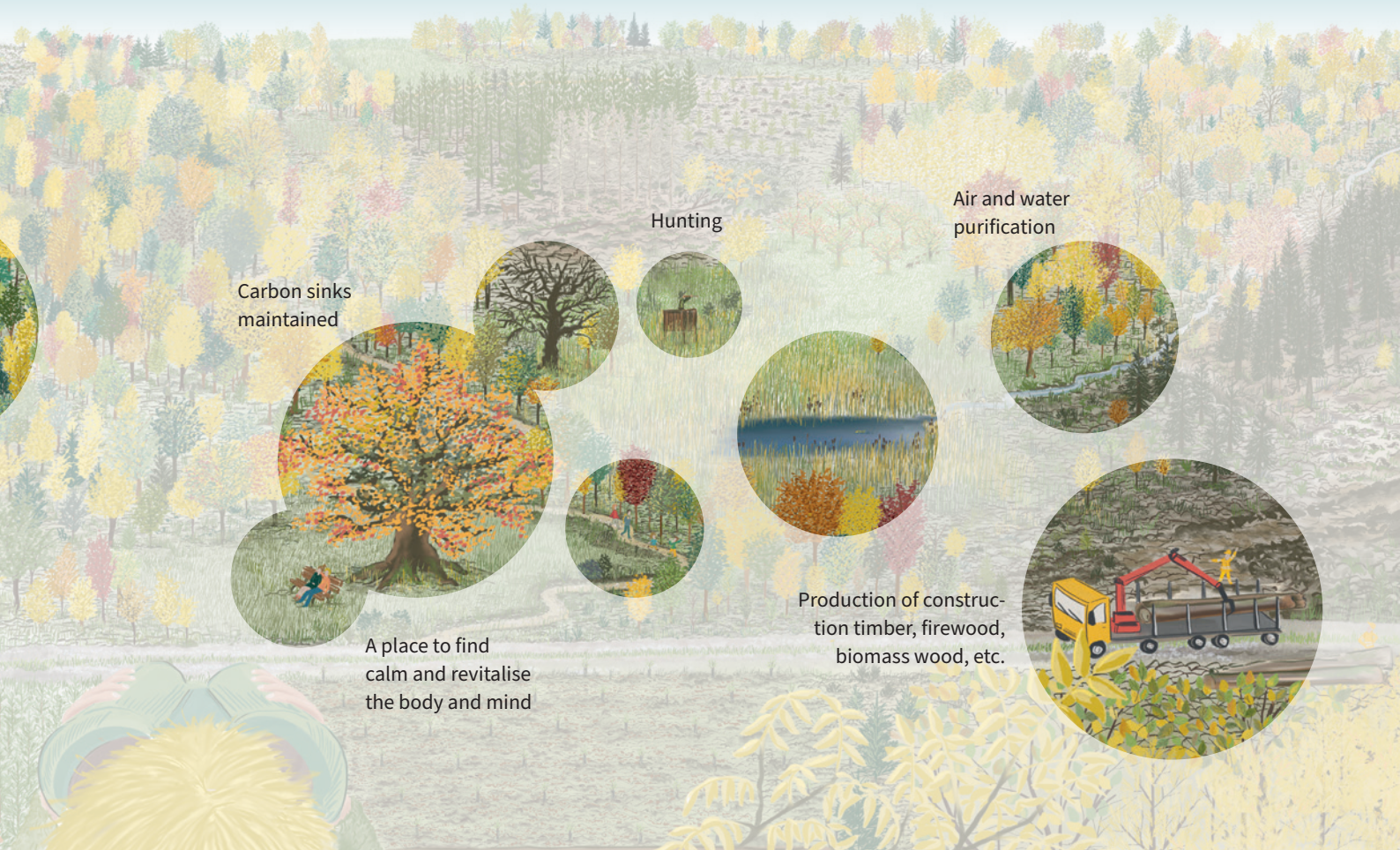
Furthermore, producing high-quality wood using sustainable methods is entirely compatible with preserving biodiversity and the productive capital of the forest ecosystem.

CCF seeks to produce trees of the highest possible quality, to commercialise a renewable material with recognised technological qualities for use in construction, woodworking, thermal insulation and soundproofing, among others. Leaning toward the production of high-value wood in this way enables the forestry owner to optimise their revenue while also reducing investments, because this kind of management chiefly relies on the natural dynamics at work in forest stands' renewal and development. With this objective in mind, it is crucial to ensure the continuity and improvement of the «productive wood capital» that the stands represent, which entails constant effort to maintain a healthy, functioning forest ecosystem.

__52 %__ of French people are keen on products made from local wood because of transparency about their origin

In Wallonia, nearly __50 %__ of people who plan to install decking would like to use native wood varieties. 71% of those would choose native varieties for reasons linked to short supply loops and ecological factors. In 2016, only 28% of decking in Wallonia was made from native wood varieties.

«Local wood», Profilwood Interreg project



Continuous cover and economic viability

CCF is an example of «tree-scale forestry»: the major management decisions are taken at individual tree scale, not stand scale. During forestry operations, the utility of a given tree in the stand is evaluated; the tree will only be harvested if the role it occupies in the ecosystem no longer meets the management objectives.

If the tree still meets these objectives, it will be left in place, regardless of its age or diameter, because it still has at least one role to play: wood production, conservation of the forest microclimate, training young stems in the understorey, aiding biodiversity, landscape, seed dispersal, holding the soil in place, protecting banks, etc. The result of this individual approach is the creation of heterogeneous forests that are irregular and mixed (in height, diameter, age and/or variety), and preservation of continuous cover. It means that each tree can be harvested at the optimal time.

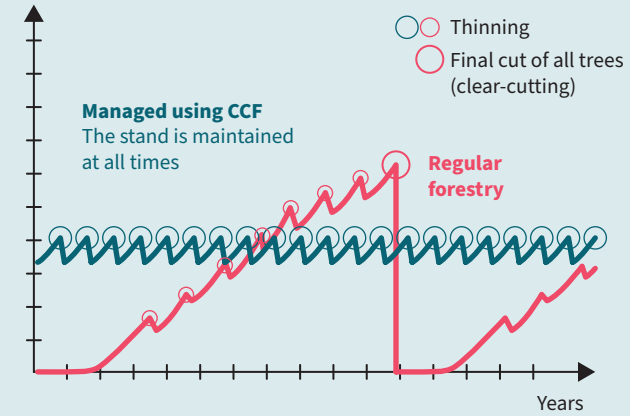
Purely economic* comparisons of regular vs. irregular management have been hotly debated for several decades. Under the regular model, all the trees in a stand are the same age and grow together. Over the life of the stand, the trees are thinned out several times, followed by the final cut of all the trees (clear-cutting), and then a new cycle begins. With the irregular model, the stand is maintained at all times (continuous cover). Trees are regularly removed from the stand, either if they have reached maturity (blue curve on the graph) or to favour the growth of higher-quality wood. From the point of view of productivity, expressed as cubic metres of wood, scientists are in clear agreement that there is no significant difference between the two management systems. However, from a quality point of view, the proportion of lumber produced is higher in the irregular model, plus it is produced continuously. In a regular approach, if a land asset is balanced and includes stands with an even spread of ages, it will generate regular revenue. If this is not the case, revenue will be concentrated in the periods of final harvesting of the stands. For more than 30 years, a group of French private forest managers called the Association Futaie Irrégulière (AFI) has been monitoring the economics of a network of reference compartments in Europe. One of its objectives is to verify whether irregular forestry reduces production costs, improves the revenue level and the quality of the productive capital, and preserves as much biodiversity as possible. After 30 years of observations, the AFI can show the profitability of irregular management, associated with gradual improvement of the trees' quality, preservation of biodiversity, and maintenance of a constant carbon stock in the ecosystem. The French forestry expert Evrard de Turckheim has also demonstrated and costed the viability of CCF, using an analytical accounting method based on 40 years of managing different forest assets. ⊕

In addition, this type of management offers the extra economic advantage of reducing risks (e.g. relating to health or climate)..

The regular model, which has dominated our countrysides for more than a century, was recognised as viable in a completely different context from today's. Given constant increases in the cost of labour, plus a higher risk of disturbances to the trees' cycle (attackers, storms, droughts) this profitability is no longer guaranteed, while the model carries serious financial risks by «putting all the eggs in one basket.» In the regular system that relies on balanced land surfaces, the smallest disturbance can destabilise the economics of the whole project.

* Omitting the many non-financial benefits that CCF delivers by definition.

Variation in the volume of wood on a compartment



⊕ **Economic inventory of 40 years of Pro Silva management**

Conference talk by **Evrard de Turckheim**, given in Liège, 2022

Available **to watch** at foretnature.be/evenement/bilan-economique-de-40-annees-de-gestion-pro-silva/

Effective forest management means minimising expenditure and maximising income, by harvesting valuable wood without harming the stability, flexibility and resilience of the stands.

« The benefits of irregular tree selection on the different functions of the forest», AFI (2020).

The resilience of a stand, i.e. its ability to recover following a shock, is an important part of the trees' future value. From a purely economic standpoint, the risk aspect must now, more than ever, be factored into the equation when we try to estimate a forest's profitability. Therefore, the scales definitely tip in favour of having mixed stands managed using an irregular approach (CCF). This is reinforced by the biodiversity, carbon storage and multi-functionality aspects, which also contribute to the ecosystem's resilience.

Evolution of the forestry model towards higher resilience: strengths and weaknesses



	Even-aged single-species stand, processed using a regular approach	Even-aged single-species stand, in transition to CCF management	Irregular stand of mixed-age and mixed-species trees, processed using CCF
Productivity as a volume	Similar		
Types of product harvested	Varied products, 50% lumber.	Varied products with an increasing proportion of lumber.	Varied products, 80% lumber.
Organisation of operations and harvesting	**Simple.** Follows standard schedules.	**More complex to understand**, fewer rules, technical schedules, more case-specific intervention. Requirement for technical expertise increases gradually as the stand develops (learning spans a long period).	**More complex to understand**, fewer rules, technical schedules, more case-specific intervention. Requires more technique and know-how.
Renewal of the stands	Planting, preparing the soil, protecting from animals, reinforcement planting, etc.	Self-seeding utilised first and foremost, perhaps with further planting for diversification.	**Self-seeding utilised first and foremost**. Possible further planting for diversification, to adapt to climatic changes.
Regeneration monitoring	**Investment** in several rounds of tree release will be necessary after planting.	**Operations are few and targeted** thanks to the use of natural forest dynamics, in both self-seeding and planting.	**Operations are few and targeted** thanks to the use of natural forest dynamics
Supporting young, developing trees	**Investments** in thinning, formative pruning, artificial pruning…	**Operations are few and targeted** thanks to the use of natural forest dynamics (larger trees supporting young, developing ones), in both self-seeding and planting..	**Operations are few and targeted** thanks to the use of natural forest dynamics (larger trees supporting young, developing ones)
Regeneration costs	**High** (preparing the soil, planting, reinforcement planting, tree release, thinning, formative pruning, artificial pruning…)	**Low** thanks to preferential use of natural forest dynamics (e.g. self-seeding, supporting young trees, natural pruning). Some targeted planting may be necessary to achieve a diverse range of varieties.	**Low** thanks to preferential use of natural forest dynamics (e.g. self-seeding, supporting young trees, natural pruning).
Resistance to disease, parasite attacks, climate hazards	**Low**. More susceptible, due to being of a single age and single species.	**Gradually builds resistance and resilience** as diversification progresses, and through maintenance of the continuous cover.	**Improved resistance and resilience.**



	Even-aged single-species stand, processed using a regular approach	Even-aged single-species stand, in transition to CCF management	Irregular stand of mixed-age and mixed-species trees, processed using CCF
Use of resources (water and nutrients)	All the trees have the same requirements, to the same extent and concentrated at the same time. Places a strain on the resources.	The use of space and sharing of resources in time is improved as the trees become more diverse in age and variety.	**Space is optimised via the use of every ecological niche**. The irregular, mixed structure enables optimal use of the water and nutrients, because trees of different ages and varieties do not have the same needs at the same time, and do not all draw their resources from the same place(s).
Biodiversity	**Habitat has little diversity of species**. Temporary biodiversity in large open spaces.	Gradually improving.	**Diversity of habitats.** A framework of mature lumber is maintained at all times, which encourages a range of species particularly found in forests. Biodiversity is associated with the maturity phases, an older canopy, a mixture of varieties and small open areas.
Carbon	**Carbon is lost** due to creating gaps in the canopy and the final harvesting of all trees. **Carbon is stored** in the wood products.	**Carbon is maintained** in the ecosystem thanks to regular, light removal of trees and preservation of the continuous cover. High-quality wood represents an increasing proportion (potential for long-term carbon **storage** in the wood products).	**Carbon is maintained** in the ecosystem thanks to regular, light removal of trees and preservation of the continuous cover. High-quality wood represents the major proportion (potential for long-term carbon **storage** in the wood products).
Soil	Need to limit plant machinery movements to the network of felling tracks.	Need to limit plant machinery movements to the network of felling tracks.	Need to limit plant machinery movements to the network of felling tracks.
Eau	Risk of erosion and run-off during the rejuvenation phases (clear-cutting); poorer-quality humus, less water retention.	Canopy is preserved and the soil protected, gradually improving the humus and its water-retention capacity.	Canopy and humus are preserved. Optimum retention function. Humidity in the atmosphere is maintained.
Other ecosystem services (landscape, social function, etc.)	Natural landscape is interrupted by treeless patches after clear-cutting.	Landscape retains its trees and character, and becomes gradually more diverse.	Landscape retains its trees and character, while also providing visual diversity, mitigating temperature extremes and conserving humidity.
Risk (e.g. of uprooted trees, bark beetles)	**High**. At the end of the rotation, there is a risk of destabilising neighbouring stands following the final cut, and a high probability of failure after replanting a whole area exposed to the elements.	**Moderate**. Reduces bit by bit as varieties become more mixed and the structure more complex. High risk if unstable or ageing stands are maintained.	**Low**.
Personnel qualifications required	Low	Requires a higher qualification for workers (particularly forest workers). **Learning takes a long time and is always continuing.**	

So CCF is good in ecological terms, but will I earn enough to live on?

One of the main objectives of CCF is for the forest to be viable. There are many important advantages in addition to profit, because forests managed using CCF are multi-functional. The key specific feature of CCF is that it aims for high-quality results in all size categories, with the emphasis on harvesting mature lumber whose value is reflected by higher prices and end-uses intended to endure. The AFI (Association Futaie Irrégulière) which has spent 30 years measuring and compiling data on a network of more than 140 reference compartments in Europe can show the profitability of irregular management, as can the French forestry expert Evrard de Turkheim (see p. 6).

For my unproductive compartments, I agree, but on good sites, are you sure?

CCF is a major asset when it comes to reducing economic risk! It helps you find the balance between profitability and a well-functioning ecosystem. It is applicable in every context (different varieties, qualities, sites, etc.) and in any type of forest asset (public or private) irrespective of their size, and it can begin at any moment. The owner can be sure of a regular income that increases with each passing year. The forest capital remains stable, while its proportion of high-quality wood increases incrementally as operations take place. In the end, revenue is increased through constant improvement of the value of the harvests, and expenditure is reduced thanks to the support and guidance of the forest's natural dynamics.

Regular income, and dramatically lower investment

By drawing first and foremost on natural forest dynamics* (natural regeneration, natural selection, supporting young trees beneath the tree cover, mixing of varieties, etc.), CCF harnesses natural processes to reduce the need for human interventions (such as planting, thinning, formative and other pruning) and their associated costs.

With measured and regular interventions, continual improvement of the trees' quality, and with lumber production as the objective, CCF ensures a sustained revenue and the longevity of the stand through continuous renewal. In a stand that is transitioning to CCF, the proportion represented by lumber (which holds most of the value of the stand) increases over time, as does the quality of this wood.

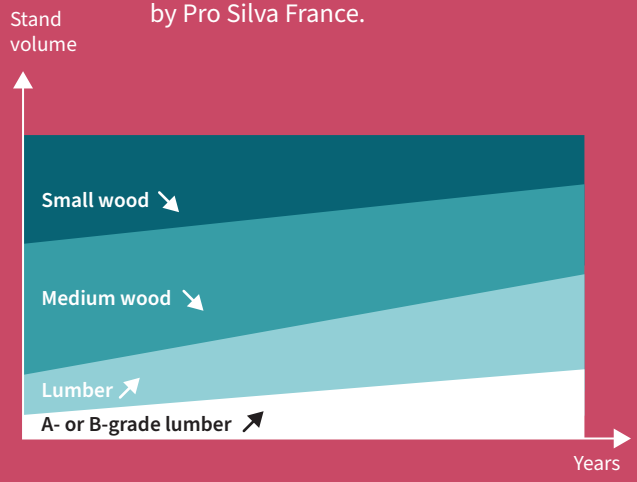
To estimate the economic performance of a stand and of its management process, one has to look at the changing monetary flows (revenue and expenditure), and also changes in the value of the stand volume (the capital). By concentrating on encouraging the growth of the best-quality trees, CCF gradually increases the proportion of high-quality wood in the stand, and therefore the value of the stand volume. This stand volume, or capital, is maintained all the time in CCF, whereas it regularly drops back to zero under the regular approach.

An interesting approach for evaluating the profitability of a management mode is to calculate the rotation time of the capital on a stand.

* We call this «biological automation».

The «rotation time» is equivalent to the notion of «rotation» for a forest under regular management. The term expresses how long it takes to recover, in volume or value, the equivalent of the initial volume/value of the stand. It is a direct indicator of how quickly the wood capital is «turned around» and replenished in the economic machine represented by the forest. On average, it is around 35 years for a near-balanced compartment managed according to an irregular model. This means that every 35 years, on average, we will have harvested a volume equivalent to the initial volume on the compartment, through successive thinnings, maintaining the forest atmosphere and without ever removing all the trees. If we express it in financial terms, the capital rotation time is even shorter, since the trees improve in quality over time.

Changes observed in the reference forests monitored for over 20 years by Pro Silva France.



Source. Luigi, 2019.

Yes, but if we work on all sizes of tree, the batches are no longer uniform; surely this complicates harvesting and sales?

A lot of deciduous stands are already irregular and managed using continuous cover. Forest managers and logging companies adapt to this very well, by separating logging of mature lumber from chopping down smaller trees, or by staggering the extraction periods (for example, the logs leave the site first, followed later by batches of firewood – kindling and pieces of the tree crown). Therefore, for variable products, you just need to create separate batches. If they are deciduous or softwood, that's no problem. However, over time the batches will become increasingly uniform, because it will be the larger trees in particular that are harvested. We can also alter the method of felling and selling the trees, for example by moving to a logging-led system rather than a standing sale, which puts the forest manager/owner in charge of logging, sorting and finding market outlets for the different categories of wood.

Will there be no more need for forestry contractors or forest workers?

There will be plenty of high-quality work available! Workers will have to adapt to performing new tasks (as they already do regularly). No more chopping down every tree in an area! Instead, their operations will be targeted and considered: enrichment planting, occasional tree release, and perhaps later, targeted pruning. And like the tasks, management actions are also qualitative, requiring genuine expertise and know-how that must be rewarded with decent pay.

And will there be no further work for tree nursery?

When we use natural regeneration, we plant fewer trees, which saves the forest owner money (in a regular system, the cost of replanting a whole area after clear-cutting is between 3,000 and 6,000 euros per hectare, which can be 50% higher if there is a high population density of game animals). However, nursery personnel will still play an essential role in supplying a diverse range of varieties that are not naturally prevalent in forests (70% of current stands comprise only one or two tree varieties), providing high-quality and impeccably sourced plants that deserve higher-value opportunities to thrive.

Sometimes people say: «Yes, but it's difficult!» What? Difficult to make a whole range of cars rather than just one model? The forest can make lots of different products far more easily than car manufacturers can, or industry in general, and yet that's what they have chosen to do! The diversity of products present at any moment, in a forest under irregular management, provides the means to adapt to market fluctuations and to ensure that, thanks to intelligent stock management, anything that users seek at a given time is always available. The diversity of the output is a formidable asset; it helps us reach a whole array of market outlets, and avoid being dependent on a single client.

Gilles Tierle, Pro Silva France

A toolbox that can be applied everywhere

It may not be based on standards or precise technical schedules*, but CCF nevertheless calls for compliance with a set of principles that must be applied everywhere and at all times. There are a number of methods for doing this, but they have to include the essential ingredients such as maintaining the continuous cover, seeking a mixture of varieties, and harnessing the natural dynamics of the forest ecosystem as much as possible.

CCF does not amount to «doing nothing»; it is a method that entails regular observations which lead to targeted, qualitative interventions (requiring technical knowledge).

CCF is applicable everywhere and in all conditions, for deciduous and softwood stands, under regular or irregular structures, on poor soils as well as rich ones... with the constant objective of improving the quality of the trees and ecosystem.

Even after a catastrophe that devastates a stand (e.g. bark beetle attack or storms), it is possible to restart from zero by following CCF principles.

* These would be irreconcilable with a set of complex natural dynamics.

Enrichment planting in small units, and management of the understorey.

“No standards to follow, and no set recipe... isn’t this kind of management too difficult to put into practice?”

CCF represents a series of principles that must be analysed on a case-by-case basis. Interventions are based on the forester’s observations and the decisions are made in the forest, one tree cluster at a time or one tree at a time. These choices require thought, responsibility and know-how from all the people involved – foresters, forest workers, loggers, traders and transformers – to make the best use of every tree. CCF values every person in the chain, and it is relatively easy to put into practice once these principles have been adopted.

There is no set revenue, but CCF is a management method in its own right, with objectives, processing, a selection of varieties and a set of guidelines.

Steeped in pragmatism and common sense, it is accessible to any forester who is keen to try it, has even a little observational skill and above all, wants to keep on learning.

“Is it as effective for deciduous stands as for softwood ones? And for small forest areas?”

Traditionally, in Wallonia, the structure of deciduous stands tends towards irregular, while softwood stands are regular or even-aged. In the east of France, it’s the opposite way round: softwood stands in the mountains follow an irregular model, whereas deciduous stands on the plains have a more regular structure. So as we see, CCF is equally applicable to deciduous and softwood trees.

It can also be applied on small forest areas, just as for large ones. There is no minimum surface area as long as the harvested volume can be sold, which it can for volumes starting at 20 to 30 m3 (one lorry load). It is also possible to join a grouped sale venture with neighbours.

Valuing owners' and managers' input at the heart of every decision

It may sound like CCF involves no checks or monitoring, but this is far from the truth; its implementation relies on observations that prompt forest management action (felling or other works) depending on the owner's objectives. It is management based on adjustments that avoids – barring some major event – sudden shocks like those that can leave big gaps in the forest cover (such as clear-cutting). Continuous steering, based on monitoring of precise indicators (ecological, dendrometric, economic and social), enables the forester to adjust their process over time, depending on the dynamics in play and other unforeseen aspects.

In CCF, ongoing training is essential for foresters, since the work is about managing what is currently there. As decisions about the next interventions are made in the forest, based on observation of the natural dynamics in that location, the forest manager's experience is a must-have!

"If I move to CCF, won't I have to fell trees before they are fully grown?"

Not at all! CCF, which is management on a per-tree basis, avoids sacrifices in yield capacity by harvesting each tree when it has reached its optimum-value size. In regular forestry, i.e. management on a per-stand basis, all the trees are harvested at the same time during the final cut, when the average tree size in the stand meets the desired objective. Therefore, some trees are felled too soon, others too late. This never happens in CCF.

"Won't I make my stand more fragile by moving to CCF?"

Before starting to change the management method, we always check whether the individual trees are sufficiently stable, and whether the variety is suited to the site. Because harvesting focuses on the largest trees, we extract fewer of them but obtain the same volume of wood. By adapting tree extraction to the specific context, the stand is not opened too much or too suddenly, which better preserves the stability of the remaining trees. Because we strive for quality in all sizes of tree, the stand structure gradually becomes less regular, which increases the trees' resistance to the wind. However, if the stand is very unstable at the outset (if thinning has been left too late, for example), a change in processing method involving extraction of lumber must be undertaken cautiously, or even avoided in some cases.

"Won't it take up more of my time?"

No, because it entails a transfer of activities. Foresters do need to spend more time observing and monitoring their regenerated areas, but they reclaim time they would have spent on certain tasks that will no longer happen (e.g. planting, whole-area work). The principle of CCF is to draw maximum advantage from the ecosystem's natural processes. Therefore, the forester's actions are highly targeted, and allow forest processes to reach their natural conclusion as long as they are fulfilling the expected aims. If they are not, the forester makes the small adjustment needed to nudge the course of the natural dynamics.

A constant quest to ensure quality

CCF involves constant effort to improve quality in all areas. This continuous improvement in quality is part of the reason behind the strong economic performance of this management style.

Beneath the continuous cover, seedlings and young trees are supported by the larger ones and start to take shape: slender branches, natural pruning... Frequent but gentle interventions give rise to regular growth rings. CCF produces high-quality wood.

The best choice we can make in our forests is to strive for high-quality wood, in light of our production costs and the globalised market of mass-produced goods.

The wood market creates opposition between very different time frames. Forest management action is reflected at century scale. Aiming to produce high-quality lumber ensures a versatility of end-uses, and this is inherently the most appropriate quality given the unknown nature of the future market. This industry, whose machines are replaced every 10 to 15 years, has significant capacity to adapt to the resource.

Evolution of the proportion of different qualities of wood in a balanced irregular forest structure (monitoring of reference forests for over 20 years, by Pro Silva France)

Source. Luigi, 2019.

> **Will I be able to find buyers for my lumber?**

In recent years, it had become difficult to sell lumber* because a lot of sawmill operators had invested heavily in canter lines for small and medium trees, to increase productivity in quantitative and standardised terms.

However, this is starting to change! In our regions, some sawmills have already started to kit themselves out with production tools specifically designed for use on lumber. The craft of sawing softwood lumber is making a comeback. If sawmills adapt to this primary material within the next 10 to 100 years, it will pose no problem in terms of investment capacity (the equipment takes 10-20 years to pay off in this sector). In addition, CCF does not rule out the option of choosing a smaller harvesting size. Today, buyers are easily found for Douglas firs and larch trees with circumferences of 300 cm, and prices for these trees are rocketing.

* By which we mean very large logs with circumference of at least 200 cm.

Forests with high ecological value

CCF is based on the assumption that any stand can be improved. Improvement is achieved via different combinations of economy and ecology, depending on the forest owner's choices, but with the common principle of care and consideration for the ecosystem. CCF is a nature-based solution, and goes hand in hand with constant effort to ensure that the forest asset is in good ecological condition.

As it focuses on producing high-quality lumber, it means that a framework of large lumber is maintained at all times, and this wood represents the highest ecological value. Maintaining forest cover also ensures protection of the soil, and of all aspects connected to water and to forest biodiversity.

Through measures that are specific but present no real constraints – such as leaving dead trees standing or on the ground, preserving trees that provide micro-habitats, and/or leaving some areas unharvested – the manager preserves a functional ecosystem, while enhancing (for little cost) its natural state and thus the associated biodiversity.

Better-protected soil, and an ecosystem that stores more carbon

CCF is based on the idea of maintaining tree cover at all times. It protects the soil (structure, humus, microfauna, flora, fungi and more) and preserves the forest microclimate, ensuring that the whole forest ecosystem is healthy and functioning. During harvesting, we take great care to avoid compacting the soil, because a single machine passage over it in poor conditions can cause long-term alteration of the soil structure. In fact, compacted soil can take more than 1000 years to return to its former state*.

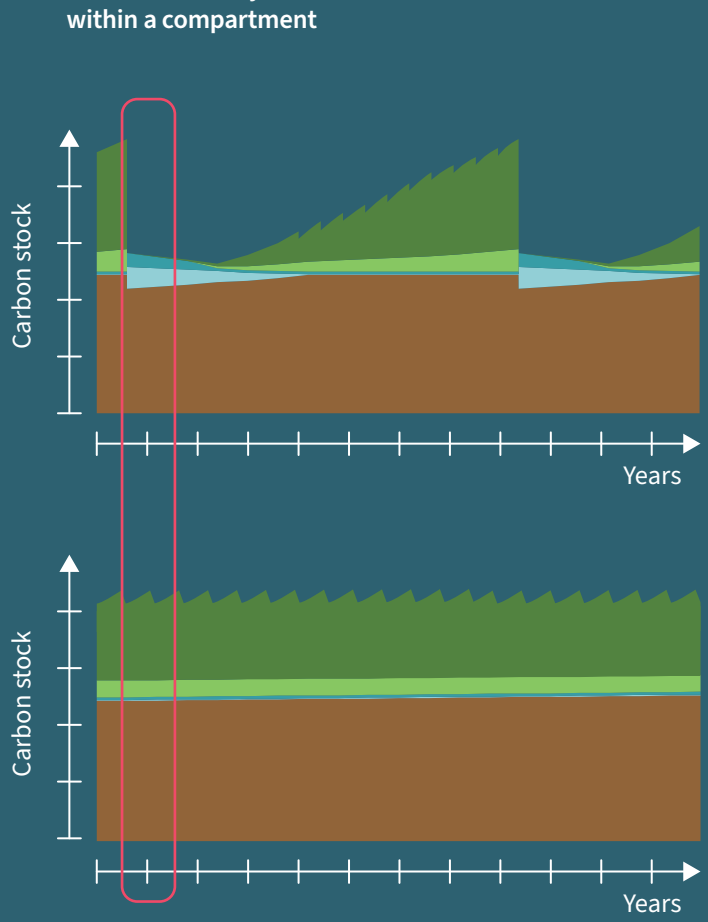
Maintaining permanent tree cover and taking light action on the trees are also highly advantageous for carbon storage.

In a forest ecosystem, carbon is sequestered in the tree's aerial parts (trunk and branches) and roots, but also in the soil. Forestry decisions can have a positive, negative or neutral effect on this stored carbon, both in the ecosystem and in the products extracted from it. From this point of view, the different wood-harvesting methods are far from equal. When any forest tree is felled, carbon is lost from the forest ecosystem. This is linked partly to the exported wood, but also to the accelerated decomposition of the felling remnants (thin branches, roots) and to the mineralisation of part of the forest soil when trees are felled over a fairly large area. As such, when a stand is clear-cut and replanted, it takes dozens of years for the stored carbon to return to its initial level. However, right now – the coming decade – is the critical moment for reducing our CO2 emissions if we are to limit climate-related changes and their consequences.

With CCF, light and regular extraction, coupled with maintaining continuous cover, dramatically reduces the carbon loss associated with felling trees. Felling that extracts less than 35% of the stand volume, with careful harvesting (without soil compaction!) will have a neutral effect on the soil carbon. If more is taken, the impact on soil carbon will be significant. With CCF, we typically extract 15% to 25% of the stand volume at a time, which has a far lighter effect. Therefore, we believe

*** Source.** Erwin Ulrich, leader of the project «Adaptation of Forests to a Changing Climate», in France's National Forests Office (Office national des forêts).

Variation of the carbon stock in the main forest ecosystem sections within a compartment



Regular harvesting method
Decision to perform clear-cutting once the stand reaches maturity, followed by renewal of all trees in the stand. Continue harvesting using regular method.

CCF – Continuous cover
Decision to transition to CCF, maintaining a continuous cover and continuing regular extraction of sufficiently grown trees.

It is urgent that we conserve the carbon in the ecosystem this decade, 2022-2032!

that in a balanced stand managed using continuous cover, whose trees are extracted lightly and regularly, carbon stocks are stabilised in the trees' biomass (aerial and roots) and fluctuate very little. The carbon sequestered in dead wood and in the soil, on the other hand, may be increased if we take specific measures to encourage this (e.g. leaving dead wood and remnants in place).

Wood extracted from the forest can contribute in part to carbon storage. It will be more, or less, durable depending on its end use (construction timber or pulping, for example).

Because CCF concentrates on encouraging the growth of high-quality trees, a larger proportion of the wood it produces is destined for a long service life (e.g. in construction, furniture or cask-making), and will therefore continue to store carbon. CCF is therefore also an effective strategy for carbon sequestration, both in the forest ecosystem and in the wood products.

"If I harvest my trees and then plant a fast-growing variety, is that not better for the climate?"

No, because a young stand, even a fast-growing one, grows slowly for the first few years simply because it doesn't have many leaves. The stand needs several dozen years to recover the carbon that was lost as a result of the felling. However, we absolutely must reduce our greenhouse gas emissions over the next 10 to 20 years. By maintaining continuous cover, concentrating on producing high-quality trees and harvesting our trees lightly and regularly, we preserve the carbon stock in the forest ecosystem and we encourage carbon retention in end-products with a long service life. So CCF ticks both boxes, and it's also quicker!

For coexistence between forest and animals



A healthy balance between the forest and large animals (stags, deer and boar) is essential in order to create enduring forests with long-term resilience, and implement CCF. In fact, this management largely depends on introducing natural regeneration. Considerable pressure from game animals leads to a loss of diversity in forests due to the animals' systematic nibbling (or "browsing") of certain more appetising varieties (oak, mountain ash, Douglas fir, etc.). This exposes the forests to greater risk in the face of the changing climate. Self-seeded trees, like planted trees, are vulnerable to hungry herbivores and need to be protected. In situations of imbalance between the forest and numbers of large animals, the cost of regeneration is at least triple.

Paradoxically, once the situation is in balance, CCF has a greater capacity than traditional forest management to provide homes for wild animals. Effectively, the trees' ages and varieties are mixed throughout all compartments, which offers wild animals just as much variety regarding shelter (peace) and food.

"I've heard that CCF doesn't work if there are too many large animals. Is that true?"

It would be more accurate to say that none of the forest management methods are feasible with an overpopulation of large animals. Since it is heavily reliant on natural regeneration of the stand, CCF is difficult to set up if nature's free seed-sowing is severely hampered. However, the constraint is similar for planted seedlings. In either case, we must resort to expensive plant-protection systems if we wish to ensure renewal of the stands.

Hunting and forest-game balance. What can be done to restore the balance? Case study in France, Wallonia, Sarre and Rhineland-Palatinate

Summary report by **Pauline Duwe**, 2022.

Available at askafor.eu/#ressources

Forest management that respects both nature and people

In addition to wood production and the wide range of micro-habitats that support biodiversity, a forest managed under CCF provides a set of intangible assets in the form of ecosystem services, which means services rendered to humans by the forest ecosystem, with a value and usefulness that are now widely recognised.

Our post-industrial, urban societies are showing increasingly noticeable interest in forests, and expressing multiple rising expectations about what forests offer: a place to enjoy nature and leisure, countryside, a source of physical and mental health benefits, and of artistic inspiration and experiences; a place of discovery and learning about nature, plus many kinds of value: heritage, sentimental, symbolic, cultural...

The forest also plays a quiet yet crucial role in protecting the water resource, in terms of both quality and quantity. This represents a strategic challenge, given the climatic changes that are already here, and those yet to come.

In addition, the forest is a source of local jobs, and the larger the proportion of construction timber produced, the more jobs there will be (for an equivalent wood volume, construction timber generates far more jobs than industrial wood or wood used for energy).

By ensuring continuous forest cover, thanks to light-touch interventions in the stands, CCF avoids sudden changes on the landscape. Changes take place gently, as this or that tree reaches maturity and is harvested, creating temporary openings, opportunities for a patch of seedlings or a young tree to develop. Continuous cover also ensures protection of the water resource. By seeking to produce high-quality wood, CCF opens a potential route to recreate local transformation sectors with high added value, plus associated local jobs.

How to become trained in CCF

In order to understand how the ecosystem works, gauge levels and combinations of actions, and learn the appropriate practices, additional competencies are needed, regardless of our knowledge and at any point on our path.

A forest manager, forest owner, naturalist, elected representative, teacher or anyone interested in forests could learn about CCF and get trained by combining a range of types of learning (a reading list, practical courses on site, online learning, etc.).

Askafor

Adapted Skills and Knowledge for Adaptative Forests

Brochures and leaflets
- A forest landscape of today, with all its qualities and fragilities
- Why get into Continuous Cover Forestry?
- Reference documents on the management principles of continuous cover forestry (CCF)

Videos
- Let's take a look at a forest landscape of today, with all its qualities and fragilities
- How can continuous cover forestry respond to the challenges of future forests?

Technical documents
- CCF/Pro Silva
- Practical guide to support mixed tree renewal in forest stands managed according to CCF principles – Post-crisis reconstruction

askafor.eu

CCF MOOC

Objectives: to raise forest managers' and forest owners' level of information, knowledge and skills about CCF, in order to impact their practices in favour of appropriate changes in management to confront the challenges of a changing climate.

Key points

This MOOC providing an introduction to CCF will be accessible to everyone:
- remotely
- from forest sites to learners
- via recognised site specialists
- in three languages: English, German and French
- for all managers/owners of public or private forests, who know the basics about the forest ecosystem and its management
- with a focus on continental, Mediterranean and young forests

This MOOC will be delivered in 8 chapters over 8 weeks, with each chapter including:
- 1 video on the theory, duration 20 to 30 minutes
- 3 videos about on-site application, duration 5 to 7 minutes per video
- 1 field guide providing a simulation exercise in each partner country
- 1 quiz comprising 30 questions
- 1 interactive question/answer session, duration 60 minutesactive de 60 minutes

moocforchange.eu

Forêt.Nature

Training courses
- Theoretical foundations of CCF
- Support for CCF implementation in your compartments
- Tree marking in irregular management of deciduous and softwood varieties
- Marteloscopes («Hammerscopes»): evaluate your hammer strike
- Travailloscopes («Workscopes»): targeted forest operations
- Natural regeneration of oak
- Natural regeneration of softwood
- Making softwood stands irregular`
- Post-crisis management
- Constructing and adjusting forested edges

Technical bookshop online
Forêt.Mail : rfree monthly media review about forests and nature
Technical visits and **conferences**
Resources and international reading list

foretnature.be

Pro Silva France

Training courses
- Introduction to Continuous Cover Forestry
- Description of stands and intervention planning in continuous cover forestry
- Tree marking, tree quality and harvesting. Applications in deciduous or softwood forests
- Planning and performing forestry tasks in continuous cover forestry. Theory and practice
- Monitoring and checking irregular management of forests. Inventory systems and permanent test plots

Resources and **reading list** in French
Newsletters and **current articles**
Technical visits on CCF

prosilva.fr

Arbeitsgemeinschaft Naturgemäße Waldwirtschaft

Technical visits CCF in each land:
- ANW Sarre
- ANW North Rhine-Westphalia
- ANW Rhineland-Palatinate

Newsletters and **current articles**

anw-deutschland.de

Pro Silva Wallonie

Technical visits on CCF
Newsletters and **current articles**

prosilvawallonie.be

Pro Silva Luxembourg

Technical visits on CCF
Marteloscopes
Newsletters and **current articles**

prosilva.lu

Pro Silva Europe

Newsletters and **current articles**

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ASKAFOR

ADAPTED SKILLS AND KNOWLEDGE FOR ADAPTIVE FORESTS

The objective of the 2021-2022 Askafor project is to promote continuous cover forestry (CCF) by reducing the barriers to its development. By doing this, Askafor will increase the coverage of forests managed using this innovative and sustainable forestry approach, which simultaneously incorporates the environmental, economic and social functions of a forest.

The project covers:

- The accumulation of experiences, practices and knowledge about CCF in European reference documents.
- Dissemination of this knowledge by installing teaching aids (marteloscopes and travailloscopes), creating technical training modules that will be delivered by top technicians, and leading group forestry sessions for managers on particular site situations.
- Creation of an international network of reference forests and control compartments.
- Scientific research actions, including adaptation of modelling software that simulates the evolution of forests managed using CCF, technical guides on forest renewal (post-crisis management), a sociological study seeking to identify the barriers to developing this innovative forestry approach.
- Raising awareness of the challenges of this «close-to-nature» forestry through an AskaforTOUR (conferences and workshop) and multiple information-distribution channels: video, brochures, website, social media.

askafor.eu

Why get into Continuous Cover Forestry?

For private and public forestry owners

The impacts of our management choices on limiting economic and health risks, on biodiversity, soil preservation, water and carbon storage are now better known, and must guide the decisions made by forest owners and managers. In a domain where time is measured in units longer than a century, it is important that these choices – binding on future generations – are not made lightly. In order to adapt to the changing climate and the societal context, we need to rethink forest management for today's world.

This is the second in a series of three publications, produced as part of the Askafor project:

1. "Living forests for tomorrow's world?» for all readers.
2. "Why get into Continuous Cover Forestry?» for private and public forestry owners.
3. «Continuous cover forestry: instruction manual», for private and public forestry managers.