Forest Restoration

IN PRACTICE

SUPERB
Upscaling Forest Restoration

Citation

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SUPERB

Forest restoration in practice

Forest restoration in practice – a synthesis

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Summary

This deliverable represents a synthesis of forest restoration in practice based on 12 demonstration areas. The synthesis is a collection of experiences and lessons learnt on various aspects of forest restoration processes conducted within the timespan of SUPERB (2021 – 2025). The forest restoration processes described in this deliverable are: (1) Stakeholder and media engagement, (2) Governance, (3) Finance, (4) Restoration methods, (5) Monitoring, (6) Upscaling and (7) Long-term maintenance plans. The synthesis has been written through an interactive process with the representatives of 12 demonstration areas. The lessons learnt in the document may apply across all demos, but some may only be relevant to a subset of the demos, depending on how experienced the demos were already in particular aspects of forest restoration.

Key messages

Forest restoration is a long-term commitment, not a one-off intervention (chapter 8). All demonstration areas show that lasting ecological benefits depend on continuous monitoring, adaptive management (including control of browsing), and engagement with stakeholders over decades.

Catastrophic natural disturbances, often in single species monocultures, can trigger more intensive restoration activities geared at an adapted forest ecosystem which will lead to a significant change in the forest ecosystem and the long term mix of ecosystem services (e.g. increased biodiversity and reduced wood production) (chapter 5).`

Local communities are beneficiaries and key partners in restoration; though this needs intense processes from the beginning. Restoration strengthens cultural connections to forests, provides eco-tourism and recreation opportunities, and safeguards ecosystem services such as flood protection, water quality, and climate regulation (chapter 2).

Financial and institutional support are fundamental, but private finance mechanisms do not adequately function at this moment under the current set of voluntary schemes. Restoration at scale demands stable, long-term funding mechanisms (public and private) and institutional mandates and capacity that match ecological timescales. Public finance is currently too much geared at management and trends that oppose restoration (chapter 4).

Demonstrations provide tested, transferable models in a wide range of local circumstances. From bark beetle recovery in Central Europe to riparian restoration in the Danube basin, fire-adapted management in the Mediterranean, and multifunctional forestry in the boreal zone, each case generates practical solutions ready for replication. Restoration measures vary from rather drastic changes in regeneration of tree species at large scales to subtle measures such as creating single tree standing dead wood (see demo examples in every chapter).

Costs of restoration vary in scale, complexity and patchiness of measures and opportunity costs from 1,036 (Romania) – 21,700 (Italy) Euro per hectare. This includes direct preparation, execution and some follow-up and monitoring costs only (chapter 7).

Upscaling requires alignment between local practice and demands with policy frameworks. Lessons from demonstration areas shall feed directly into National Restoration Plans and help operationalize the EU Nature Restoration Regulation (chapter 7 & 8).

Knowledge consolidation infrastructures ensure impact beyond projects and assure take up by those institutions that are setting up national restoration plans. Permanent support and capacity building structures are needed. A permanent forest restoration support facility is needed. Having a bank of available potential sites, helps in finding funders in capacity building and in quick starts. The Forest Knowledge Gateway makes e.g. tools and methods broadly accessible, enabling replication and upscaling, though more will be needed (chapter 7).

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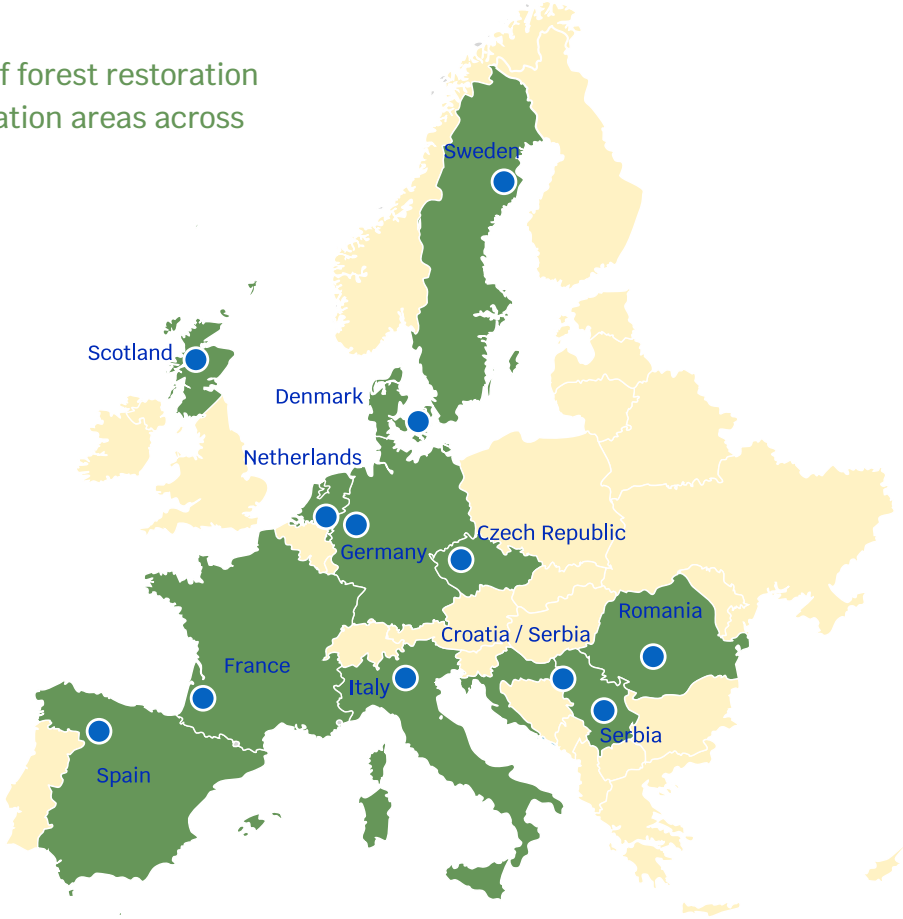
1. Introduction

Forest restoration has become a cornerstone of European and global strategies to address the twin crises of biodiversity loss and climate change. International agreements such as the Global Biodiversity Framework and the EU Nature Restoration Regulation (NRR) establish ambitious goals, requiring not only the protection but also the active regeneration of ecosystems. For forest landscapes, this means moving beyond scattered projects and embedding restoration in long-term national and regional plans that can transform ecological trajectories at scale.

The SUPERB project was created to bridge the gap between small-scale pilots and large-scale implementation.
By establishing a unique network of forest restoration demonstration areas across diverse ecological and socio-political contexts in Europe, SUPERB tested practical approaches to forest restoration while also identifying the barriers and enablers that determine whether local innovations can influence broader policy and practice.

Network of forest restoration demonstration areas across Europe



The insights gained from these demonstrations highlight several critical dimensions of upscaling. Barriers include financial gaps, fragmented governance, technical and knowledge limitations, and ecological uncertainties under climate change. Enablers, by contrast, emerge from strong policy frameworks, institutional leadership, innovative financing, cultural ties to forests, and participatory governance structures. Just as important, the demonstrations reveal how restoration requires sustained commitment.

Across the demonstration sites, a wide range of pressures and disturbances are present. Drought, storms, intensive harvesting, nitrogen deposition, pest and diseases, and browsing are the most widespread pressures, affecting many of the sites across Europe, while fire occurs more regionally. Soil degradation and land-use competition are also common challenges in several of the sites. The sites also represent a variety of restoration goals, ownership structures and forest functions. The forests include productive, protective, and conservation forests, as well as urban, educational and recreational forests, illustrating the multifunctional role of European forests. The restoration measures commonly aim to enhance habitat connectivity, climate adaptation, and species and structural diversity, with some also addressing soil improvement, slope stabilization, and natural flood management.

The project was structured around six key themes that all together are essential for effective and lasting restoration (1) stakeholder and media engagement, (2) governance, (3) finance, (4) restoration actions, (5) monitoring, and (6) upscaling. For each theme, this document highlights practical experiences from the demonstration sites, illustrating both challenges and successful approaches.

In addition to sharing experiences and lessons learnt, this document also outlines the future plans and long-term maintenance of the demonstration areas. The areas will continue to serve as demonstration areas for forest restoration, providing opportunities for long-term monitoring and exchanging knowledge.

2. Stakeholders and media engagement

Engaging stakeholders and local communities throughout the restoration process is essential for long-term success. Stakeholder engagement across the demos highlighted that restoration should be considered a social as well as an ecological and practical process. Actively involving locals, stakeholders, and landowners from the early stages is highly important.

Local communities are beneficiaries and key partners in restoration; though this needs intense processes from the beginning. Restoration strengthens cultural connections to forests, provides eco-tourism and recreation opportunities, and safeguards ecosystem services such as flood protection, water quality, and climate regulation. Truly listening to their perspectives and incorporating their suggestions in adapted plans helps in gaining and maintaining support for restoration activities. This can also lead to new insights and prevent conflicts.

The following examples and experiences have been selected to illustrate how stakeholder and media engagement contributed to the restoration process.

DENMARK, NYSTRUP, THY

Rethinking Landscapes as Lived Environments

Stakeholder engagement workshop on forest restoration in Denmark.

During our different workshops and informal meeting with stakeholders new insights were gained into how nature is often understood and managed within the Danish Nature agency. The workshops and visual mapping participatory method made us aware that much of the current practice tends to treat nature as a kind of container – a neutral space with fixed boundaries that can be mapped, categorized, and managed. In this way, nature is often described through surfaces: species, habitat types, and functions. Activities are always in or beside nature, but not really with it. Places, and experiences are separated, and nature itself becomes detached from meaning – a backdrop for management and scientific knowledge. This way of seeing has its strengths, as it provides a clear framework for protection and conservation. But it also leaves something out. It risks flattening the richness of landscapes, making it harder to think across scales, rhythms, and the many ways people actually live with nature.

Lessons learnt (success factors and constraints)

- ✓ What we have learned from the workshops is that landscapes, however, are more than biology or culture. They are lived places – made through the interplay of plants, animals, humans, and histories. They are not just objects we look at or manage, but living environments that also shape us as an agency within a local context. In this way the workshops had helped us thinking about landscapes – social and biological – as more than just a blank surface; it carries textures and rhythms which is reflected in the local community's engagement with it. From this perspective, landscapes are not neutral. They are filled with values, precisely because people invest meaning in them. Political, economic, moral, and aesthetic interests all shape how nature is seen, which is why landscapes so often become contested. At the same time, this is what makes them powerful: they hold both the material and the subjective, the ecological and the cultural, the external and the internal. Recognizing this have helped us in our planning, forcing us to think about restoration not only as an ecological processes, but also as a lived experience.
- ✓ The workshops have invited us to ask questions such as: what does the landscape afford people? How do they embody it in their daily lives? And how can projects avoid depersonalizing nature, instead creating spaces where people and landscapes co-shape each other?

SPAIN, CASTILLA Y LEÓN

Central role of stakeholder engagement and local institutions in achieving long-term restoration outcomes

Three participatory workshops were conducted in the

Stakeholder engagement workshop on forest restoration in Spain.

Spanish demo, involving all stakeholders identified in the stakeholder mapping process. These workshops, held across the demo area, allowed stakeholders provide input on restoration activities and helped shape the future direction of the area.

Lessons learnt (success factors and constraints)

- ✓ Insights from the workshops revealed a demand among stakeholders to promote association, cooperation, land concentration and tax incentives for forest owners. They also emphasized the need for awareness-raising efforts on forestry practices and the challenges posed by the presence of bears for both rural and urban populations. Additionally, stakeholders expressed a desire to establish suitable financial systems for long-term monitoring and maintenance of restoration activities, particularly through private sector involvement and potential payments for ecosystem services. Finally, they highlighted the importance of streamlining procedures for addressing bear-related damage and directly linking management plans to specific regulations, rather than relying solely on guidelines.

SERBIA, COPPICE FORESTS

Alternative approach for stakeholder engagement

At the start of the project, our demo encountered significant challenges in effectively engaging with the monks and nuns from the monasteries within our restoration areas. Initial attempts to connect and engage were limited, most likely the reason was that they are very private in nature. Recognizing the necessity for a more thoughtful and most likely successful approach, we began prioritizing personal interactions by visiting the nearest monasteries during our trips to the restoration sites. During these visits, we took the time to engage in meaningful conversations with the monks and nuns, discussing the project and ongoing restoration activities. This change in strategy enabled us to establish stronger relationships and trust, creating a collaborative atmosphere where the insights and perspectives of the monks and nuns could be heard.

Lessons learnt (success factors and constraints)

- ✓ Informal, face-to-face conversations can significantly enhance engagement, allowing for more relaxed exchange and better understanding.
- ✓ Being adaptable for various stakeholder engagements is necessary.
- ✓ Multiple shorter informal meetings are better for communities that like to be more reclusive.

GERMANY, NORTH-RHINE WESTPHALIA

Role of stakeholder engagement and dialogue in restoration efforts

Stakeholder engagement workshop on forest restoration in Germany.

Forest restoration efforts involve a diverse range of stakeholders with varying backgrounds. During the demo implementation and in conversations with the local foresters implementing restoration actions, it became evident that meaningful engagement with this diverse group of stakeholders is crucial for the successful implementation of restoration measures. This was also highlighted in stakeholder workshops, where participants emphasized the importance of open dialogue to address certain contentious topics, such as hunting. Feedback from the collaborative learning workshop that took place in the NRW demo further underscored the value of bringing diverse stakeholders together to facilitate learning and develop improvements around conflicting topics. Participant noted that such platforms, along with local exchanges, helped in improving understanding and facilitating compromises between stakeholders.

Lessons learnt (success factors and constraints)

- ✓ Proactive Stakeholder Engagement: Based on the experience from the NRW demo, it is important to prioritize meaningful stakeholder engagement throughout the restoration process. This proactive approach helps to prevent conflicts or, if issues arise, ensures they are addressed early to maintain trust and cooperation as well as allowing for timely resolution.
- ✓ Resource constraints: Conflicting views, particularly around sensitive topics such as hunting or nature conservation regulations, may require more effort and time to resolve. Additionally,

ensuring meaningful stakeholder engagement requires a significant investment of time and resources, both for organizing workshops and maintaining ongoing dialogue. Nevertheless, regular interactions facilitate stronger relationships and a deeper understanding of differing perspectives which in turn can help to foster better cooperation in the long-term. Such cooperation then likely leads to a more efficient implementation and upscaling of restoration actions.

SCOTLAND, QUEEN ELIZABETH FOREST PARK

Multi-level stakeholder engagement for forest restoration and upscaling in Scotland

A structured engagement pathway was developed to ensure that restoration actions at Queen Elizabeth Forest Park (QEFP) were informed by, and co-designed with, relevant stakeholders. An initial mapping identified 82 actors across local, regional and national levels – from policy and regulatory agencies (Scottish Forestry, SEPA, Nature Scot) to community trusts, NGOs, landowners, and education and research bodies.Three successive co-creative workshops were organised in Aberfoyle (Nov 2022, Nov 2023 and May 2025). Each combined field visits with moderated discussions on Continuous Cover Forestry, Riparian Woodland and Natural Flood Management restoration sites. Feedback gathered through structured group consultation exercises, evaluation forms and open discussions shaped the demonstration's implementation and its upscaling strategy. A newsletter shared with workshop participants was used to share updates and maintain communication with the stakeholder network.

Key national-level stakeholders were later convened at a dedicated Upscaling & Green Finance workshop (Forest Research's Northern Research Station, Roslin, Dec 2024) to identify barriers and enablers for restoration expansion across Scotland using a PESTEL framework. This participatory process linked local perceptions and national policy needs, directly informing the Scottish Upscaling Plan.

Lessons learnt (success factors and constraints)

- ✓ Early and transparent engagement with community representatives fosters trust and long-term participation; local communities view QEFP as "their back garden" and expect clear communication on restoration purposes and benefits.
- ✓ Multi-level dialogue—linking local, regional and national stakeholders—proved essential to connect on-the-ground experiences with governance and financing discussions.
- ✓ Field-based sessions combining demonstration visits and informal exchange were more effective than formal presentations in promoting engagement and generating constructive feedback.
- ✓ Plain, non-technical language and continuous feedback loops increased inclusiveness, particularly for non-specialist participants.
- ✓ Maintaining stakeholder continuity across workshops allowed visible progress and strengthened ownership of outcomes, a prerequisite for successful upscaling beyond QEFP.

3. Governance

The success of restoration depends on effective governance. Across Europe, common governance challenges include unclear institutional responsibilities, inconsistent policies, conflicts among stakeholders with different land-use values and perceptions of what restoration means. Successful governance emphasize inclusive and transparent decision-making, early stakeholder analysis, and tailored communication (O'Brien, 2025).

The following examples and experiences have been selected to illustrate successful governance approaches during the restoration process.

FRANCE, NOUVELLE-AQUITAINE

Three-party, complementary coordination of the demonstration area

The French demonstration area (a productive area with many small private owners) was coordinated by a consortium of three different organizations with complementary profiles, which proved invaluable. The consortium brought together an economic operator specializing in productive forest management, responsible of establishing the restoration trials; a nationally recognized environmental research institute, responsible for conducting chronosequential biodiversity sampling; and a neutral cooperation body in the forest-wood sector, responsible for communication and animation of the demo site. This balanced composition provided a diversity of perspectives and contributed to building trust among stakeholders who recognize the legitimacy of one or more of these organizations. This configuration enabled us to pursue a systemic approach for the development of the restoration solution, including assessing ecological benefits at the stand and landscape levels, monitoring tree health, organizing nursery, transportation, and planting services, and communicating and facilitating the project with the best expertise.

Lessons learnt (success factors and constraints)

- ✓ This configuration requires significantly more coordination work to stay informed of everyone's progress, resolve conflicting visions, and ensure consistent communication.
- ✓ Tripartite coordination has made it necessary to address biodiversity and forest productivity issues together rather than in opposition, bringing together stakeholders with opposing views on the territorial planning strategies.
- ✓ Similarly, tripartite coordination has bridged the gap between scientific research and operational forestry practices, helping to reconcile these two worlds, particularly in the face of growing mistrust of science among certain stakeholder communities.

CZECH REPUBLIC, VYSOČINA NORTH MORAVIA

Cooperation of diverse actors responsible for the landscape restoration

Successful forest restoration relies on cooperation among diverse actors who share responsibility for the landscape. Forest administrations contribute with expertise and ensure long-term management, while hunters play a key role in maintaining the balance between wildlife and forest regeneration. Municipalities and local authorities connect restoration efforts with financing mechanisms established by regional or national institutions, and local service providers are often responsible for implementing the work in the field. Such a complex task cannot be achieved without effective governance, which provides the framework for coordination, transparency, and shared decision-making among stakeholders. In the Czech demo, various stakeholder engagement activities promoted interdisciplinary exchange, supported the design of restoration actions, and encouraged dialogue on complex issues such as climate-adapted forest restoration in Central Europe.

Lessons learnt (success factors and constraints)

- ✓ Forest restoration when triggered after large-scale disturbance is such a complex task that it cannot be effectively addressed by focusing on only a few of its aspects. Strong governance is essential to coordinate and balance the stakeholders' needs, priorities, and capacities, ensuring that restoration efforts are coherent, inclusive, and sustainable. The private owners in the region were maybe left out too long.

4. Finance

Forest restoration often entails higher net costs for forest owners compared to conventional management practices. Financial and institutional support are fundamental, but private finance mechanisms do not adequately function at this moment under the current set of voluntary schemes. Current public funding in forestry is too often geared towards processes contrary to restoration. The higher costs of restoration geared forest management can be attributed to increased direct costs of restoration activities relative to a baseline scenario as well as to the potential loss of income when shifting management toward less economically driven objectives.

Restoration may also be required after disturbances, or in forests with low economic viability, where limited financial returns make it difficult to fund new silvicultural interventions. Finally, forest restoration often supports social and environmental purposes (e.g. development of recreational activities for urban populations, restoration of wildlife habitats) whose services are not directly remunerated. It is for all these reasons that the additional cost is often a limiting factor in initiating a restoration project. The lack of stable funding mechanisms is therefore one of the main challenges to successful forest restoration and to scaling up the dynamic initiated within SUPERB. The lack of stable finance has several causes and consequences:

i. Restoration finance has traditionally come from philanthropic or government grants, but this is constrained for adequate scaling up of activity,
ii. lessons are emerging from attempts to develop more market-based mechanisms, but their reliance on voluntary participation is a major constraint on scale, confidence and consistency, and
iii. limited public and philanthropic finance may be better deployed with a focus on leveraging private finance (e.g. in establishing baselines and co-ordinating monitoring activity)

To establish and assess forest restoration experiments, some SUPERB demonstration areas explored potential additional fundings to pursue their activities in longer run. Annex 10.1 includes list of different possible public and private funding schemes relevant to SUPERB-like restoration activities.

The following examples and experiences have been selected to illustrate financing the restoration process.

FRANCE, NOUVELLE-AQUITAINE

Securing private funding for the deployment of the restoration method

The restoration approach entails additional costs compared to the standardized management of monospecific pine plantations in the Landes de Gascone Forest. Financial gaps remain one of the main barriers to the upscaling of the restoration method. Anticipating the end of funding from the SUPERB research project, we have secured a partnership with a private charitable endowment fund, gathering donations from private foundations, NGOs, companies and individuals who are committed to support reforestation and climate-resilient projects in France. The fund agreed to support the establishment of broadleaved hedgerows as developed within SUPERB, and has allocated a total of 220 000 euros in potential funding for approved projects. This financial support could enable the restoration of an additional 1000 ha, 6 times the initial target set within the SUPERB project. The demo representatives have been invited to join the fund's project selection committee, which allows for direct oversight and alignment with the restoration method's strategy.

Hedgerows of broadleaved species in France.

Lessons learnt (success factors and constraints)

✓ Having quantitative data is essential to persuade potential funders—whether the case is built around carbon sequestration, biodiversity gains, or climate change adaptation.

- ✓ Private charitable funds often provide greater flexibility and faster access to resources than public funding mechanisms, typically involving less administrative burden and fewer scientific justifications required from applicants.
- ✓ Co-developing application guidelines with the broader stakeholder community can help anticipate practical challenges and define necessary conditions for successful project implementation.

SERBIA – CROATIA CROSS-BORDER, SERBIAN SIDE

Securing funding for forest restoration in Serbian state owned forests

In Serbia and its Vojvodina Province, forest management of public-owned forests follows a simple rule: after trees are harvested, the same areas must be replanted. This ensures that forest cover is maintained, and natural resources are not depleted.

Beyond this mandatory replanting, additional measures are implemented to restore degraded sites or expand forested areas. These activities are supported by one of the dedicated state funds, which allocates 3% of the value of all timber harvests across the country. This financial mechanism allows a wider range of projects to increase forest cover, enhance biodiversity, and promote climate-resilient landscapes. By combining regulatory obligations with targeted funding, Serbia has been able to strengthen sustainable forest management practices while addressing both ecological and socio-economic goals.

Lessons learnt (success factors and constraints)

- ✓ Clear rules and mandatory replanting ensure that forests are not lost.
- ✓ Financial mechanisms, such as the 3% timber harvest fund, facilitate project implementation.

Success depends on careful planning, effective monitoring, and coordination with local communities.

SWEDEN, VINDELÄLVEN-JUHTTÁTAHKKA

Having a “bank” of potential restoration objects makes it easier to catch the opportunities when they arise

For a nature restoration project to be successful, several conditions must be met. The most important is that there is a need for restoration and this need must be described. Someone has to be committed and drive the project, and landowners, local residents and others who may be affected must be on board. It is also particularly valuable if the project contributes to increased ecological functionality at the landscape level. Finally, for a restoration project to actually happen, some form of external funding is almost always required. However, while it often takes time to investigate, describe and document the other required conditions, it is not uncommon for funding opportunities to arise suddenly.

In the Swedish SUPERB demo-site Vindelälven-Juhttátahkka, we have experienced that by mapping and building a “bank” of objects that are suitable/in need of restoration, including descriptions of current situation, stressors, ownership situation, suggested restoration actions etc. for each specific object, and potentially also prioritize the objects, it is easier to catch the opportunity for financing when it suddenly arises.

Lessons learnt (success factors and constraints)

- ✓ Include a landscape analysis in the mapping and prioritization of potential restoration objects. This will give you a broader picture and makes it possible to not only see the restoration needs and potential for each individual object, but also how they are, or could be connected to strengthen the whole landscape.
- ✓ It is not necessary to have all the information for each object in your restoration “bank”. However, the more “ready” an object is, the easier it is to quickly respond when an opportunity for financing (or engagement etc.) suddenly arises.
- ✓ Having a bank of potential restoration objects can also be useful in other situations, for example for public coordinators to communicate and to encourage stakeholders to engage in restoration

Oak seedling planted in Serbian forest restoration stand.

activities or for NGOs or small local communities etc. to build a case and to argue for the need for restoration, in contact with permitting authorities and financing bodies.

SPAIN, CASTILLA Y LEÓN

Securing restoration funds for the long-term maintenance of restored areas

Several public funding streams necessary to initiate large-scale restoration in the Spanish demo area have been activated within the framework of SUPERB. This process started with the funding of a small-scale project (138 ha) in El Bierzo (H2020 SUPERB funding) and by supporting similar actions with the same objectives across the rest of the demo area. These efforts are implemented by forestry crews funded by the Junta de Castilla y León, who carry out silvicultural treatments aimed at multiple objectives, including wildfire prevention and vegetation structure improvement. At the same time, forest reforestation actions co-financed by EAFRD funds have also been launched. However, we believe that the SISREP tool (System for Information, Monitoring, and Evaluation of Projects), developed under the H2020 programme, could help mobilize additional resources needed for upscaling. Together with the biodiversity conservation plan, the forest plan, and the national restoration plan, this represents a major coordination challenge among the different administrations involved.

Potential alternative funding sources may come, on a smaller scale, from European research project calls such as Horizon Europe, LIFE, and ELSP, as well as from national projects co-financed with European funds, such as those promoted by the Biodiversity Foundation and Operational Groups.

Lessons learnt (success factors and constraints)

- ✓ Having quantitative data is essential to evaluate the cost–benefit trade-off of restoration projects and to persuade potential funders—whether the case is built around carbon sequestration, biodiversity offsets, payments for ecosystem services, or Corporate Social Responsibility actions.
- ✓ Coordination among administrations to secure several public funding streams remains a major challenge.
- ✓ Public–private collaboration should be fostered through jointly led meetings.

ITALY, PO VALLEY

Securing private funding for the deployment of the restoration method

In anticipation of the conclusion of the SUPERB research project's funding phase, a strategic partnership was established to ensure the long-term continuity of restoration efforts and the implementation of the SUPERB restoration method. The initiative brought together:

- ✓ Four public local administrations (municipalities), which have formally undertaken long-term management of the restored areas through official "public management takeover" contracts lasting 25 years.
- ✓ Private foundations, which have committed to co-financing part of the annual management costs in exchange for visibility and social responsibility recognition.
- ✓ NGOs and local associations, which pledged to use the areas for recreational and educational activities, ensuring ongoing community engagement and social value creation.

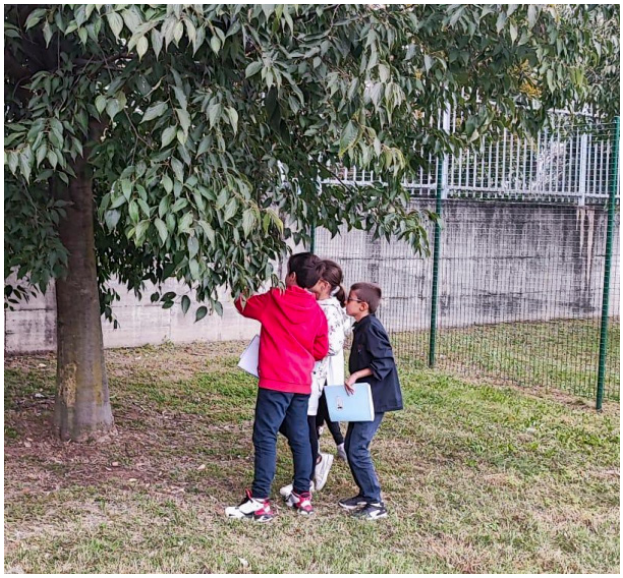
These partnerships collectively support reforestation and climate-resilient projects across the Milan Metropolitan Area.

Building on this foundation, the Parco Nord Milano authority is currently leading the expansion of urban forests in collaboration with the ForestaMi Fund. Forestami is a Foundation that coordinates the large-scale urban forestry plan for the Metropolitan City of Milan, aiming to plant 3 million trees by 2030. Funding comes mainly from private companies and, to a lesser extent, from individual citizens through dedicated fundraising campaigns. The initiative operates through Memoranda of Understanding with municipalities and public agencies that define roles, shared objectives, and management responsibilities. Suitable public lands are identified through territorial mapping and scientific analysis. Tree maintenance is guaranteed for five years after planting, after which management is handed over to local authorities. This funding mechanism provides opportunities to extend restoration efforts to additional areas, potentially multiplying the scale of intervention beyond the original SUPERB project objectives. The integration of academic outcomes from the demonstration site into the ForestaMi Fund's project selection and implementation framework will facilitate direct oversight, methodological alignment, and continuity with the SUPERB restoration approach.

Lessons learnt (success factors and constraints)

- ✓ Engaging local administrations from the outset and obtaining formal commitments of long-term management responsibility proved essential for ensuring durability and institutional accountability.
- ✓ Involving a diverse network of local actors, including private stakeholders, expanded the potential funding base and enhanced social ownership of the project.
- ✓ Private charitable foundations often offer greater flexibility, faster access to resources, and reduced administrative requirements compared to traditional public funding mechanisms, which typically demand more extensive technical and scientific justifications.

Public administrative bodies tend to require fully developed, technically robust project proposals that are ready for implementation, underscoring the importance of detailed preparatory work and clear methodological documentation.

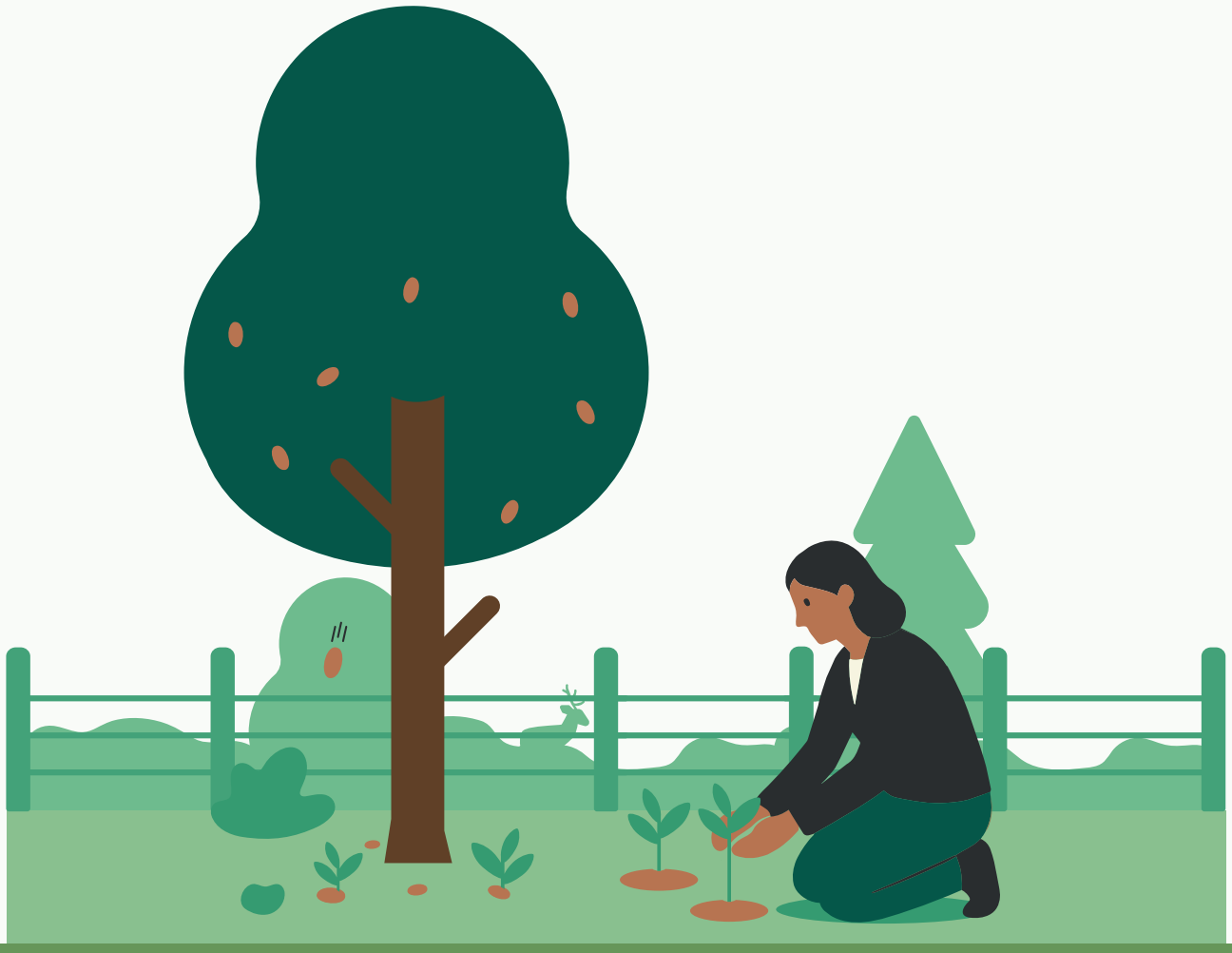


Workshop on forest restoration with primary school pupils in Italy.

Cam James - Unsplash

5. Restoration Methods

Within SUPERB a best practice information base Kremer et al. (2025) was developed which includes a restoration practices overview. Restoration measures and methods in the field vary widely from rather subtle creation of dead wood to full replanting of a site. Catastrophic natural disturbances, often in single species monocultures, can trigger more intensive restoration activities geared at an adapted forest ecosystem which will lead to a significant change in the forest ecosystem and the long-term mix of ecosystem services (eg. increased biodiversity and reduced wood production).



Although all practices can be highly relevant based on restoration goals in certain areas, we focus in this section first on the most common practices across the demos. After this some more in-depth experiences are shared. The complete overview of applied restoration methods is in Annex 10.2.

In any case, before starting in the field a thorough process of analyses, stakeholder process and planning has been gone thorough. Pressures that led to degradation should in the best cases be taken away first, if possible.

Site preparation

Site preparation was generally limited and adapted to local conditions. On most sites, only minimal interventions were carried out like the creation of standing dead wood or cutting a few mature trees to improve light conditions for regeneration and planting. In some sites, non-native or unhealthy trees or stumps were removed to prepare the site for planting.

Only a few sites implemented more intensive site preparation focusing on the soils or hydrology, such as mulching or ploughing or closing ditches, to reduce competing vegetation, prepare the soil for planting, and promote natural regeneration. Decisions on the measures that need to be applied, depend on the site degradation and the desired regeneration method.

Natural regeneration

The encouragement of natural regeneration is a decisive stage for the genetic diversity of the future stand and, consequently, of its ability to adapt to environmental changes. It is also a stage of opening up the stand, which can disadvantage species that are dependent on closed stands. Given these challenges, the general principle is to favour natural regeneration through progressive cutting or small clearings.

Natural regeneration also played an important role in the restoration efforts across the demonstration sites, often combined with planting. In several of the sites, the naturally regenerated trees were retained and protected through fencing, thinning and the removal of competing vegetation. Mature trees were left at sites to provide seeds and facilitate the establishment of the regeneration. Not all sites achieved the desired species composition, mainly due to limited seed availability, poor soil conditions, and browsing pressure, but in many of the sites, the regeneration of target species is expected to occur over time.

Planting

Artificial regeneration is an alternative – or supplementary - strategy to achieve forest restoration objectives, especially when aiming to re-establish a different tree cover in severely degraded or deforested areas. This approach complements natural regeneration by addressing some of its key limitations, such as the reliance on the availability and viability of seeds in the soil seed bank, or on proximity to seed-bearing trees. Planting different species and genetic material can also accelerate forest recovery to its natural state, enhance biodiversity, and proactively adapt forests to future climate conditions and other biotic pressures. Planting operations can take multiple forms, such as strip planting, group planting, or intimate mixtures, and can be implemented along a gradient of naturalness. Below we provide a summary of the tree planting strategies implemented across the SUPERB demonstration areas to restore forest ecosystems.

Oak seedlings ready to be planted on the Serbian side of the Croatia-Serbia cross-border demo.

Almost all of the 12 demonstration areas relied either partially or entirely on tree planting to carry out forest restoration. This widespread adoption demonstrates the relevance and versatility of artificial regeneration across diverse ecological zones e.g. to bring in species and genetic diversity lacking at the sites. Though natural regeneration remains an important aspect of nature-oriented management. This technical choice is motivated by a combination of rationales. The need for planting arises firstly in the event of failure or deficiency of natural regeneration, as reported by 55% of the demos. Several drivers were identified:

- Increasing seedling mortality due to climate extremes such as prolonged droughts or excessive rainfall
- Unbalanced herbivory populations leading to intense browsing pressure
- Competition with ground vegetation
- Severe land degradation, where natural processes are no longer sufficient to initiate regeneration

These degraded conditions often coincide with critical areas for restoration, where passive recovery is either too slow or impossible. Degradation drivers include:

- Occurrence of forest fires that destroy soil seed bank or kill mature seed trees
- Soil degradation, such as compaction, erosion or nutrient depletion
- Pest outbreaks that cause seedling dieback and disrupt forest dynamics

Over 80% of the demo areas used planting to increase tree species diversity beyond what natural regeneration would likely achieve and to enable rapid establishment. The introduced species can help restore key ecosystem functions, improve soil condition, recreate habitats for the biodiversity, etc. While practitioners often favor the use of native species in restoration projects to recreate local natural forests, planting offers the opportunity to introduce new climate-resilient tree species or provenances through assisted migration. Finally, the establishment of seedlings through plantation can also accelerate the restoration process by overcoming the natural variability and delays associated with seed production, dispersal and germination. The use of vigorous nursery-grown seedlings, combined with site preparation, can ensure better establishment and survival, particularly in harsh or degraded environment.

The selection of the tree species to be planted is a critical phase. The selected species on a given site could be totally different depending on the plantation objectives and on the type of media and knowledge used. Most of the demos mobilized a combination of practical knowledge from forest practitioners and scientific knowledge based on field experiments and climate models. This artificial regeneration technique requires first a precise soil condition analysis to select the most suitable species. Local practitioners can also rely on regional guidelines, distribution maps and soil maps to guide them through the selection process.

Knowledge from local communities can also be relevant to retrieve some historical tree species presence and usage, or when the restoration projects aim to support recreational activities.

Once the species are selected, the seedlings must be sourced from a certified nursery to ensure provenance suitability and compliance with national regulations. The choice of nursery should be based on its qualification and ability to meet the specified quality standards and requirements (e.g. root and shoot ratio, provenances, production capacity and delivery timeline, seedling size, etc.). Site preparation may be necessary before planting and include clearing brushes or invasive vegetation, improving soil structure, installing drainage systems, etc. Planting should be carried out during the most appropriate period for seedling survival, typically in late autumn, winter, or early spring, depending on regional climate. These periods offer cooler temperatures and higher soil moisture, which are essential for seedling establishment and root development before spring bud break. However, climatic anomalies—such as unusually dry or wet years—may require flexibility. In such cases, planting operations may need to be postponed or adjusted to ensure seedlings are established under optimal conditions. Restoration managers must stay responsive and adaptive, monitoring weather forecasts and soil conditions closely. The forestry company in charge of the planting must be selected with great care and supervised by the restoration project managers, especially when dealing with non-standard or complex planting schemes.

The downsides of planting compared with natural regeneration include cost, the increased palatability to browsers and the challenge of matching planting operations to unpredictable weather conditions. To optimize the extra costs, managers must provide special care to the plants by implementing adapted soil preparation measures, maintaining adequate site condition (e.g. weeding or replacing missing seedlings), or by providing protection against game pressure (e.g. fencing or repellent).

Browsing protection

High browsing pressure was common across most demonstration sites, and because most demonstration sites used tree planting as part of the restoration measures, effective protection of young trees was vital.

Across the demo sites, different protection measures against browsing were used, depending on the browsing pressure, site conditions and the type and quantity of planting materials. In areas where the number of planted trees was high and the browsing pressure was high, fencing was often used, either wired or wooden fences. Some sites reported noticeably higher seedling survival within the fenced areas.

In one case, taller trees were planted. Here, bamboo sticks were used to protect the planted trees from deer. In another case cylindrical plastic guards were used to protect stems from bark damage caused by small rodents. In a few sites, no protection was needed because large herbivores were absent or population densities were kept low through hunting. Observations showed that the protection was helpful in supporting the early establishment of the young trees.

Protection of artificial regeneration in restored forests in Czech.

Some restoration measures were only applied in specific demo sites. The following examples show some of these relevant restoration measures.

DENMARK, HORSERØD HEGN, NORTHERN ZEALAND

Veteranisation as a restoration tool for bridging the time gap

Timber producing forests are characterized by their even-aged stands of single tree species. Due to the tree harvesting these forests contains very few old trees and also low levels of dead wood (both laying and standing). Many organisms are connected to the microhabitats in old trees as well as to both standing and laying dead wood. But with few of these habitats in a typical production forest these organisms are at high risk of disappearing. Veteranisation is a restoration tool that can be used to bridging the gap between the many young/middle aged trees and the few old trees as well as increasing the levels of both standing and laying dead wood. By ringing the bark, making holes, cracks and scratches in the bark of the young/middle aged trees the potential for establishment of microhabitats is initiated. Some trees will die shortly after the veteranisation (those ringed) while others despite of the wound will live many years after. In that way both standing and laying dead wood is assure both in the short but also in the long run. This is important in order to assure a continuous supply and web of suitable habitats. Veteranisation can be done both by machine (Menzi Muck) and by man with a chain saw. The advantage of the machine is that it can make veteranisation in ways that to a higher extent simulates natural disasters and processes like e.g. storm felling. Furthermore, with the machine veteranisation can be done on a larger scale.

Veteranisation of trees to increase deadwood and bridge age gap between different forest patches in Denmark.

Lessons learnt (success factors and constraints)

- ✓ In bridging the gap between young trees and the few old trees found in production forests, assurance of dead wood also in the long run is a key point. Different methods of veteranisation (making holes, cracks and scratches) are important full-filling that task.
- ✓ Veteranisation by machine to a higher degree mimic natural disasters and processes and thus looks more natural. It is to a higher degree accepted by the stakeholders and the public in general than veteranisation done by man with a chain saw.
- ✓ Veteranisation is a costly restoration tool whether it is done by man or machine.

SWEDEN, VINDELÄLVEN-JUHTTÁTAHKKA

Fire mimicking measures – a way to create habitat for fire dependent species in places where controlled burning is not possible

Fire is a natural disturbance in boreal forests, causing many ecologically important effects, such as natural thinning of young and non-fire adapted species, hardening of those trees that survive the fire, provision of fire specific habitat such as burned wood, ground disturbance and opportunity for regeneration of deciduous tree species. However, today when wildfires are effectively suppressed, many species dependent on burned forest are threatened. To improve the conditions for these species, controlled burnings are regularly used. However, controlled burning is not possible everywhere, e.g. if the area is too important as grazing area for Sámi reindeers, it is situated too close to inhabited areas, or the terrain makes it too difficult to keep the fire under control. Instead, fire mimicking measures are increasingly adopted in Sweden, both by nature conservation authorities and forest companies, substituting some of the effects of natural fires, without causing negative effects on local communities. Some of these measures were tested and demonstrated within the Swedish SUPERB demosite Vindelälven-Juhttátahkka.

Lessons learnt (success factors and constraints)

- ✓ Fire mimicking measures could not substitute the full effect of real forest fires, therefore conservation burning should always be first choice. However, if fire mimicking measures are adopted, it is good to combine different measures in an area, since each of the different measures only mimic a

Fire mimicking measures for creating habitats in Sweden.

small subset of the effects of a real forest fire.

- ✓ Partial girdling and point burning gives different wood response where point burning results in more and deeper resin impregnation.
- ✓ Doing point burning on snow cover allows for efficient implementation since the firewood/portable campfires can be distributed among trees with snow mobile and skis. And once ignited, one person can handle many fires at the same time since the risk for spreading is minimal.

THE NETHERLANDS, KRONENBERGSE BOSSEN – HORST

Restoration approach at the Dutch demonstration site starts with the soil

On the sandy soils of the Dutch demonstration site, the soil is very nutrient-poor and acidified. Low availability of base cations such as calcium, magnesium, and potassium can limit plant vitality and negatively impact soil biota, thereby hampering nutrient cycling and forest vitality. Improving soil quality is therefore a crucial first step in the restoration process.

Planting nutrient-rich litter species such as lime, hornbeam, and hazel helps improve soil quality. These species produce leaf litter rich in base cations, which raises the base saturation and pH of the soil. Research shows that at least 30 per cent of the ground area should be covered with these species to have a noticeable effect on the soil. Moreover, they boost the activity of soil organisms like earthworms and fungi, which are crucial for breaking down organic matter and making nutrients available. This promotes a healthy soil and increases the resilience of the ecosystem.

Rock dust applications using a helicopter in the Netherlands.

When the soil is too acidic and lacking in base cations that even hardy litter species struggle to survive, amendment of rockdust can help to improve soil chemical quality. It contains minerals such as calcium, magnesium, and potassium, which raise soil pH and increase the availability of base cations. This diminishes the negative effects of acidification. Studies show that using rock powder can result in noticeable improvements in leaf mineral content within a year, boosting the nutritional value of the vegetation.

Lessons learnt (success factors and constraints)

Amendment of rock dust:

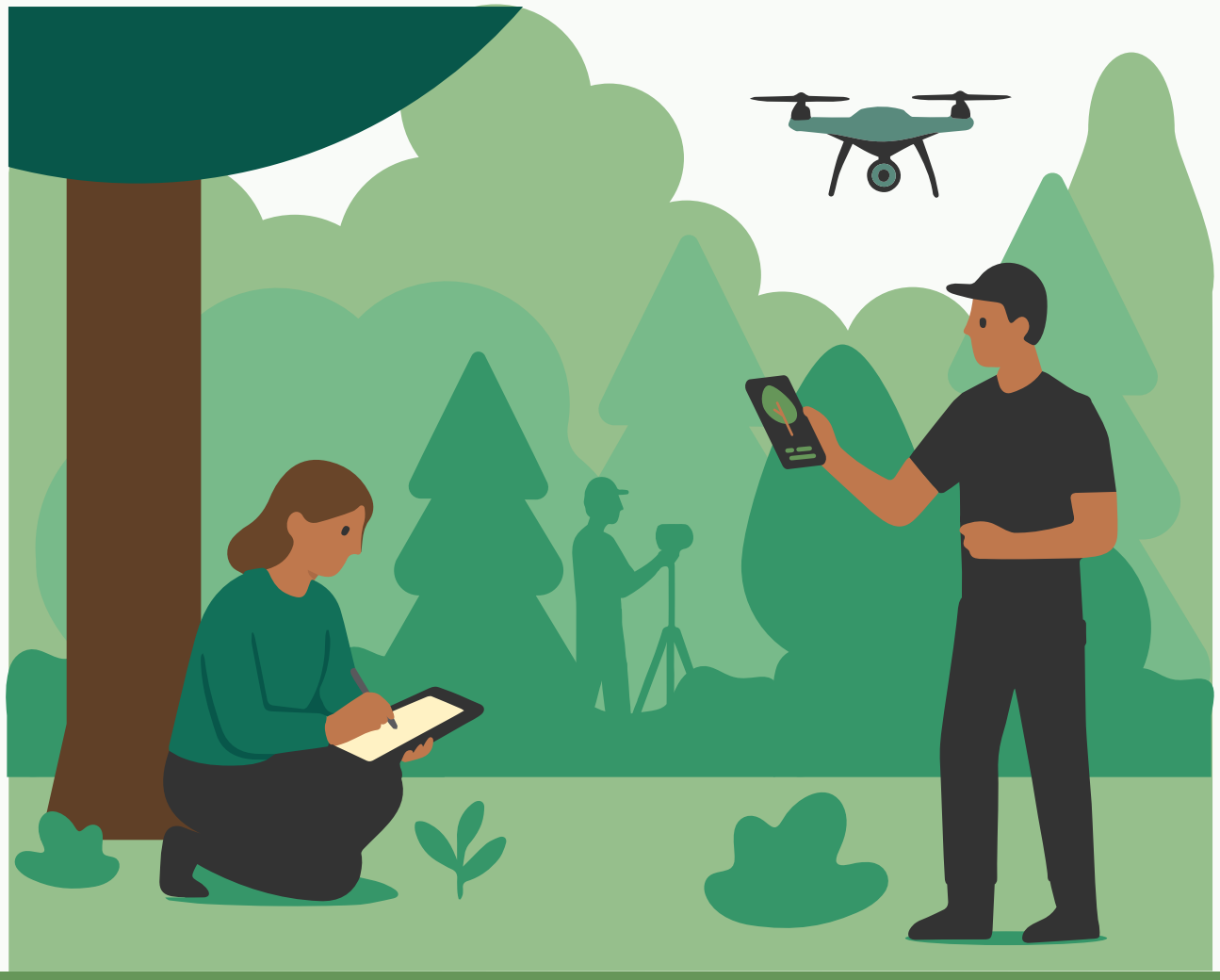
- ✓ Conducting a preliminary soil assessment, including analysis of the soil base saturation, is essential and allows for targeted and efficient application.
- ✓ The effects of rock dust on soil fauna are various and partly unknown. Therefore, it is recommended to leave areas untreated within the forest, which can serve as refugia and recolonization spots for soil fauna
- ✓ Using the helicopter to spread the rock dust is the most efficient and sustainable method for the forest.

Planting rich litter species to enhance mineral cycling:

- ✓ is only applicable on soils with some essential minerals left in the top soil or deeper soil layers.
- ✓ The use of large forest planting stock in smaller numbers is often more effective than deploying many small plants.
- ✓ Safeguarding the plantation from deer is essential.

6. Monitoring

Monitoring the restoration effort is essential to evaluate whether developments are in line with restoration goals aimed for and if there is a need to adapt. It is also often important for funders to track their investment and to maintain community engagement in the long term – so that changes can be demonstrated. Few or almost no long-term analyses of effectiveness and efficiency of various forest restoration measures are available.



Within the project, monitoring was a particular focus with activities carried out both in the actual restoration sites and in the chronosequence sites that served as a reference to specific restoration stages. In the restoration sites an initial assessment and a first monitoring of restoration success were conducted and its design and storage methods were developed before any activities started (Filipek et al., 2023, Filipek et al., 2024). By monitoring early successes or failures, potential problems can be noticed in time, allowing for follow-up actions to steer the restoration process in the right direction – a key feature of adaptive management. There were several common challenges and strategies of the early restoration phase noted as a result of early and targeted monitoring across the sites:

- Efficient planning of restoration and monitoring coordination of early action are crucial, especially where legislation requires restoration within two years of disturbance.
- Monitoring will be essential also with respect to the national level reporting needed under the Nature Restoration Law.
- In real life projects, the monitoring is often forgotten or underestimated in the planning of the projects.
- Novel monitoring techniques like eDNA, acoustics recorders and drones may in some cases help, but are not always necessary. In small projects, traditional monitoring is cost effective, certainly when it can be taken up in existing monitoring schemes like voluntary biodiversity networks or national forest inventories.
- On the indicators of the nature restoration regulation it is important to realise that even decades after the measures were taken, the restored areas may score lower. Monitoring thus has to be scheduled after 1, 3, 10, 20 and 30 years.
- Involvement of local communities in the planning and implementation process is essential to raise public awareness and increase their engagement.
- Ensuring continuous supply of adequate planting material is important when survival rate of regeneration is likely to be low due to challenging site conditions.
- Protection of restored forest stands is critical to ensure the sustainability of restoration efforts where herbivore populations are high.

Ground vegetation and tree seedlings assessment in Romania.

Soil profile taken in coppice forest in Serbia.

Unforeseen weather and climatic events such droughts, floods, storms, wildfires and pest outbreaks require adaptive restoration strategies. In addition to the initial and early phase assessments of the restored sites, evaluation of the effectiveness of applied restoration measures requires relevant benchmarks of progress and forecast objectives (e.g. chronosequence sites). To understand the spatial and temporal scale of ecosystem recovery Bush et al. (2025) developed guidance of various survey techniques including monitoring of vegetation, insects, birds and bats, forest inventory and techniques that refer to use of drone-based imagery, lidar and satellite imagery. Guidelines for restoring and monitoring soil health (Cordaro et al., 2025) also propose a scheme for selected scalable indicators to support long-term assessment of soil health. The soil carbon analyses over chronosequences gives a mixed picture.

Restoration measures that focused on diversification, underplanting with mainly broadleaved species and adaptive management consistently enhanced recovery of forest carbon stocks in both biomass and soils in the long term. The measures also had a positive effect of improving structural and species diversity. As in some cases forest restoration led to change in wood supply, the substantial adaptation in wood processing industry and related technologies will be necessary in the future.

Examples of monitoring experiences and lessons learnt are described below.

THE NETHERLANDS, KRONENBERGSE BOSSEN - HORST

Long-term Monitoring and Evaluation of Restoration Measures

Monitoring is a vital part of the restoration process. Establishing clear measurement points enables the objective tracking and evaluation of the effects of implemented measures. Monitoring must be conducted over multiple years, as some effects of restoration actions only become apparent in the long-term. For this reason, the establishment of permanent monitoring plots is essential. Data obtained from these plots can be reused and compared in future projects, enhancing knowledge of success factors and potential challenges in restoration initiatives. In the Dutch demo, we have ensured monitoring in the following ways:

- ✓ We have monitored the effects of planting rich litter species and rock dust amendment in permanent plots since 2019.
- ✓ All monitored restoration sites have been marked with GPS.
- ✓ In the Kronenberger bossen, the location of all planted trees has been marked with a GPS system, which ensures future follow up on e.g. survival success and growth. The first follow up will be done by the landowners in 2027, who will use the same information for their forest management.

We aim to revisit and monitor both types of plots in the upcoming five years. In new project proposals we

Forest monitoring measures to assess stand development in Czech.

Litter of broadleaved species planted to enrich soil in the Netherlands.

explicitly include the integration of these previous monitoring plots and allocate sufficient resources for their maintenance and continuation of these plots.

Lessons learnt (success factors and constraints)

- ✓ Establishing clear monitoring plots (and design before any action is taken in the field) is essential for objectively tracking and evaluating the effects of restoration measures.
- ✓ Long term monitoring is essential in slowly developing and long living ecosystems as forests.
- ✓ Monitoring in forests should include the whole ecosystem, including soil (abiotic and biotic), understory, and trees (both dead and alive). Novel methods of monitoring (eDNA, acoustics, drones) can be employed, but are not essential. Low cost dendrometric data, vegetation and fungal recording is sufficient.
- ✓ Permanent plots need management and maintenance.
- ✓ It is very difficult to find financial resources for long term monitoring.
- ✓ Discussing monitoring results with landowners stimulates their motivation to manage and monitor forests.

Collaboration with local volunteers and stakeholders can make monitoring more efficient and ensures direct involvement in the management and evaluation of the project.

ITALY, PO VALLEY

Planning for long term monitoring and research

In anticipation to ensure the long-term monitoring and research of the Italian demonstration area, the restoration initiative brought together:

- Two universities (University of Milano and University of Bolzano) that will provide, in the medium to long term, know-how and manpower for at least two future planned studies: the first at year 8 to 10 after planting, and the second after 16 – 20 years.
- Milan's main public planting institution (Parco Nord) will implement the results of these future findings into their operational methods used to reforest the city of Milan.
- Milan's main restoration-related accessible fund – ForestaMi will implement the latest scientific findings in their projects.

All these partnerships will collectively support the technical area of the reforestation and climate-resilient projects implementation across the Milan Metropolitan Area.

Baseline monitoring studies have been conducted in the Legnano area and are already planned for the remaining 3 areas. They consist in a complete census data after 18 months of planting, that include mortality (presence/absence), height, specie and competition

Afforestation in Italy.

index with neighbouring herbaceous plants, plus SPAD values for 3 representative species (*Acer campestre, Carpinus betulus* and *Celtis Australis* – heliophilous, intermediate and shade-tolerant respectively). SPAD values indicate leaf chlorophyll content, which reflects nitrogen availability and photosynthetic activity. Higher SPAD readings correspond to greater chlorophyll concentration, making them reliable indicators of early vegetative growth and plant vigour. Monitoring of the baseline census will allow to check initial growth and mortality rates of all species for each plot and will be evaluated after 10 and 20 years. Additionally, established SUPERB monitoring plots might be used by University of Milano as pivot plots to drone-monitoring training, so they will increasingly become "the" better drone-studied plots by the Forest Lab Team at the Department of Environmental Sciences Group. Drone monitoring will allow to generate detailed NDVI multi-seasonal indexes, mapping canopy structure and density through multispectral texture and shadow analysis, estimating biomass and leaf area index (LAI) via calibrated reflectance models and supporting species classification through spectral signatures and machine learning integration.

Lessons learnt (success factors and constraints)

- ✓ The integration of scientific outcomes from the demonstration areas into the ForestaMi Fund's projects will facilitate direct oversight, methodological alignment, and continuity with the SUPERB restoration approach.

Leaky dams installation as a form of Natural Flood Management structure in Scotland.

SCOTLAND, QUEEN ELIZABETH FOREST PARK

Monitoring restoration effectiveness across contrasting forest interventions

Monitoring in the Scottish demonstration area focuses on the ecological and hydrological performance of three restoration types: High-Elevation Planting (HEP), Natural Flood Management (NFM) and Continuous Cover Forestry (CCF).

At the HEP plots, Forestry and Land Scotland (FLS) will assess in 2026 the survival of seedlings and the effectiveness of bracken-control mats, with replanting if required. Installation of a cosmic-ray neutron sensor (CRNS) is under consideration to monitor soil-moisture dynamics and landslide risk.

At the NFM site in the Allt Glas sub-catchment, hydrological monitoring uses a SonTek-IQ flow-velocity probe to measure discharge. Three timber bunds and fourteen leaky dams are already operational, with a fourth bund under construction. Drone-derived terrain models from 2023–2025 indicate about 5,000 m³ of additional flood-storage capacity for extreme events and are guiding future designs. Continued hydrological monitoring will build a long-term dataset to analyse flow dynamics, evaluate the effectiveness of NFM interventions, and assess opportunities to extend the approach to other Duchray River sub-catchments.

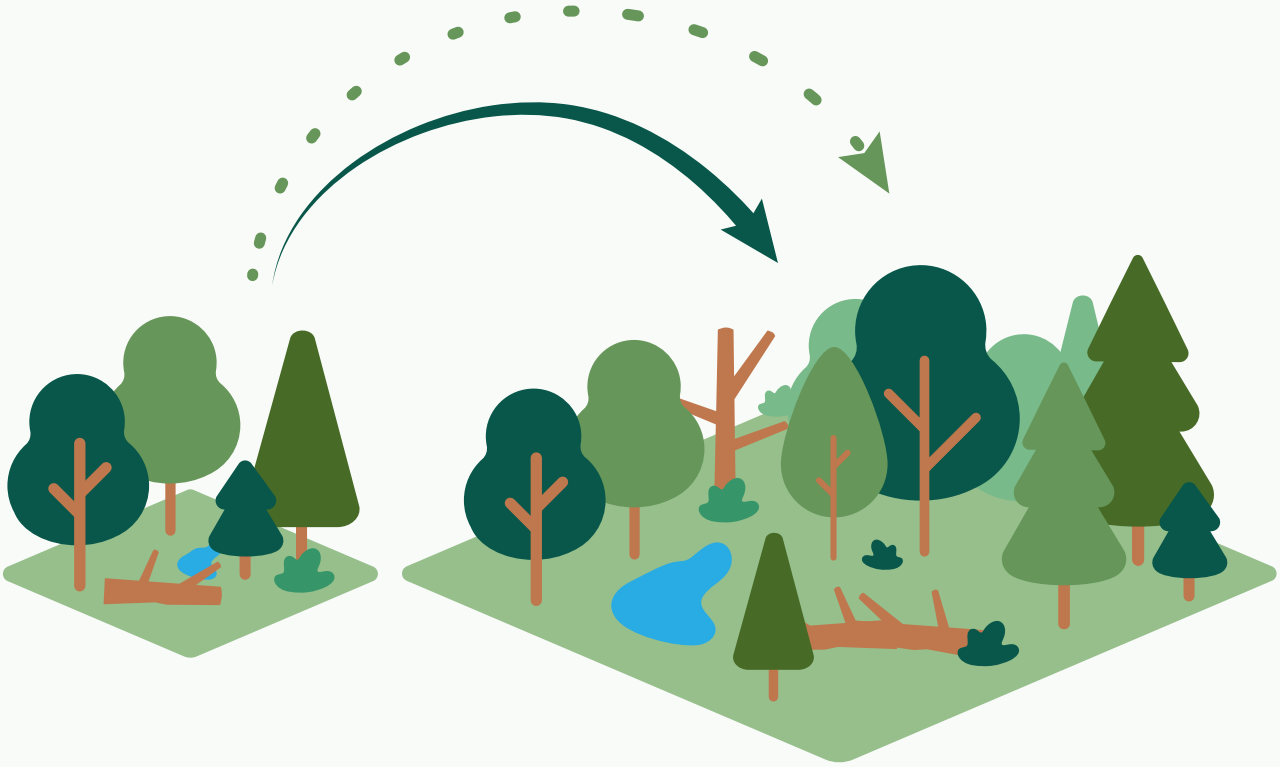
The CCF plots are monitored within FLS's Research Forest framework, focusing on basal area change, natural regeneration and browsing impacts under an active deer-management plan.

Lessons learnt (success factors and constraints)

- ✓ Site-specific yet harmonised indicators improve comparability and efficiency.
- ✓ Collaboration among Forest Research, Forest and Land Scotland and Scottish Environmental Protection Agency strengthens data quality and policy relevance.
- ✓ Long-term continuity depends on embedding monitoring within national research programmes.
- ✓ Combining ecological and hydrological data provides tangible evidence of multiple restoration benefits.

7. Upscaling

Upscaling of forest restoration from small-scale demonstrations to larger-scale restoration initiatives requires a multi-pronged strategy. The strategy that aligns financial incentives with ecological processes and regional and national demands, improves coordination between political and institutional actors, strengthens technical capacity, and builds strong cultural and social connections to forests. And most importantly the strategy that remains flexible and can be adapted to varying ecological, economic, and political contexts across European countries. Upscaling requires alignment between local practice and demands with policy frameworks. Lessons from demonstration areas shall feed directly into National Restoration Plans and help operationalize the EU Nature Restoration Regulation.



Within SUPERB various tools were developed and used to scale restoration initiatives. A bottom-up approach to upscaling was explored and developed into a good-practice guide for developing 'route-maps' for upscaling forest restoration. This approach encourages those involved in demonstration and pilot projects to identify challenges and explore the possible pathways to enable regional or national restorations (Jonsson & O'Hara. 2025). Knowledge consolidation infrastructures ensure impact beyond projects and assure take up by those institutions that are setting up national restoration plans. Permanent support and capacity building structures are needed. A permanent forest restoration support facility is needed. Having a bank of available potential sites, helps in finding funders and in quick starts.

- The 'route-map' plans developed by the SUPERB demonstrators indicated several cross-cutting lessons:
- Financial gaps remain the single most common barrier, as restoration costs tend to be high and long-term, while public and philanthropic funding schemes tend to have very limited time-frames.
- Costs of restoration vary in scale, complexity and patchiness of measures and opportunity costs from 1,036 (Romania) – 21,700 (Italy) Euro per hectare. This includes direct preparation, execution and some follow-up and monitoring costs only.
- Political misalignment between forestry and conservation policies complicates planning, but political champions and common EU-level frameworks, especially the Nature Restoration Regulation, create opportunities for progress.
- Stakeholder engagement is both a challenge and an enabler. As many landowners and forest industry resist change or lack restoration expertise, demonstration sites and participatory processes can build trust and transfer learning.
- Technical capacity remains uneven across Europe, underscoring the importance of research partnerships, training, and demonstration networks.
- Environmental uncertainty caused by climate change and invasive species looms large, yet reframing restoration as climate adaptation strengthens its legitimacy.
- Policy and legislative fragmentation and conflicts between forestry and nature laws can hinder upscaling, but harmonisation efforts and supportive governance can act as powerful enablers.

To assess the future trajectories of scaled out restoration methods from small-scale demonstrations to larger-scale restoration initiatives, modelling tools (e.g. EFISCEN-Space model) can be applied to investigate the long-term effects of applied restoration practices on the state of future forest. For instance, the outcomes of projected restoration scenarios (Filipek et al. 2025), developed together with SUPERB demonstration managers, highlighted that active management (not abandonment) is a key to achieve sustainable, structurally diverse and climate-smart forests. Although the short-term trade-offs resulted in net carbon loss with more drastic interventions applied, the long-term benefits included greater stability and adaptability to climate change.

In addition, developed platforms such as the Forest Knowledge Gateway (https://forestknowledge.eu) including the Marketplace (https://oppla.eu) showcase how knowledge exchange, innovation, and financial support converge to drive the scaling of forest restoration initiatives.

Below some examples of upscaling initiatives and lessons learnt based on the demonstration areas experiences.

CZECH REPUBLIC, VYSOČINA NORTH MORAVIA

Transferability and adaptability of restoration practices

In the Czech demonstration area upscaling represents the process of expanding proven forest restoration practices from pilot sites to a larger area and into forest management practice. The goal is to transfer the acquired knowledge, technologies, and organizational models to other regions through stakeholder engagement, practical educational, and data sharing. Emphasis is placed on the transferability and adaptability of solutions under different ecological conditions. In the first phase, upscaling focused on forest managers who already applied SUPERB's restoration practices in their forests (Lesy České republiky s.p, Vojenské lesy a statky ČR, s.p, KINSKÝ Žďár, a.s.). In the future, the plan is to use gained know-how knowledge and established network of sites in other projects as Living Labs, accompanied by

workshops and practical demonstrations, to encourage adoption among additional forest owners.

Lessons learnt

- ✓ The extent of the bark beetle outbreak largely accelerated the shift in forest owners' approach to restoration. After its decline, some forest managers no longer perceive the need to replace spruce monocultures with mixed stands as urgent. Therefore, it remains essential to actively disseminate scientific knowledge and promote best practices among the professional forestry community.

GERMANY, NORTH-RHINE WESTPHALIA

Stakeholder engagement for upscaling reforestation efforts

The upscaling of reforestation efforts is largely dependent on the interest and actions of forest managers and owners. These stakeholders value concrete guidance and inspiration on how to reforest calamity-affected areas. However, reforestation and silvicultural concepts provided by the regional public administration are often abstract and not easily applicable at the site-level. In this context, demonstration sites and practical exchanges can help translate theoretical approaches into actionable ideas and motivate the relevant stakeholder to take action. For instance, an excursion was organized with a local forest owner association to visit one of the SUPERB demo sites that a member of the association had realized. The visit was well-received, providing participants with a real-world example of how climate-adapted reforestation can be implemented. Forest owners had the opportunity to engage directly with those responsible for planning and execution, ask practical questions and possibly gain a clearer vision for their own forests stands. Following the excursion, the local forest manager reported a noticeable increase in requests from forest owners seeking support for reforestation measures on their properties.

Lessons learnt

- ✓ Demonstration sites are essential to inspire and motivate forest owners and managers to adopt climate-adapted reforestation approaches on their land. They provide tangible best-practice examples, helping to translate abstract guidelines into actionable steps for forest managers, practitioners and owners.
- ✓ Organizing ad-hoc excursions to restoration sites is often challenging due to limited personnel and time resources. The SUPERB demonstration sites are well documented and can thus be visited with limited preparation time to foster practical understanding and engagement.

Bark beetle calamity area in Germany.

SERBIA AND CROATIA CROSS-BORDER – CROATIAN SIDE

Upscaling forest restoration and supporting related activities through broader funding in Croatia

Upscaling forest restoration in Croatia presents financial challenges, especially compared to conventional forest management practices. To bridge funding gaps and ensure long-term continuity, partnerships with public and private stakeholders committed to climate-resilient landscapes need to be developed. These collaborations will support restoration activities such as planting, maintenance, and biodiversity enhancement, with new projects already being planned to secure additional funding.

Lessons learnt

- ✓ Co-developing funding strategies and project guidelines with stakeholders helps anticipate implementation, recognize possible challenges, improve effectiveness, and support the selection of the most suitable restoration approaches while aligning efforts with long-term restoration goals.
- ✓ Monitoring and data on ecological benefits such as biodiversity gains and climate adaptation are necessary for attracting more financial support.

Mature coppice forests in Serbia.

SERBIA, COPPICE FORESTS

Enhancing upscaling of new approaches in coppice forests management and restoration

The Coppice forests Serbia demonstration area covers coppice forests owned by two eparchies of a Serbian Orthodox Church (Žička and Šabačka) that operate as separated legal entities and are managed by two different forest management companies (ForestIng d.o.o. and Manastirske šume d.o.o.). The majority of the demonstration area (260 ha) is managed by ForestIng and only 20 ha is managed by Manastirske šume. ForestIng company will continue to apply experiences gained during the SUPERB not only on existing demonstration sites but on all coppice forests they manage in Serbia. Manastirske šume company plans to expand their forest management from the existing demonstration site (Cer) to suitable coppice forests under their management. Additionally, experience and knowledge gained by these two companies will further be shared through Chamber of Forestry Engineers of Serbia to a wider professional audience and make its way to the policy makers in Forestry Directorate.

Lessons learnt

- ✓ Smaller companies are more willing to experiment and to introduce new approaches due to their simpler organization and decision-making process, which allow them to be more dynamic in changing directions.
- ✓ In early days, the financial support for the upscaling initiatives was limited as foresters were not enthusiastic to deviate from their usual practices and existing instructions. The financial support provided within SUPERB was excellent tool to implement ideas into the demonstration sites, which can be used as a good practice reference for new companies that want to improve management of coppice forests. Yet, financial support by the Forestry Directorate can boost the upscaling.

8. Long-term maintenance plans

Ensuring that restoration efforts continue to deliver benefits well beyond the project lifetime has been a defining concern across all SUPERB demonstration areas. From the outset, future management and maintenance were conceived not as isolated interventions but as processes unfolding over decades, anchored in legislation, institutional mandates, and the commitments of forest administrations, while also relying on the engagement of landowners, managers, and local communities. Although the approaches vary according to ownership structures, ecological challenges, and governance frameworks, they all converge on the recognition that restoration cannot stop at initial planting or ecological intervention but requires continuous monitoring, long-term adaptation, and stakeholder participation.

Taken together, all twelve demonstration areas confirm that restoration is understood as a long-term process rather than a project with a fixed endpoint. Maintenance is assured either through legislation, management contracts, or institutional mandates. Monitoring remains at the core of every plan, using approaches ranging from national inventories to innovative digital tools. Follow-up measures, already scheduled, include invasive species control, enrichment planting, fire management, water retention, and habitat connectivity. Nearly all sites are anchored in comprehensive management plans that balance ecological, social, and economic objectives. Crucially, each area envisages itself as a demonstration site well into the future, ensuring that SUPERB's knowledge and practices remain visible and relevant, inspiring future restoration efforts across Europe.

In the remainder of this chapter, the long-term maintenance per demo is described.

Denmark – Northern Zealand

The demo area is part of a national political agreement concerning layout of 75.000 ha biodiversity forest in the state-owned forests where production forest through restoration activities is turned into biodiversity forests with no timber production. This means that for the time being there is a strong political frame which assures that the demo site will be kept as a restoration site. Further restoration activities are planned within the demo area as well as in the whole forest complex. Further restoration plans include restoration of natural hydrology, cutting of forest stands to promote old trees and tree with highest potential for biodiversity as well as removal/cutting of non-native species. Cutting will be performed within the next 5 years while restoration of hydrology have a time frame of 15 years.

The restoration actions performed within SUPERB is described and incorporated in the management plan made for whole the forest complex. Furthermore, the scheduled additional restoration activities within the demo site (described above) are also described and incorporated in the management plan. The management plan has been in public hearing and was approved recently.

In the Danish demo in Northern Zealand they plan to keep assessing the development of the restored area by monitoring of the survival rates and growth rate on a subset of plants in each enrichment plantings and the plantings of Ash. This data will help refine species recommendations as well as optimizing planting schemes of mixtures of species when plants are planted in mixtures and not as monocultures. Furthermore, hopefully additional biodiversity monitoring can be performed in order to document the potential and value of the different restoration activities.

Nature Agency has in general a long tradition for engaging with stakeholders and different user groups of the state owned forests in order to balance all the different interests connected to the areas. With the change from production forest to biodiversity forest Nature Agency have had an intense focus on engagement with stakeholders and users to get their input concerning the planned restoration activities in order to balance nature and restoration activities and at the same time assure that the areas still remains attractive for the many stakeholders and user groups. An example could be engagement with stakeholders in order to assure that fenced grazing areas is made with sufficient gates placed conveniently to make it possible for users to trespass grazing areas in the most convenient and smooth way. The plan is to continue with the engagement of stakeholders.

The restoration site will be used as demonstration site for students, forest managers and forest owners as a practical example on how production forest through restoration activities can be turned into a forest more biodiverse and rich in habitats.

Denmark – Thy

The restored areas in Thy are all state owned and thereby object to/for political movements. However, for the time being there is a strong political frame that assures that the demo site can continue as a restoration site. Nevertheless, there is no legislative agreements as such assuring that the demo site is secured.

Further restoration activities are planned within the demo area as well as in the whole forest complex. Further restoration plans include restoration of natural hydrology, cutting of forest stands to promote old trees and trees with highest potential for biodiversity as well as removal/cutting of non-native species. Cuttings will be performed within the next 5 years while restoration of hydrology have a time frame of 15 years. The established corridor, which is an essential element of the restoration site, will be closely monitored to ensure a continued light open corridor - by continuously removing regrowth of invasive species, especially Sitka and Contorta. The restoration actions performed within SUPERB are described and incorporated in the management plan made for whole the forest complex. Furthermore, the scheduled additional restoration activities planned to do within the demo site (described above) will be incorporated in the future management plan.

In the Thy demo it is planned to keep assessing the development of the restored area. This includes lighter monitoring like e.g. monitoring of survival rates of the enrichment plantings. Furthermore, additional biodiversity monitoring is planned in the demo area in order to document the potential and value of the different restoration activities, with a special attention to the area where the topsoil was removed. Here the development of the vegetation on those 'new' chalk soils will be followed.

In the Thy demo it is planned to continue with the engagement of stakeholders. In general, The Danish Nature Agency have a long tradition for engaging with stakeholders and different user groups of the state owned forests in order to balance all the different interests connected to the areas. The Nature Agency have had an intense focus on engagement with stakeholders and users to get their input concerning the planned restoration activities in order to balance nature and restoration activities and at the same time assure that the areas still remains attractive for the many stakeholders and user groups.

The restored areas in the Thy demo site will be used as demonstration site for students, forest managers and forest owners as a practical example on how production forest through restoration activities can be turned into a forest more biodiverse and rich in habitats.

The Netherlands

In the Dutch demonstration areas, two main groups of stakeholders are involved: the municipality of Horst aan de Maas and private forest owners. Bosgroep Zuid Nederland is a cooperative of members who jointly manage forest and nature areas, and the municipality of Horst aan de Maas is a member of this cooperative.

In collaboration with the municipality, a ten-year management vision has been developed to define the management of all municipal forests, including the Kronenbergse Bossen, where the demonstration site is

located. The management of these forests is therefore secured for the coming years. The management plan includes maintenance of the new plantings, monitoring of establishment and growth, vegetation control, and potential thinnings to improve light conditions and structural diversity. Within this management framework, part of the monitoring of the new plantings is included, such as checking establishment success and maintenance. However, the scientific monitoring of the permanent monitoring plots is not covered by regular management. To continue this monitoring, new project opportunities will be explored.

For the municipal site, the newly planted areas will be monitored and released from competing vegetation over the next ten years. If necessary, an additional thinning may be carried out to increase light availability in the canopy. For the privately owned sites, follow-up will continue for the next five years, during which the plantings will be monitored three more times, in 2027, 2029 and 2030. The implementation of any required management measures will be the responsibility of the private owners themselves.

For private forest owners, a document has been signed in which they commit to maintaining the plantings for five years after the project. Beyond this commitment, participation is voluntary, and the responsibility for implementing and continuing restoration measures, and monitoring lies with the owners themselves. In the coming five years, the plantings will be followed up on in collaboration with Bosgroep and the local volunteer group. The decision to implement further measures, however, remains with the owners, who are also financially responsible for them. Bosgroep offers guidance and support, but there are no additional legal or regulatory obligations requiring private owners to keep the site as a restoration area.

An online application will be made available by the municipality and Bosgroep Zuid Nederland, which will show all plantings within their properties. As this application also gathers data on tree survival, Bosgroep Zuid Nederland is able to monitor survival of planted trees (per species), being an important restoration success factor.

Bosgroep Zuid Nederland and the municipality of Horst aan de Maas will continue to be actively involved in managing the demonstration site. For the privately owned areas, the Bosgroep will maintain contact with the landowners and offer advice when necessary. Additionally, the online platform will function as a communication and information tool, enabling all private forest owners to monitor the inventory of the groups planted. A WhatsApp group will also be established with the landowners to facilitate direct communication and coordination of follow-up activities. However, no wider public engagement is planned beyond the group of involved landowners, Bosgroep Zuid Nederland, and the municipality.

The site is not the only location in the Netherlands where these measures have been implemented, but it is the only one within the municipality of Horst aan de Maas. If events or activities are organised in or near the municipality, the demonstration site will certainly be used as an example location. It will serve to illustrate the applied restoration measures and to share experiences with local forest owners, professionals, and other interested stakeholders. In addition, the permanent plots that have been used within the WP6 chronosequence are also demonstration sites.

France

In the French demo, unfortunately, there is no signed agreement or contract with the forest owner to ensure the long-term preservation of the restored site. The owner is free to remove the hedgerow if it pleases him. This compromise was necessary to facilitate the owner's acceptance for the experimental restoration process, as they usually are resistant to administrative procedures and constraints. However, forest managers

and advisors have been informed of the importance of these forest hedgerows and of the need to safeguard them wherever possible. The newly planted hedgerows are spread across dozens of private properties and are not yet included in individual management plans. They will be incorporated by the forest manager as each management plan is renewed, on average every 10 to 15 years. The forest manager will include a description of the hedgerow and its vitality, but no management interventions will be prescribed that could undermine the integrity of the hedgerow unless its survival is at stake.

It is planned to keep assessing the development of the restored area for the next 10 years. This lighter monitoring will still include recording survival rates, game and drought damage, and measuring growth rate on a sample of plants in each planted hedgerow. These data will help refine species recommendations across different soil types and under varying climatic conditions. In addition, additional biodiversity monitoring is planned in the newly established hedgerows to document the onset of their beneficial effects.

INRAE still has remaining funds from a parallel H2020 project, which will be allocated to model the impact of broadleaved hedgerows on the landscape resistance and resilience to storms and fires. Another action expected for 2026 involves conducting semi-structured interviews with private forest owners to better understand why they choose to preserve the mature hedgerows located in their property. Motivations may include ecological values, property boundaries, topography, opposition to conventional management, or other reasons. Gaining insights into these incentives will help us adapt our communication strategies to encourage wider hedgerow preservation. In addition, new research proposals are submitted to secure funding for further follow-up studies and to strengthen stakeholder engagement.

The SUPERB project helped create momentum that has already led to the formation of a dynamic local community focused on monitoring, conserving and expanding broadleaved habitats. It is likely that the organisation of annual stakeholder workshops are pursued to gather this community. At these events, new results will be shared in the coming years, while also inviting other stakeholders to share their experiences in a less top-down approach.

The restored areas will be used as demonstration sites for both forest owners and forest managers to disseminate the demo's results and keep engaging new people. A tour route and educational materials have already been developed and used several times and will continue to support outreach and knowledge transfer.

Italy

All four public local administrations (municipalities) have formally undertaken long-term maintenance plans of the restored areas through official "takeover" public contracts lasting 25 years. After that time window, the area will be legally considered a Forest and then actively protected by the regional law.

Municipalities will keep the maintenance efforts for the foreseeable future. Plans include occasional watering during drought events, pruning and cleaning. Also, municipalities will probably choose to insert the new areas into the local "green plan" (an urban planning tool that defines the medium- to long-term strategy for the management and development of green spaces within a municipality, integrating them with general urban planning) and/or the regional green network, etc.

It is planned to keep assessing the development of the restored area for the next 10 years. An initial baseline study is already currently underway, and include recording survival rates and drought damage, and measuring growth rates. These data will help refine species recommendations across different density gradients and under varying climatic conditions. In addition, additional biodiversity monitoring is planned in the newly established forests to document the onset of their beneficial effects. At year 10, a thorough study

of growth and overall stand performance comparing both density and provenance is planned.

Stakeholder presence will be maintained at least at base level because the demo has been invited to participate in the school's environmental education program each year (paid by the school themselves), and studies for academic purposes are planned and detailed in previous point. The area will also be presented to local possible users in the next years.

A tour route and educational materials have already been developed and used several times and will continue to support outreach and knowledge transfer. Besides, the areas will be the base for the academic density and provenance studies.

Czech Republic

For the Czech demo area no formal agreement on follow-up management has been established, but they rely on mutual trust with stakeholders and their commitment to carry out site management in consultation with the Czech demo partners. The standard silvicultural recommendations based on the forest management plan apply also to regenerated areas. This plan is typically prepared for a 10-year period and is mandatory for all forest properties larger than 50 hectares. Smaller properties follow a simplified version, referred to as management guidelines. Following the SUPERB project, topics for final theses (bachelor's and master's) are being assigned, focusing on monitoring the development of forest stands in selected study areas. For selected forest properties, it is planned to formulate basic recommendations for the regeneration of disturbed sites. In cooperation with forest management, efforts has been focused on identifying optimal tending practices for newly established, mixed stands.

It is planned to maintain the monitoring for at least 5 to 10 years to assess the dynamics of vegetation development on disturbed sites. The focus will primarily be on evaluating which tree species mixtures are most promising and which regeneration methods have met the silvicultural objectives.

It will depend on the project and financial resources if the Czech demo is able to secure stakeholder engagement in the future. However, in the proposed projects, it is planned to build on the workshops already carried out with the stakeholder community, which has been successfully established in previous years.

The demo area will be used for demonstration purposes in the future, showcasing both alternative regeneration methods and the management of young forest stands. This will take place either during specialized events or as part of excursions to the respective forest properties.

Sweden

After the SUPERB project, the main responsibility for the restored areas will be taken by the forest owners, Umeå Municipality and Sveaskog. In restoration site Ume Älvdal, the development of the area will initially be followed within a research project led by SLU. In Ecopark Skatan, the future development will be followed by Sveaskog together with the external advisory board of Ecopark Skatan, in which both SLU and the County Administrative Board of Västerbotten (CAB) are members. At a larger scale, the development and effects of the nature conservation measures done in the network of Sveaskog's Ecoparks in Sweden, are followed by the project Effekt 20, which is run in close collaboration with researchers at SLU. Besides this, the Nature conservation department of CAB will follow the development of both restoration sites as part of a general interest in following and learning from the restoration measures they have been involved in, especially as the CAB is likely to get a coordinating role for the implementation of the NRR in the county. the restoration actions will continue in both restoration site Ume Älvdal and Ecopark Skatan, also after the ending of the SUPERB-project.

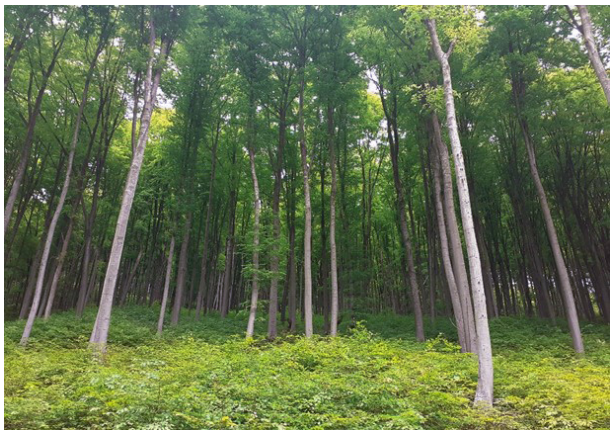
The management of restoration site Ume Älvdal is part of the local action plan for the White Backed Woodpecker in Umeå Municipality, which in turn is part of a national action plan for the species. The local plan describes the purpose and aim of the plan, the pre-conditions in the area (both in general and in specific forest stands), what actions that are suggested in each stand or area, the impact of the suggested actions (both ecological and in society) and how the area will be monitored. In restoration site Ume Älvdal, all forest owners have signed an agreement to follow the intentions in the municipalities action plan for White backed woodpecker for at least ten years.

The management of Ecopark Skatan follows the management plan that was developed in 2009, when the park was initiated. It describes the purpose and aim of ecoparks in general and specifically for Ecopark Skatan; the initial conditions in general and in each stand based on different factors such as amount of dead wood, deciduous trees and nature conservation species; stakeholders and other interests in the area (reindeer herding, cultural values, recreation and outdoor activities, hunting and fishing) and different management activities and methods and what forest type to aim for in each stand. In restoration site Ecopark Skatan, Sveaskog have a 50-year nature conservation agreement with the state for all their Ecoparks, agreeing to manage the forests with higher nature conservation ambitions and with more concern of recreational values and outdoor life than in the conventionally managed forest outside the Ecoparks. In restoration site Ume Älvdal there will more meetings with the local villages and neighbours as the project continues. No other stakeholder engagement activities are planned now but are likely to be arranged later on. In restoration site Ecopark Skatan, Sveaskog have regular consultations with the main stakeholders in the area, discussing planned restoration actions for the coming year and giving the stakeholders possibility to rise any concerns or questions they might have.

In Vindelälven-Juhttátahkka demo area as a whole, there will be continuous occasions for stakeholder engagement with focus on restoration, both as part of the regional forest program, the coming implementation of the NRR and other projects and assignments that CAB and SLU are involved in.

Both restoration site Ume Älvdal and Ecoparc Skatan are already today regularly used as demonstration sites and visited by e.g. student groups. In Ume Älvdal the SUPERB-project have produced information boards directed to the public and people living nearby the site. The SUPERB-project have also produced information boards about different kinds of restoration measures that will be placed within a demonstration and research site at Svartberget Research Station. The information on these boards are mainly directed to forest owners, forest students and other forest stakeholders.

Serbia



There was no need for signed agreements with forest owners. Monasteries will keep it as forest restoration sites as long as it is needed to become grown forest. The current management plan developed during the SUPERB project lasts 6-7 more years. It includes silvicultural measures such as: vegetation control, additional planting if needed, cutting offshoots and shoots of unwanted species. Besides these silvicultural measures, there are no follow up actions

scheduled at the moment. The silvicultural measures will be performed by the private forest management companies that are working with monasteries. The company that has been doing the forest restoration activities will also be conducting forest monitoring according to protocols relevant to the reforestation and forest regeneration.

It is planned to stay in contact with the monasteries and their forest management companies by visiting them in the upcoming years. Most likely an annual meeting (less formal ones) with both groups of stakeholders separately will take place. The demo area can be used within the educational institution to showcase the demonstration area to future forestry engineers during field excursions. Also, it will be used as dissemination of our demo's work to other forest owners and forest managers.

Croatia – cross-border

Most restoration activities—such as site preparation, planting, maintenance, and fencing—were carried out by state enterprise. These actions will continue beyond the project, as they are mandated by the Forest Act, which includes obligations for the upkeep of restored areas. A forest management plan exists beyond the SUPERB project, based on the national Forest Act. It includes sustainable practices such as restoration, protection, biodiversity conservation, and regular monitoring. These plans are implemented by the state forest enterprise in collaboration with scientific institutions and local communities. The future development of the restored area will be supported through ongoing maintenance activities, including weeding, additional planting, and the securing or replacement of fencing. Monitoring and surveys will continue as part of academic research, and new projects are planned to expand restoration efforts.

Through the SUPERB project, existing communication and collaboration with a state enterprise in Croatia were further strengthened through joint activities. Building on this progress, it is planned to continue stakeholder engagement with a focus on shared responsibilities in maintaining and monitoring restored areas. The demonstration sites will promote biodiversity and enhance forest value. They will also serve educational purposes for scientists, practitioners, forest owners, and local communities. Through the SUPERB project, two informational panels were installed at the sites in Croatia to explain the project's purpose, the restoration process, and to educate all visitors about the importance of these efforts.

Serbia – cross-border

The restoration site is managed by the PE Vojvodinašume and is located on state-owned land. Forest management is carried out according to 10-year management plans, which are approved by the State Directorate for Forestry (Ministry of Forestry) and the Provincial Secretariat for Forestry. Conditions for protection and restoration activities are provided, among other state and provincial institutions, by the Provincial Institute for Nature Protection. These legal and regulatory frameworks ensure that the site is maintained as a restoration area and that all management activities comply with national and regional conservation and forestry regulations. The management plan includes measures for sustainable harvesting, reforestation, and restoration activities,

ensuring that ecological integrity is maintained. It also outlines monitoring protocols, protection of species and habitats, and coordination with local stakeholders to guarantee that forest management aligns with both conservation objectives and socio-economic needs.

The 10-year forest management plans provide legal framework for continuous monitoring and sustainable management. Following these regulations, regular monitoring is conducted to assess the development and success of restoration activities. Key measurements include tree height and diameter at breast height (DBH), which are recorded systematically. Additionally, the survival rate of planted trees is tracked annually to ensure that reforestation goals are being met. Monitoring also includes assessing pressures from game and other potential disturbances, such as pests or environmental stressors. This structured, legally mandated monitoring ensures that restoration objectives—such as increasing forest cover, improving biodiversity, and enhancing resilience—are carefully evaluated and adjusted as needed over time.

Several follow-up actions are planned through ongoing projects. One of them is the IPA SRB-CRO REBIOFORESTS project, which started in 2025 and will run until 2027 in collaboration with Croatian partners. This project focuses on forest restoration and management, building on the experience and lessons learned from our demo area. Another related initiative is the Interreg Danube CLIMANATRES project, which addresses forest restoration across the region, with particular emphasis on climate resilience and ecological sustainability. Through these projects, the implementation of restoration activities, monitor outcomes, and share best practices for sustainable forest management will continue.

Stakeholder engagement will continue in the future. Through other project activities and ongoing long-term collaboration with relevant actors in forestry and nature protection, regular contact with key stakeholders is maintained. Currently, for the nationally funded SmartTogether project, planned activities include active engagement of relevant stakeholders to improve cooperation and facilitate the exchange of information between science and practice in the forestry sector. This approach ensures that restoration and management practices are informed by both scientific knowledge and practical experience, fostering stronger partnerships and more effective implementation of forest management objectives.

The site will serve as a demonstration area for best practices in sustainable forest management and restoration. It will showcase effective collaboration between science and practice, providing a practical example of how restoration methods can be successfully implemented. Within Vojvodinašume, the Tourist Center of the biosphere reserve “Gornje Podunavlje” will promote the site as a model for training, knowledge exchange, and outreach to forest managers, researchers, tourists, and other stakeholders. The demonstration area will also be used to share lessons learned, encourage the adoption of innovative restoration techniques, and support the long-term sustainability and resilience of the region’s forests.

Spain

No formal agreements are required for public forests, as the restored areas funded by SUPERB will be integrated into the Junta de Castilla y León’s restoration programme under its direct management. In heritage forests, although no written agreements have been signed after SUPERB, there is a shared commitment to continue collaboration with local councils and mediators, either through direct management by Cesefor or through delegated management arrangements. Each public forest or group of public forests within the demo area has its own management plan, which defines the specific actions to be carried out in each site. In addition, the demo area is included in the annual forest fire prevention and extinction plan.

Spanish public procurement law requires a two-year monitoring period for restoration actions. In the longer term, the Junta de Castilla y León can continue pursuing SUPERB's objectives—such as wildfire prevention and silvicultural treatments—through its forest management crews, whose capacity may be expanded depending on the restored area. Additional reforestation actions co-financed by EAFRD funds are also possible. Moreover, long-term monitoring could be supported by the European Forest Damage Network if its plots are established in the upscaling areas.

Stakeholder engagement will continue through the *Mesa de la Castaña del Bierzo*—an organization promoting chestnut cultivation and linking landowners with policymakers—and through *Biocastanea*, the annual international chestnut fair held in El Bierzo.

Experimental plots for biodiversity monitoring have already been established by other projects (e.g., AGROFOres, funded by Fundación Biodiversidad) and through collaboration agreements between Cesefor and the Junta de Castilla y León. Future soil biodiversity sampling will continue if the current LIFE project proposals are approved.

Scotland

Within the Memorandum of Understanding between Forest Research (FR) and Forestry and Land Scotland (FLS) that sets out the terms of the Queen Elizabeth Forest Park (QEFP) research forest, the ambition exists that existing experimental research stands are preserved for as long as practicable, in alignment with FLS management plans where possible.

The inclusion of these sites within FLS's operational management framework and within the Research Forest network provides both institutional and regulatory continuity, ensuring that the areas will remain under active restoration and monitoring management for the foreseeable future.

For the Continuous Cover Forestry (CCF) areas, FLS – an agency of the Scottish Government and a SUPERB co-partner – has already integrated the long-term maintenance and progression of CCF management into its forest management planning framework. This includes a projected target of maintaining and gradually expanding CCF practices to approximately 10 % of the total forest area managed by FLS, wherever site conditions are suitable – while ensuring that the broader requirements of the Scottish Government are met, i.e. timber production and carbon storage targets.

For the Natural Flood Management (NFM) and High Elevation Planting (HEP) sites, monitoring and follow-up maintenance will continue in collaboration with FLS.

- On the NFM site, monitoring of hydrological performance will be continued after the project, with FLS supporting the maintenance of in-stream structures and data infrastructure, and FR continuing with the data analysis and modelling, supported by existing funding streams.

- On the HEP site, follow-up project proposals are under preparation to carry out mid-term monitoring of soil water content and to assess the influence of vegetation on slope stability. Part of the required instrumentation is already available within Forest Research (FR). At the HEP site, the planned installation of a Cosmic-Ray Neutron Sensor (CRNS) will allow the creation of a small local soil-moisture monitoring network, complementing two CRNS probes installed by FR in summer 2025 on nearby sites. This network will provide a data backbone to link soil moisture, vegetation development and slope stability.

Several project proposals are currently being developed that build directly on the work and data produced under SUPERB.

- Within the NFM catchment, FLS is evaluating additional interventions to strengthen the effectiveness of existing measures, in line with recommendations from the FR hydrological analysis report.
- A new concept is also being explored to scale up the NFM assessment to a larger neighbouring sub-catchment (the Duchray River) in order to evaluate the downstream effects of NFM on flood attenuation in the main catchment.

These follow-up initiatives will ensure that the knowledge and infrastructure developed through SUPERB remain active and continue to generate new evidence for nature-based flood mitigation.

The long-term management and maintenance of the restored areas will be ensured through FLS's management strategy and its operational planning framework.

- The CCF component is embedded in FLS's long-term objectives for forest restructuring and continuous cover expansion.
- For the NFM and HEP sites, management will focus on maintenance of restoration structures, continued environmental monitoring, and integration into ongoing research programmes (e.g. Living Labs framework).
- Stakeholder engagement will continue, involving both local communities and institutional partners such as SEPA and the Forth Rivers Trust, which are active in related or sister initiatives (e.g. the MERLIN project). Several research projects are underway and more planned for QEFP, all of which include and will include Knowledge Exchange and social science components including stakeholder activities.

An agreement with FLS on the long-term maintenance of the SUPERB demonstration areas and chronosequence is in place and subject to yearly updates.

The entire demonstration area lies within the QEFP – one of FR's Research Forests – ensuring institutional continuity and long-term visibility of the restoration work.

Stakeholder engagement is among our objectives and has been included in new project draft proposals. The aim is to maintain strong connections with local communities, institutional partners (e.g. SEPA, Forth Rivers Trust) and organisations involved in related or sister projects such as MERLIN. Planned activities include:

- Post-project communication and outreach, to share updates and collect local feedback.
- Collaborative workshops and data-sharing initiatives with FLS and FR, aimed at transferring knowledge and coordinating restoration monitoring efforts.
- Integration into wider catchment-level networks to align SUPERB outcomes with ongoing regional nature-based restoration initiatives.
  - » This continued engagement will help sustain visibility, stakeholder ownership and adaptive management beyond the project's duration.

The SUPERB demonstration area will remain fully operational within the Queen Elizabeth Forest Park (QEFP), benefiting from its designation as one of Forest Research's Research Forests. Both the NFM and HEP components are included as candidate Living Labs sites, ensuring that the restored areas continue to be used for demonstration, knowledge exchange and applied research on climate resilience and forest adaptation. Several CCF chronosequence stands are currently the focus of UK Government-funded research on the interaction of CCF silvicultural and abiotic disturbances (windstorms and drought)

Germany

The public state subsidies that were used in conjunction with the SUPERB project funding in some of the demo sites require maintaining the introduced species mixtures on the restoration sites for a duration of at least 10 years. It is in the general interest of the owners to maintain the restored forest stands, but there are no signed agreements besides the mentioned legislative obligation for some sites. The majority of the local forest

managers and owners verbally confirmed their interest in maintaining the established stands in their structure and composition and provide the sites as demonstration sites for future site visits and excursions.

There is no dedicated management plan including all demonstration sites. The demo sites will be managed according to the goals and forest management plans of the respective regional forestry offices and forest owners. The site managers will reassess the development of the sites as part of regular forest management interventions and decide on appropriate site tending measures. There are no dedicated monitoring efforts foreseen. However, the sites are intended to be maintained as demonstration areas. Their use in follow-up projects is possible depending on future research objectives and the approval of the respective forest owners and local site managers.

There are no immediate follow-up actions scheduled for the SUPERB demo sites. The state forest service is working on developing a regional network of demonstration sites focused on climate-adapted reforestation throughout North-Rhine Westphalia. The SUPERB demonstration sites are intended to be integrated into this network. The additional restoration sites are likewise designated for use in demonstration and training activities such as treatment interventions and maintenance of mixed-species forest stands.

The SUPERB demo sites as well as the additional demo areas are intended to serve as platforms for ongoing stakeholder engagement through site visits, excursions and training activities for forest manager and owners. There has already been considerable interest in such visits and future requests will continue to utilize these areas to foster knowledge exchange and practical learning.

The restored areas will be used as demonstration sites to disseminate and build on the experience gained through the SUPERB project. It is also intended to use the sites for practical silvicultural trainings of forest managers and possibly other interested stakeholders. It is intended to place information boards on the sites to educate local visitors about the activities that took place there. The sites will also be used for outreach and knowledge transfer targeting local and national media.

Romania

Biodiversity in the Făgăraș Mountains demonstration area is on its increasing trend to the levels found only in natural undisturbed areas. This goal is mainly supported by the non-intervention based management perform by Foundation Carpathia partners in the remaining natural forests. Also the recovery processes in forests disturbed by anthropic activities are enhanced through the restoration activities performed within the SUPERB project. The restoration activities in the project area will continue in the Norway spruce monocultures for at least another 10 years, same in the former clear cuts where the species composition was diversified through plantations.

After the restoration activities will end the transition to forests similar to the natural ones will be based only on natural evolutive processes. Beside the specific monitoring activities inside the project, the whole Natura 2000 forest habitats will be monitored at a larger scale and special attention will be given to the following aspects:

- transition trends between forest habitats,
- shift the forest species following climatic changes,
- health of the forest habitats,
- sensitive borderline and transition habitats to alpine areas will be carefully monitored.

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10. Annex

Overview of funding schemes relevant to SUPERB-like restoration activities

European Union funding programs

The European Union can support forest restoration through several funding instruments:

- The European Agricultural Fund for Rural Development (EAFRD) provides subsidies for afforestation, agroforestry and forest-environmental measures under EU Rural Development Policy (RDP) as part of the Common Agricultural Policy (CAP). However, historical data show that CAP-RDP funding is mainly used for agri-environmental measures, with forest-related biodiversity measures accounting for only 0.3% of total RDP expenditure during the 2014-2020 CAP period (EC, 2019).
- The LIFE programme has supported hundreds of projects focused on habitat restoration, species conservation, and climate adaptation.
- The Interreg programme promotes cross-border cooperation and knowledge exchange in many topics including restoration, often funding pilot projects with strong regional benefits.

Together, LIFE and Interreg programmes have funded roughly 700 projects aiming at ecological forest restoration over the past 20 years (European Commission, 2023; Interact, 2023). The fundings are typically awarded through calls for proposals, projects require co-financing from applicants and are evaluated according to their alignment with EU goals.

National fundings

The EU member states can support forest restoration projects through several instruments. They are first in charge of implementing the CAP-RDP policy, which includes selecting the appropriate development measures suited to their national or regional context, setting up the application procedures for subsidies, managing validation processes, and providing national co-financing that matches EU contributions. The above Danish subsidy scheme is one such example. In addition, national administrations may implement their own forest restoration funding schemes, either as part of binding legal frameworks (hard-law instruments) or as voluntary initiatives aimed at supporting the fulfilment of national forest, climate or environmental strategies and action plans.

Subsidies or payments for ecosystem services (PES)

These mechanisms provide financial incentives to landowners or forest managers for maintaining or enhancing ecosystem services such as carbon sequestration, biodiversity conservation, water regulation, soil protection, etc. The implemented practices must be supported by quantitative evidence of their benefits on ES (e.g. afforestation of degraded or bare soil to increase carbon storage, avoiding tillage to avoid carbon release, avoiding clear-cutting on upstream river slopes to protect the soil and water quality, etc.). These projects can be publicly (government-run) or privately (companies, NGOs) funded.

Voluntary contracts

The administration can establish contracts with private forest owners to encourage the integration of nature conservation values on top of legal requirements through a temporary economic compensation. Building on voluntariness, these arrangements treat landowners in ways that are considered fairer than top-down regulation, potentially reducing conflict between the designer and the target of the regulation (Paloniemi and Tikka, 2008). The attractiveness of the contracts depends on their design, including the level of financial compensation, the length of the contract, and the implementation process as such, on top of contextual factors like the forest condition and owner's confidence in their authorities.

Philanthropic and private funding

Foundations, NGOs, companies, and individuals may finance forest restoration as part of their environmental or social responsibility goals. These mechanisms are often more flexible and faster to deploy than public funds, involve less paperwork or less scientific rationale for the project owner. The projects must generally be submitted in response to calls for proposals or spontaneously and are reviewed by a committee that verifies whether they meet the fund's specifications and are consistent with the fund's values.

Biodiversity offsetting

This mechanism enables project developers (in infrastructure, real estate, energy, etc.) to compensate for environmental damage caused by their activities by funding equivalent or greater restoration efforts elsewhere. Forest restoration projects like in SUPERB are suitable offsets as long as the impact on ecological function or biodiversity conservation are demonstrated. Funding may be voluntary or mandatory depending on the national legislation.

Investments

Large-scale forest restoration increasingly attracts interest from institutional investors seeking sustainable finance opportunities aligned with the EU Taxonomy and ESG (environmental, social, governance) criteria. Blended finance models – where public funding reduces risks and private investors provide scale – are being explored to fund long-term restoration projects.

Tips and tricks of how to finance restoration

Leverage pilot projects and demonstration sites

Starting small by experimenting restoration actions in a demonstration site is a valuable way to prove the effectiveness of the approach and build credibility. It also provides an opportunity to optimize silvicultural practices and reduce or stabilize restoration costs. Collecting robust scientific data to demonstrate the viability and benefits of the restoration effort is essential when applying for external funding.

Engage stakeholders and invest in communication

Funders are more likely to invest when they clearly understand the project's impact and added value. Preparing a simple, well-designed leaflet or pitch document, possibly using storytelling, can help convey your restoration concept effectively. In general, the more communication actions you implement to promote your restoration concept and experiments, the more confidence funders will have in supporting it. Similarly, funders are highly sensitive to the public image of the projects they support. Negative publicity can be damaging, which is why early engagement with local stakeholders is crucial and can demonstrates strong social support and local partnerships, making the project more attractive.

Look for the most appropriate funding scheme

There are many criteria to consider when applying for a funding scheme, and their relevance depends on your forest context and the specific purpose of your restoration action:

- The size of the restoration project. Some funding mechanisms like biodiversity offsetting mechanisms are usually looking for large-scale restoration efforts to compensate for the environmental impact of development projects. If your restoration activity is dealing with small areas, this might not be attractive to project developers.
- The type of ownership
- The type of contract, its design and the willingness of forest owners to enrol it
- Amount of the subsidy and share of the restoration cost covered
- Frequency of calls for proposals and funding timeline. Some funding schemes propose continuous project submission opportunities while others rely on a few calls for proposal per year. Adding to that the variable funding timeline, ranging from a few months to more than a year, the project manager must be able to sustain itself for some time on its own funds.
- Engagement timeframe. The engagement of the forest owner in maintaining the restored area might vary depending on the funders. Most French publicly managed fundings are requesting a 30-year maintenance of the restored area, but private solutions can be more flexible.
- Modalities and complexity of the funding requirements. Most of the fundings will request the establishment of an assessment protocol. The entrance cost might be very high for an unaccompanied forest manager.

Combine multiple funding streams if possible

Most funding schemes won't cover 100% of the restoration costs, and it might wise to combine multiple sources at once to increase the chances of successful project implementation. However, one must remain cautious as some funding sources are exclusive and doesn't allow for co-financing from other external sources.

10.2 Restoration methods applied in SUPERB

Table .1 Overview of applied restoration methods in SUPERB demonstration areas. List of restoration methods is based on Kremer et al. (2025).

Sweden	Spain	Serbia & Croatia	Serbia	Scotland	Romania	Netherlands	Italy	Germany	France	Denmark	Czech Republic		
•			•	•	•	•		•		•	•	Natural regeneration	Afforestation and reforestation
	•	•	•	•		•	•				•	Site preparation	
	•	•					•				•	Weeding	
	•						•					Mulching	
•												Prescribed burning	
											•	Seeding	
	•		•	•		•	•	•	•		•	Planting	
						•	•	•		•	•	Group planting	
	•		•				•	•	•		•	Mixed planting	
	•						•					Irrigation	
•						•						Selection cut	Structural diversity
•	•		•	•		•				•		Thinning	
•				•		•						Continuous cover forestry	
•						•						Retention forestry	
•		•								•		Grazing for maintaining open spaces	
						•				•	•	Conversion of monocultures to mixed, uneven-aged stands	Func. diversity
	•		•			•		•	•	•		Enrichment planting/underplanting	
•										•		Veteranisation of trees	Specific habitats
•												Girdling	
•									•	•		Creation of microhabitats	
•										•		Deadwood retention	
						•	•					Soil amendments	Soil health
							•					Fertilization	
						•						Rockdust application	
							•		•			Tilling/plowing	
										•		Topsoil removal	
						•					•	Introduction of litter-rich species	
							•		•			Establishment of hedgerows/corridors	Landscape connectivity and diversity
	•								•	•		Enhancing landscape diversity	
		•							•			Pest and disease control	Risk mitigation and disturbance prevention
	•								•			Fire prevention	
										•		Control of invasive species	
		•		•								Protection of riparian forest	
•	•						•					Pruning	
											•	Regulation of wildlife or ungulate populations to reduce herbivory	
•		•				•		•		•	•	Fencing	
	•											Restoration of Brown bear	Restoration of key species

SUPERB

Upscaling Forest Restoration