



Deliverable D1.1

LIVING LAB REPORT



Document Control & History

Document Control

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Document History

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Abbreviations

D	Deliverable
DEC	Dissemination, Exploitation, and Communication
EC	European Commission
EU	European Union
GA	Grant Agreement
LL	Living Labs
NTFP	Non-Timber Forest Products
PES	Payment for Ecosystem Services
S4G	Small4Good
WP	Work Package

Executive Summary

This report gives a comprehensive description of the four living labs (LL), established during the first year of the Small4Good project: North, Central, South and East. It describes the LL's characteristics and current constraints of forest management from the owner's perspectives related to the project's overall objective: To enable and activate small-forest owners to safeguard biodiversity and enhance the provision of ecosystem services from Europe's forests through multifunctional and locally adapted management models that are financially supported by PES and implemented with support by of digital- and AI-based solutions. The report further gives a summary on the already conducted activities as part of the project's co-creation process to achieve the objectives, and further outlines on activities planned to be conducted throughout the project's lifetime.

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1. Project context

All over Europe there is a high demand for biodiversity and forest ecosystem services and the behaviour of approx. 16 million forest owners plays a crucial role for achieving the desired future levels of biodiversity and ecosystem service provision from forests. Thus, S4G focuses on understanding the motivations of small-forest owners; respects their preferences, technical abilities, environmental and socioeconomic conditions; pursues the development of business and management models as well as digital tools. The project is structured around Living Labs (LLs) serving as open innovation ecosystems that operate in a territorial context (local, regional, national, or international) and integrate research and innovation processes of S4G at representative environments and conditions across the four European regions Nordic, East, Central, and South.

WP1 has established the LLs (Figure 1) and is responsible for managing and coordinating activities within them during the project's lifetime. This includes close collaboration with WP2 on improving understanding of forest owners, WP3 participates in the development of business models, for example payment for ecosystem service (PES) schemes, adapted to the local conditions, find test areas and study sites for implementation of management models (WP4) and finally function as idea generators, testers and evaluators of technical support solutions developed in WP5. The LLs also organize the interaction with local and regional stakeholders with an iterative co-creation spirit to secure a broad support for the developed multifunctional management approaches. Thus, the LLs function as good practice guidance examples that will be central to the dissemination strategy (WP6) aimed at forest owner organizations and forest owners across Europe.

Each LL is represented by individual properties that belong to small private forest owners or local private forest communities. The following criteria were defined for property selection (Figure 1):

- properties should correspond to the respective narrative of the Living Lab (LL),
- properties should be as “representative” as possible of the regional conditions in the private forest (tree species, stage of development, etc.),
- properties should be as “representative” as possible of the regional private forest owners (forest size, management motivation, etc.), and
- forest owners should be as interested as possible in the Small4Good project and be open and motivated to participate in future workshops, forest inspections and to implement new concepts in their properties.

Due to this structure and the numerous activities taking place in the LLs, S4G has the capacity to motivate and enable forest owners in the LLs, and other forest owners through their networks, to manage their forests in a multifunctional way and thereby contribute to a future with improved provision of biodiversity and ecosystem services from Europe's forests.

In the following sections, the four LLs and their corresponding properties are described, as well as the activities with private forest owner engagement that have taken place so far.

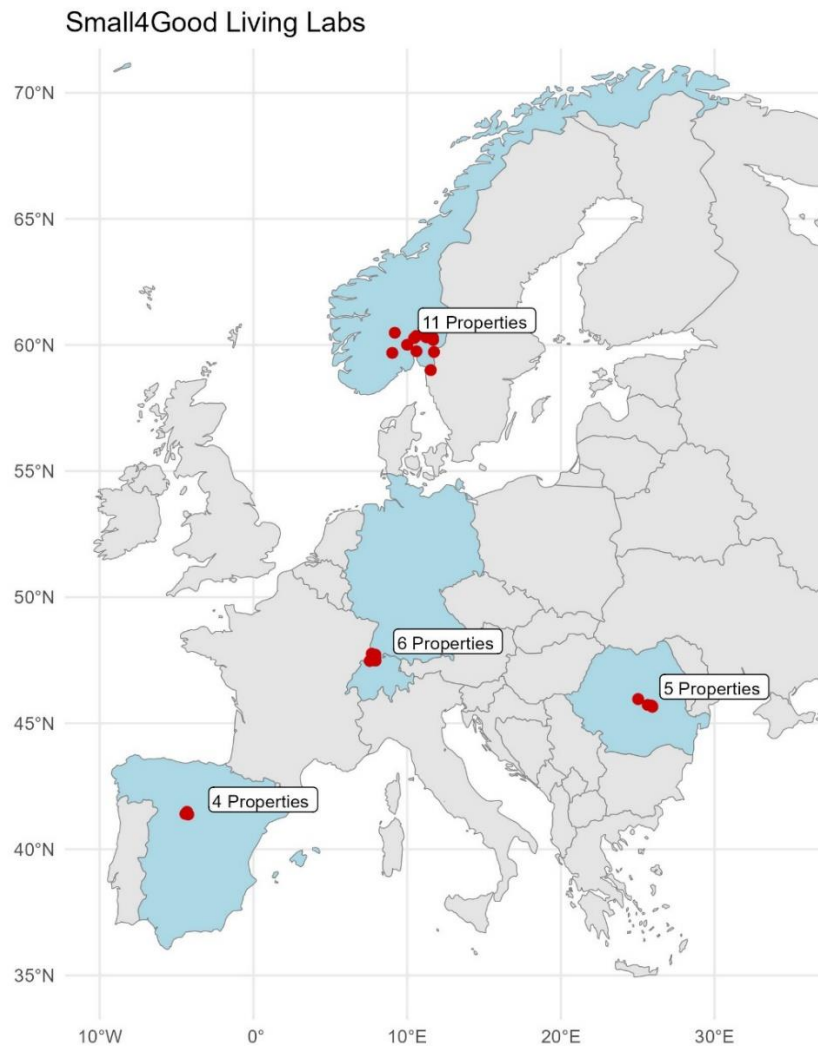


Figure 1: Location of the four Living Labs (LL) in Europe.

2. S4G's Living Labs (LLs)

2.1 LL North

2.1.1 Context

The LL North is located in the boreal forests of central eastern Norway and led by the Norwegian Forest Owner's Federation (NSF), representing 30,000 family forest owners, primarily managing single layered spruce monocultures for timber production. Clear-cutting with large-scale fully mechanized equipment (cut-to-length harvester-forwarder system) and subsequent artificial regeneration is currently the dominant operating system in Norway, facing economic constraints and leaving little flexibility for small-scale

forest owners and innovative multifunctional management. Thus, a paradigm shift with smaller scale management interventions, towards continuous cover forestry with more structured stands and where suitable, multiple tree species and the use of smaller equipment, will be the main focus in this LL. It is intended that this shift will rely on business models that include payment for inter alia carbon and biodiversity to make this change economically feasible. As multifunctional forest management requires specific low-impact operations, the potential use of small machines (e.g. mini-crawlers), but also lightweight and compact cut-to-length machines, as alternative options to today's large machines will be thoroughly evaluated in this LL (WP4). In this context, (semi-)automatic operations through the robotic carrier platform "Moritz" will be of high relevance in the Nordic countries, characterized by high labour costs. Thus, concepts of equipment share and machine rings to engage also non-traditional forest owners and manage such operations in economic manners, will be developed and evaluated with NSF members in different geographical regions of Norway, covering the various terrain conditions from lowlands to high mountains.

2.1.2 Forests characteristics

Forests are softwood dominated and consist of single species Norway spruce (*Picea abies*), or Scots pine (*Pinus sylvestris*) stands with elements of birch (*Betula sp.*). These stands can be single layered, originating from artificial stand establishment, but also more structured natural occurring single species stands are common. In addition, intermixed more diverse patches, often not managed and with a higher share of broadleaved species including next to birch; aspen (*Populus sp.*), alder (*Alnus glutinosa*), elm (*Ulmus sp.*), rowan (*Sorbus aucuparia*) and even oak (*Quercus sp.*), can be found. A typical forest picture is shown in Figure 2.

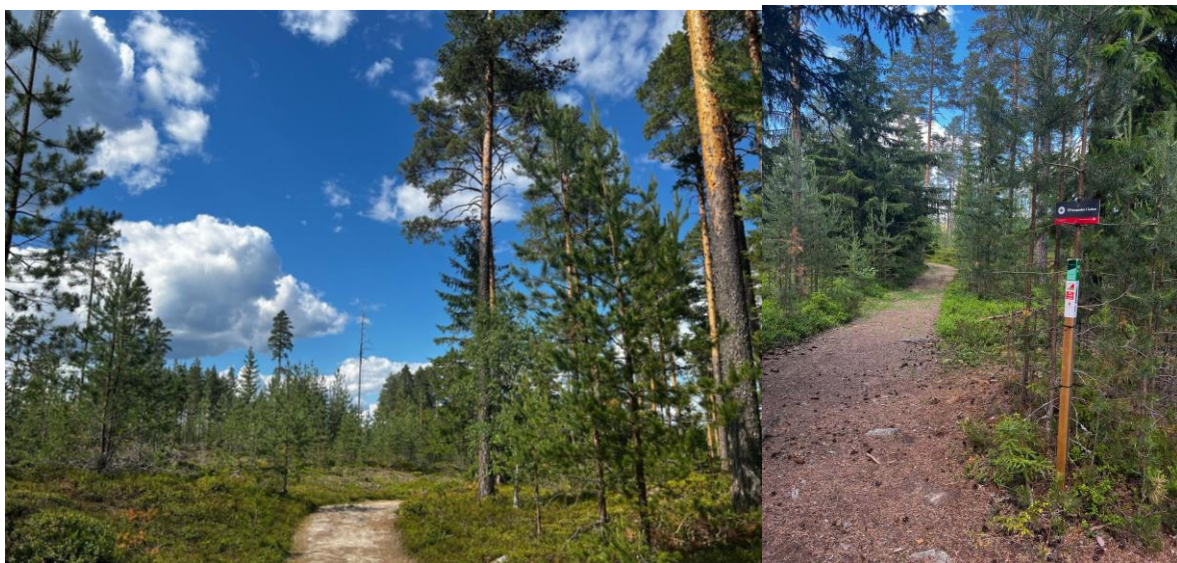


Figure 2. A typical forest in LL North (credits: Norwegian Forest Owners' Federation).

The current forest situation is that small forest owners in this region face climate change induced challenges in forest management, requiring climate change resilient forests. For forest owners with limited knowledge and capacities in alternative management and business concepts, the highly competitive Norwegian timber market, coupled with high operational costs, presents obstacles that need to be overcome. The desired state is a forest management which focuses on the increase of climate resilience supported by payments for timber, biodiversity forest values (biocredits) and carbon farming (carbon credits).

2.1.3 Properties to focus in S4G

In total, the LL North consists of 11 properties spread across Eastern Norway (Figure 3).

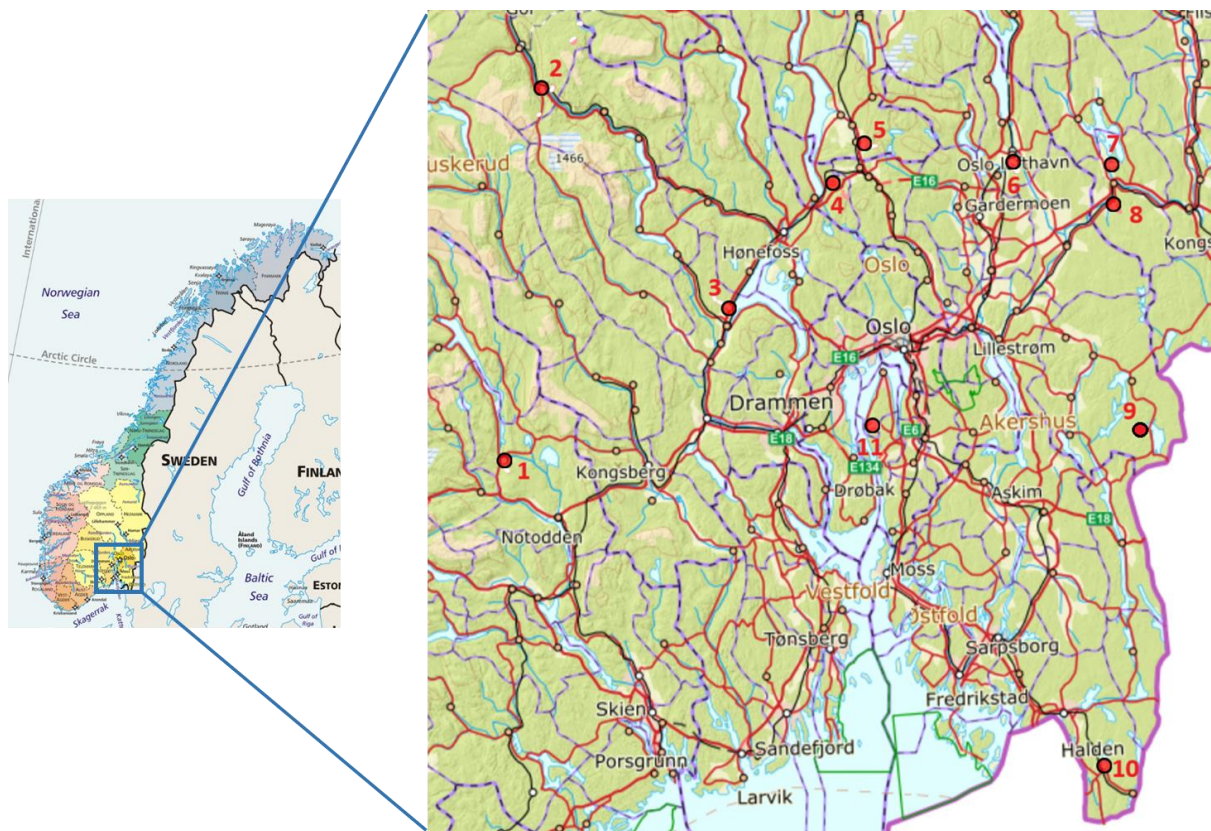


Figure 3. Location of the 10 properties selected in S4G in the LL North.

The properties fit the characteristics of LL North and are a good representation of the boreal forests of Norway (e.g. Figure 4 to Figure 7). We focused on having open-minded, new-thinking forest owners with properties less than 80 ha. The properties vary in climatic and geographical conditions, with steep forest sites in mountainous areas to more flat areas.

Key facts LL North:

- 14 forest owners on 11 properties.
- 7 female and 7 male forest owners.

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- Average area per forest owner: 45 ha.
- Stand age: a significant share of the forest is at later development stages.
- Tree species: Mainly Norway spruce (*Picea abies*) and/or Scots pine (*Pinus sylvestris*), with elements of broadleaved species such as birch (*Betula sp.*), rowan (*Sorbus aucuparia*), aspen (*Populus sp.*) etc. (see 2.1.2).
- Most forest sites are well managed.
- Main concerns: future climate; achieving a climate resilient forest and the implication of small-scale operations.



Figure 4. Property 2 of S4G in LL North (credits: Ingeborg O. Nordraak).



Figure 5. Property 6 of S4G in LL North (credits: Stephan Hoffmann, Ingeborg O. Nordraak).



Figure 6. Property 10 of S4G in LL North (credit: Ingeborg O. Nordraak).



Figure 7. Property 11 of S4G in LL North (credit: Stephan Hoffmann).

2.1.4 Activities undertaken

A first workshop took place in June 2024 (Figure 8) with 14 participants representing small forest landowners, as well as NIBIO and the Norwegian Forest Owners Federation. The following topics were discussed:

- Introduction of the forest owners.
- Presentation of Small4Good.
- Presentation on harvest methods used in Norway.
- Presentation on Ecosystem Services and the concept of Payment for Ecosystem Services (PES).
- Open discussion.

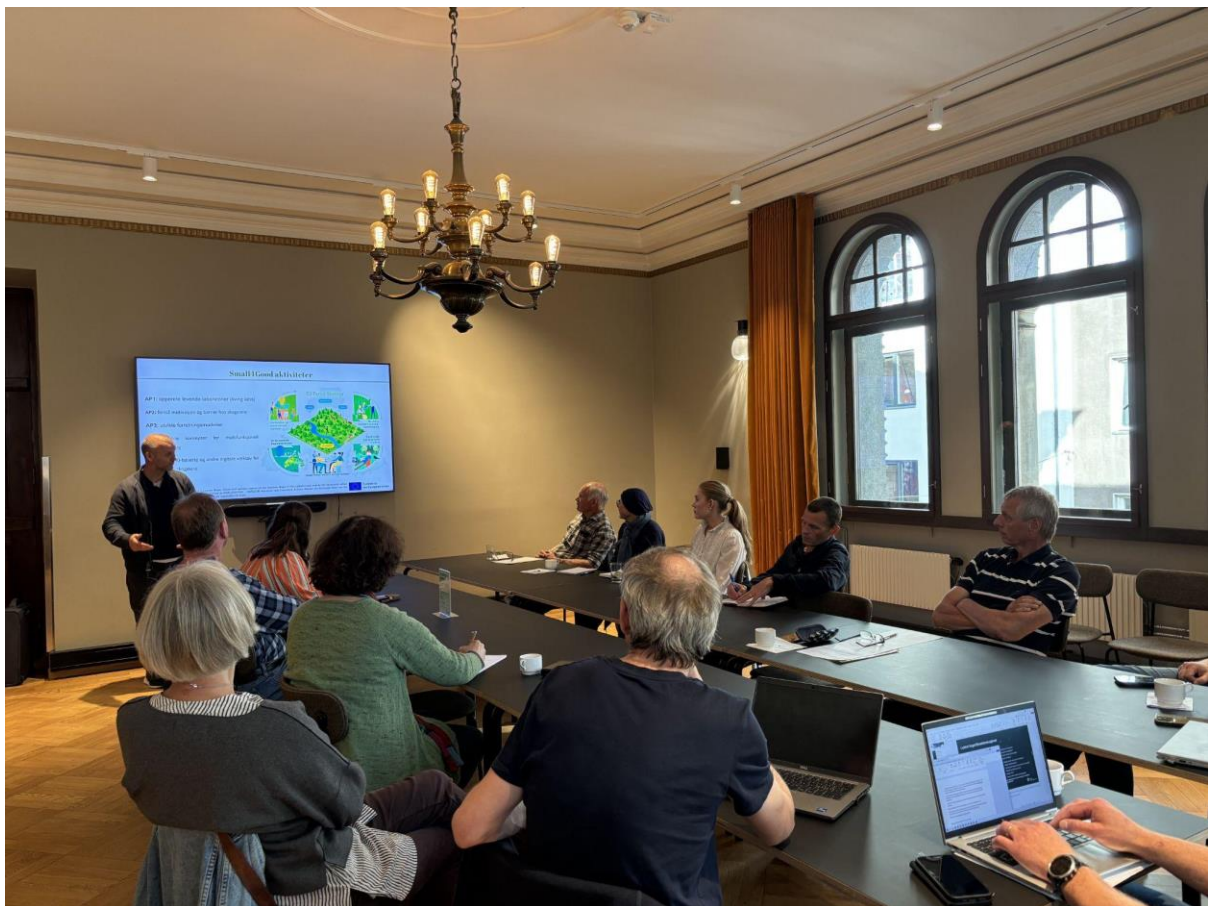


Figure 8. Impressions of the workshop in LL North (credit: Ingeborg O. Nordraak).

Beside the official initiation workshop for the participating forest owners, the LL coordinator (NSF) visited together with partner NIBIO four different properties and their small forest owners in 2024. The aim was to explore opportunities of what kind of activities could be conducted within the properties during the project lifespan, based on natural features and current management of the properties, as well as the objectives and needs of the owners. These individual visits will continue in 2025 to reach the other Norwegian forest owners participating in the project and to foster the co-creation process of activities within the project. In addition, the LL North contributed into the data collection process for WP5 activities and will continue to do so.

2.1.5 Outlook for upcoming activities

It is aimed to develop business model canvases together with the participating forest owners within a joint workshop (spring 2025), linked to WP3. Business models should address and align best to the needs of the forest owners (survey of WP2). This will pave the way to plan actual activities within WP4, for the development, modelling and implementation of silvicultural and operational systems fulfilling the business model's demands in the living lab North.

From the initial property visits and discussions with the owners, one outcome was that the owners are often unsatisfied with the organisation of the harvest, which is usually organized through the regional branch of the forest ownership organizations. The harvest usually focuses on high yielding operations, leaving little room for alternative silvicultural and operational systems. Since the profit margin is often not the main management objective of the participating owners, living lab North offers good opportunities to try out new silvicultural systems with adapted logging systems, such as continuous cover forestry and smaller machines compared to the currently established ones. This means that the project partners will assist the owners in the planning of forest operations, with the aim to fulfil alternative silvicultural targets in-line with the identified business objectives and to implement suitable operational systems. These operations will be further scientifically accompanied to draw conclusions about suitability to support the business models' implementation and to enhance BES values in Nordic forests compared to the conventional operations.

2.2 LL East

2.2.1 Context

The LL East is implemented in the temperate forests of Brasov County, Romania, and lead by the Romanian association of forest landowners (Asociația Proprietarilor De Păduri Din Romania, APPR). Many small-forest owners lack forest management knowledge, skills and business background to undertake a proactive multifunctional management and use of their forests. This is further complicated by a very restrictive regulatory framework related to timber production, as well as the lack of proper incentives and support for forest holdings in those areas under various protection schemes. This results in a low interest among forest owners to take an active role in forestry-related business and management. Further, the lack of cooperation and association, as well as the lack of accessible information and the presence of a complicated business environment could be other important factors contributing to the current state since there are many small holdings which lack involvement and management.

The goal of the LL East is to evaluate how management supported by PES schemes can be achieved given the regulatory frameworks and may push for a system rethinking to build a critical mass of forest owners committed. Additionally, the LL East will be a proving/testing ground for new, promising technologies, machines, and business models to enhance a balanced and efficient use of the forest resources at small scale. The results of the LL will be used actively to support empowerment and improvement with the aim to reach a higher commitment to small-scale forest management, as well as a proving ground for strategic planning and regulatory (re)thinking.

2.2.2 Forests characteristics

In the LL East, a mix of forest types can be found from lowland forests, oak (*Quercus sp.*) and beech (*Fagus sylvatica*) mixed forests to high-altitude spruce (*Picea abies*) and alpine

juniper (*Juniperus sp.*) forests in the Carpathian Mountains. An illustration of the forests from LL East is given in Figure 9.

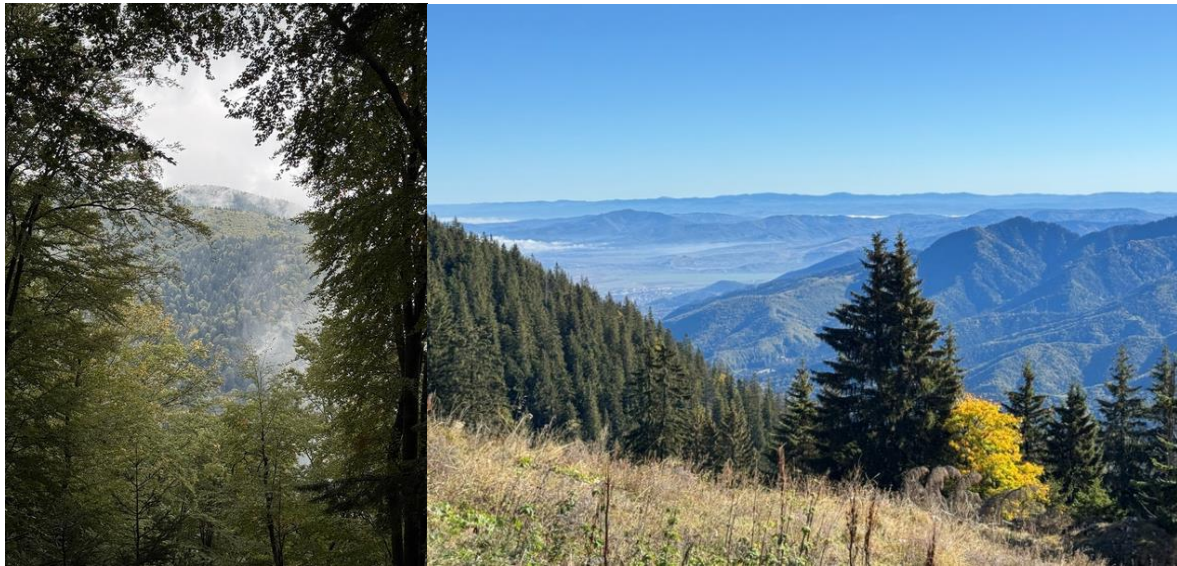


Figure 9. A typical forest (left), and landscape and topography (right) in LL East (credit: Mihai Daniel Nita).

The current forest situation is that small forest owners struggle with small and fragmented properties, insufficient knowledge, complex bureaucracy, and inconsistent compensation systems. These issues, coupled with other economic pressures, hinder sustainable forest management. The desired state is that associations among small owners are formed, simplifying bureaucracy, providing training on sustainable practices, implementing fair compensation systems, and offering technical support. These changes aim to facilitate efficient and sustainable forest management, ensuring long-term conservation and resource protection.

2.2.3 Properties to focus in S4G

Forest and forest management characteristics described in section 2.2.2 were considered when selecting the properties to focus on in the S4G project. In total, the LL East consists of 5 properties, having in mind the species occurrence, altitudinal range distribution and other factors (Figure 10). Overall, in LL East, properties vary in size and, in addition to their size and species, a criterion for selection was that of having data collected by LiDAR scanning.

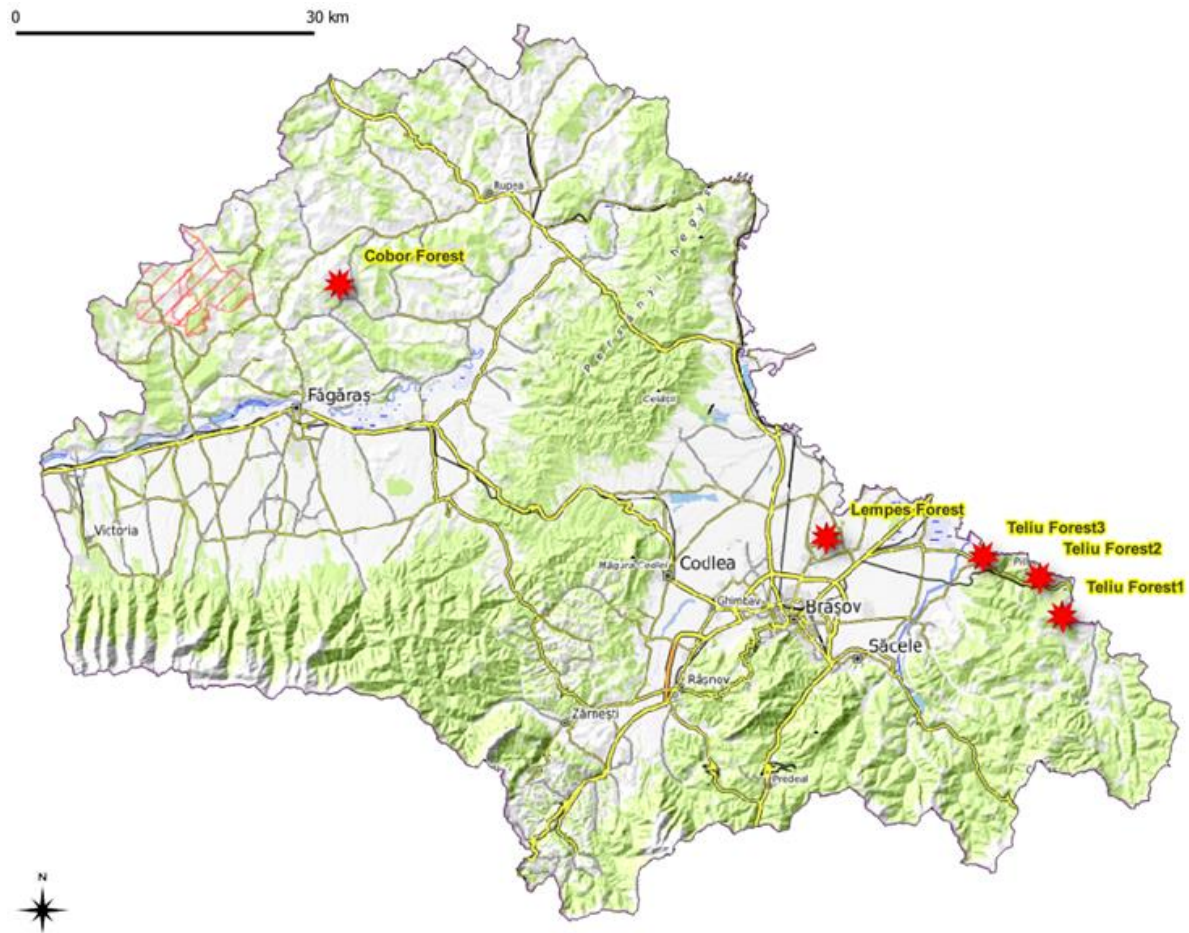


Figure 10. Locations of the properties selected in S4G in the LL East (credit: Mihai Daniel Nita).

Property 1: A sessile-oak dominated stand; Cobor Forest (Brasov County, RO)

The forest characteristics of property 1 are exemplarily shown in Figure 11.

- Natural stand (DBH 10-60 cm) dominated by sessile oak (*Quercus petraea*), coming further in two main tree sizes.
- Stand age: 80 years (average).
- Tree species: mainly sessile oak (*Quercus petraea*) and disseminated trees of hornbeam (*Carpinus betulus*), beech (*Fagus sylvatica*) and lime (*Tilia cordata*).
- Total area: about 20 ha, split into 2 different parcels. All the area is continuously scanned by TLS (LiDAR data available).
- Site description: clay-illuvial pseudogley brown soils and pseudogley brown loess soils (a subsurface zone with higher clay content, high base saturation - hilly forests with oaks and hillocks).
- Slope: flat area.
- Stand is well maintained (thinning, skid trails).
- Forest owners: several small forest owners, with the largest property of about 6 hectares, owned by a 50-year-old male forester.



Figure 11. Property 1 of S4G in Brasov County (RO) LL East (credit: Sergiu Florea).

Property 2: A common ownership association; Teliu Forest (Brasov County, RO)

The forest characteristics of property 2 are exemplarily shown in Figure 11 Figures 12-14.

- Various stands, mainly natural, with a wide range in DBH, and species. Most of the area is managed as high-forest. From this common ownership association, 3 locations were selected, hereafter called property 2.1, property 2.2 and property 2.3.
- Stand age: variable, from very young to old.
- Tree species: a high variability in species of which beech (*Fagus sylvatica*), Norway spruce (*Picea abies*), pines (*Pinus sp.*), oaks (*Quercus sp.*), larch (*Larix decidua*) and hornbeam (*Carpinus betulus*) are among the dominant ones.
- Total area: about 1200 ha, split into a high number of parcels. All the area is sampled by TLS (LiDAR data available) by considering 85 plots with a size of 300 to 10,000 square meters, that include more than 68,000 trees.
- Site description: clay-illuvial pseudogley brown soils and pseudogley brown loess soils (a subsurface zone with higher clay content, high base saturation - hilly forests with oaks and hillocks).
- Slope: a high diversity in the range from flat to steep.
- Stand is well maintained (planting, thinning, skid trails).

- Forest owners: about 650 small forest owners, with different ages, gender and professions.

Property 2.1: Teliu Norway Spruce and Beech Forest

- Natural mixed stand, with a wide range in DBH, managed as high-forest.
- Stand age: variable across the plots.
- Tree species: mainly beech (*Fagus sylvatica*) and Norway Spruce (*Picea abies*).



Figure 12. Property 2.1 of S4G in Brasov County (RO) LL East (credit: Mihai Daniel Nita).

Property 2.2: Teliu Mixed Forest

- Natural mixed stand, with a wide range in DBH, managed as high-forest.
- Stand age: variable.
- Tree species: mixed forests holding species like beech (*Fagus sylvatica*), Norway Spruce (*Picea abies*), larch (*Larix decidua*), hornbeam (*Carpinus betulus*), oaks (*Quercus sp.*), pines (*Pinus sp.*), and many other from the *Acer*, *Alnus*, *Betula*, *Populus*, *Prunus*, *Salix*, and *Sorbus* genera.



Figure 13. Property 2.2 of S4G in Brasov County (RO) LL East (credit: Mihai Daniel Nita).

Property 2.3: Teliu Mixed Forest 2

- Natural mixed stand, with a wide range in DBH, managed as high-forest.
- Stand age: variable. Individual plots are scanned with TLS and LiDAR data is available.
- Tree species: mixed forests in general, with dominance of species such as beech (*Fagus sylvatica*), hornbeam (*Carpinus betulus*), oaks (*Quercus sp.*), and pines (*Pinus sp.*).



Figure 14. Property 2.3 of S4G in Brasov County (RO) LL East (credit: Mihai Daniel Nita).

Property 3: A common ownership association; Lempeş Forest (Brasov County, RO)

The location of property 3 is shown in Figure 15 and its forest characteristics are exemplarily shown in Figure 16.

- Various stands, mainly natural, with a wide range in DBH (10-70 cm), and species. The forests are diverse and managed as high-forest.
- Stand age: variable, from very young to old.
- Tree species: a high variability in species, of which beech (*Fagus sylvatica*), pines (*Pinus sp.*), oaks (*Quercus sp.*), and hornbeam (*Carpinus betulus*) are among the dominant ones.
- Total area: about 200 ha, split into a high number of parcels.
- All the area is sampled by TLS (LiDAR data available) by continuous LiDAR scanning, that includes more than 98,000 sampled trees.
- Slope: a high diversity in the range from flat to steep.
- Stand is well maintained.
- Forest owners: local community.



Figure 15. Location of property 3 of S4G, Lempes Forest in Brasov County (RO) LL East (credit: Mihai Daniel Nita).



Figure 16. Property 3 of S4G, Lempes Forest in Brasov County (RO) LL East (credit: Mihai Daniel Nita).

2.2.4 Activities undertaken

Five meetings were organised in LL East. A general workshop took place in June 2024 (Figure 17) with 24 participants representing small forest landowners, members of communes, state forest administration local office in Brasov, local community forest administration, communes, Transilvania University of Brasov, Forest Design, Association of forest landowners, and RNP-ROMSILVA.

The following topics were discussed:

- Overview of the forest management planning and implementation for private forests.
- Ownership in Romania (very fragmented, very diverse, management tightly regulated by state).
- Definition of a “small forest owner” in Romania in the project context.
- Challenges from the small forest owner and forest manager point of view.
- Information about the model to be developed during S4G for small owners.

Based on the discussions from the meeting, the project partners have developed representative avatars with different types of small forest owners. These would be used further to investigate owner needs and decide upon management options and business models.



Figure 17. Impressions of the workshop in LL East (credit: Vasile Tatar).

Beside the official kick-off workshop, the Association of forest landowners (APPR) visited four different locations (Topoloveni, Arges county, 27th of February, 2024 - South of LL area; Biliesti and Suraia, Vrancea county, 3rd of April 2024 - East of LL area; Brasov city - annual meeting of the association, 20th of July, 2024) and met small forest owners to explain the objectives of the project and establish connections for involvement in project activities, to discuss with them, and learn about their needs (Figure 18).



Figure 18. Meetings with small forest owners to discuss project objectives (credit: Mihai Ionescu, APPR).

2.2.5 Outlook for upcoming activities

Upcoming activities will include meetings and field visits. Before organising further meetings, project partners would identify the stakeholders (real owners in each avatar category in the LL area). Next, separate meetings for each category will be organized.

The following topics are foreseen to be covered during discussions:

- Current management in small ownership and challenges for owners in each avatar category.
- Multifunctional management (discuss the app and ask for their willingness to test it in their forest) and PES schemes in small private forests.
- Business models in small private forests.
- Influences of climate change on their forest (management).

In addition, field visits to specific forest stands to discuss these topics with owners, managers, control agencies, forest management planning companies are foreseen.

2.3 LL Central

2.3.1 Context

The cross-boundary LL Central is located in northern Switzerland (canton Basel-Landschaft und Basel-Stadt) and south-west Germany (Landkreise Lörrach & Waldshut) and lead by the two respective regional forest owner associations WaldBeiderBasel and Forstkammer Baden-Württemberg. The cross-border region is characterized by similar small-scale ownership structures and environmental- and silvicultural conditions. In the last five years, the consequences of climate change are obvious through drought and insects induced large-scale forest health challenges. It is assumed that single small-forest owners are overwhelmed with this situation. Many forest owners are not familiar with sector networks like forest management cooperatives, which enable cooperation and access to forest extension. In particular non-traditional forest owners are not addressed by these forest management cooperatives, or they feel not motivated by them to take care of their own forest. The target of the LL is to enhance the multifunctional management of the disturbance affected forests through better organizational models and supported by PES schemes for carbon and biodiversity. Additionally, forest owners lack understanding of climate change and management impacts on future provisioning of multiple forest ecosystem services and biodiversity. Aim of the project is to provide forest owners a holistic view on the potential silvicultural management impacts on the multifunctional benefits of their forests supporting their management decisions.

2.3.2 Forests characteristics

WaldBeiderBasel:

The Swiss area of the LL Central is represented by the area of the cantonal association of forest owners “WaldBeiderBasel” (www.waldbeiderbasel.ch). It covers a private forest area of 4,280 ha, which is distributed among around 4,000 forest owners. The average property is around one ha. The current forest conditions are characterized by forest development stages of medium tree wood (DBH 40-50cm) and large wood (DBH >50cm) make up the largest proportion of the private forest, at 30% and 47% respectively. The dominant tree species is beech (*Fagus sylvatica*) (44.3%) with a standing stock of up to 188 m³/ha in the private forests, followed by oak (13.4%), ash (*Fraxinus excelsior*, 9.2%) and other hardwood (9.2%).

Forstkammer Baden-Württemberg:

The German area of the LL Central is represented by the department’s forest owner association Forstkammer Baden-Württemberg (www.forstkammer.de). Moreover, it collaborates with the relevant regional institutions of the involved districts Lörrach and Waldshut (FBG Dreiländereck, WG Südschwarzwald, forest authorities). Approximate 30 % of the forests in the district of Lörrach are privately owned, summing up to 11,705 ha, with: 5,902 ha of properties < 5 ha or less, 5,102 ha ranging between 5 and 200 ha, and

700 ha properties > 200 ha. In the district of Waldshut, 41.5 % of the forests are privately owned, with a total expansion of 22,809 ha, with: 10,104 ha of properties < 5 ha, 11,705 ha ranging between 5ha - 200 ha, and 1.000 ha of properties > 200 ha. For the LL region Kleines Wiesental, this makes a total of 34,514 ha of private forests, of which 16,006 ha are small holdings. The total number of private forest owners is estimated to be about 30,000. While the higher elevated district of Waldshut is coniferous wood-dominated (60,1 %), Lörrach's forests consist of more hardwood (64 %). The current distribution of tree species in the two regions is a following:

- Norway spruce (*Picea abies*): 33.8 % Waldshut / 22 % Lörrach;
- Beech (*Fagus sylvatica*): 23.2 % Waldshut / 35 % Lörrach;
- (Silver) Fir (*Abies alba*): 20.5 % Waldshut / insignificant in Lörrach;
- Douglas fir (*Pseudotsuga menziesii*): occasional in Waldshut / 5.6 % Lörrach.

Figure 19 shows a typical forest from this region.



Figure 19. A typical forest in LL Central (credit: Britta Hars).

2.3.3 Properties to focus on in S4G

Above-mentioned forest characteristics were considered when selecting suitable properties. In total, 6 properties were selected, three in each country (Figure 20).

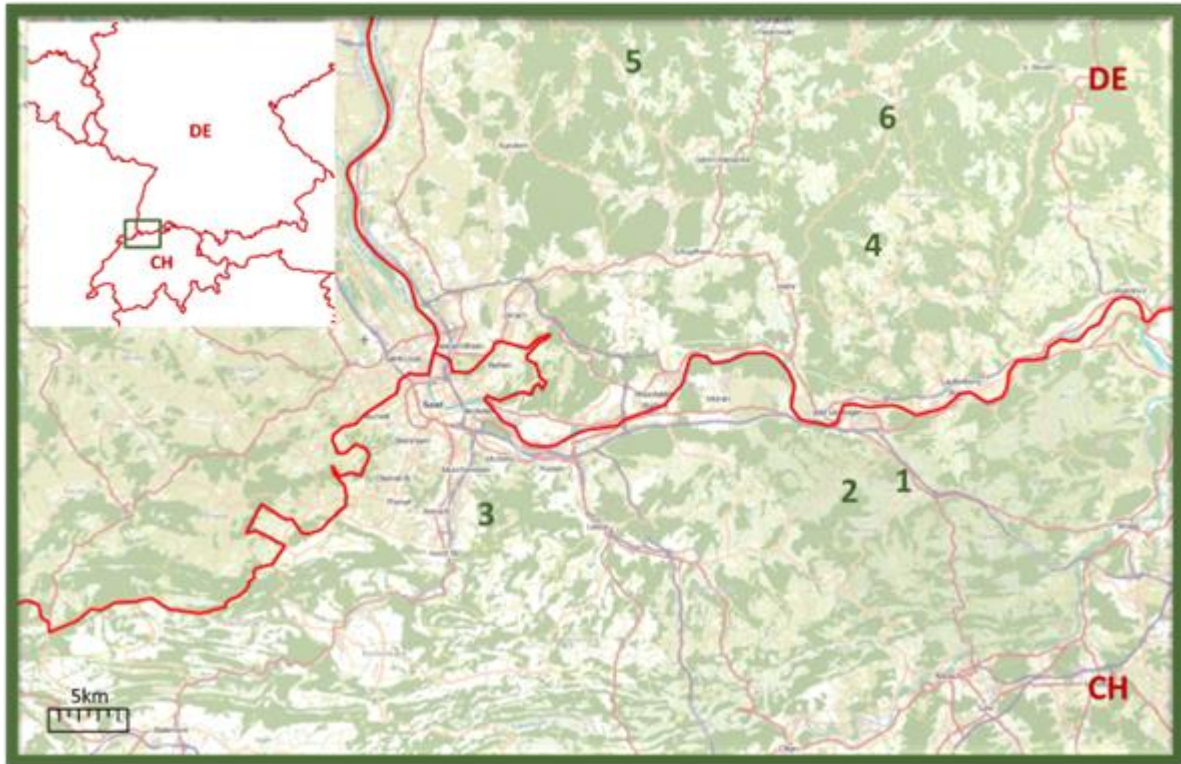


Figure 20. Locations of the 6 selected properties. Properties 1,2 and 3 are located in the Swiss part of the LL (CH), while properties 4, 5 and 6 are located in the German part (DE).

Property 1: Spruce polewood; forest area at climate change risk (Rothenfluh, CH)

The forest characteristics are exemplarily shown in Figure 21.

- Property of polewood (DBH 12-30 cm) dominated by conifers.
- The stand was planted step by step within 10-15 years.
- Tree species: mainly Norway spruce (*Picea abies*), mixed with silver fir (*Abies alba*), Douglas fir (*Pseudotsuga menziesii*); deciduous trees were promoted occasionally.
- Total area of 4.2 ha, split into 3 different parcels.
- Site description: fresh, alkaline-rich soil (beech forests of the lower montane level).
- Slope: flat area.
- Stand is well maintained (planting, thinning, skid trails).
- Forest owner: Male, around 40, farmer and forestry contractor.



Figure 21. Property 1 of S4G in Rothenfluh (CH) LL Central (credit: Andreas Gabriel).

Property 2: Beech timber wood; potential multifunctional forest (Rothenfluh, CH)

The forest characteristics are exemplarily shown in Figure 22.

- Property dominated by large timber wood (DBH >50 cm).
- The stand is partly patchy. Gaps trough windfall and single tree usage were filled with lush natural regeneration, mainly beech (*Fagus sylvatica*).
- Tree species: mainly beech, mixed with lime (*Tilia cordata*), silver fir (*Abies alba*), ash (*Fraxinus excelsior*), maple (*Acer* sp.).
- Area of 10.7 ha split into 20 parcels owned by up to 20 private forest owners.
- Site description: Fresh to moist soils (submontane beech forests).
- Slope: moderately steep with eastern exposure.
- Few forestry interventions in the last years, no systematic management.

- Forest owners: Various owners, some of whom live in the region. A few of them use wood for their own purpose.



Figure 22. Property 2 of S4G in Rothenfluh (CH), LL Central (credit: Andreas Gabriel).

Property 3: Hardwood mixed forest; community forest (Aesch, CH)

Property 3 is exemplarily shown in Figure 23.

- Property owned by Citizens' Community (a quite common ownership type in Switzerland, being an intermediate between private and public forest).
- Property with different stands of polewood to timber wood.
- Tree species: hardwood mixed forest with beech (*Fagus sylvatica*), silver fir (*Abies alba*), oak (*Quercus robur*), ash (*Fraxinus excelsior*), maple (*Acer pseudoplatanus*).

- Total area is 67.5 ha belonging as 1 parcel to the Citizens' Community. The selected property for the project covers 4-8 ha of it.
- Site description: Fresh to moist soils (submontane beech forests).
- Slope: moderately hilly area, mainly north exposition.
- The stands are owned and managed by the local Citizens' Community, which represents approx. 1200 people of the “Bürgergemeinde Therwil”.



Figure 23. Property 3 of S4G in Aesch (CH), LL Central (credit: Raphael Häner).

Property 4: Replanted disturbed forest area (Wehr, GER)

The forest characteristics of property 4 are exemplarily shown in Figure 24.

- Young plantations (2010 - 2020) on cleared beetle areas, approx. 3 ha.

- Plantation scheme: mixed forest, rich in species; focus on Douglas fir (*Pseudotsuga menziesii*) in mixed cultivation with predominantly deciduous trees (including wild service tree, tulip tree, oak, sweet chestnut, black walnut).
- Partial entrainment of natural regeneration (including wild cherry, alder tree, acer, larch).
- South-western slope, rather damp with stream, loamy soil.
- Planting was carried out with the help of EU funding.
- Forest owner: Male, around 40, employee; bought many small parcels after devastation caused by bark beetles. Forest as passion and legacy, as well as source of income. Selection of planted species mainly by market chances, but also aesthetic considerations.



Figure 24. Property 4 of S4G in Wehr, (GER), LL Central (credit: Britta Hars).

Property 5: Beetle areas and old stands (Malsburg-Marzell, GER)

The forest characteristics of property 5 are exemplarily shown in Figure 25.

- Area strongly affected by bark beetles, which has been cleared but not replanted; lower section contains standing deadwood (Norway spruce) resulting from beetle damage and old silver fir (*Abies alba*) stands.
- Total area is 24ha, of which 2 to 4 will be involved into the project.
- Natural regeneration is likely to occur, primarily with Douglas fir (*Pseudotsuga menziesii*) and beech (*Fagus sylvatica*), though other tree species should be documented.
- High southwest-facing slope with rocky soil; increasing drought to be expected.

- Desired species by the owner for future stock may include Douglas fir, silver fir, and beech.
- Forest owner: Male, around 70, farmer and forester, very involved in regional politics and forestry. Forest ownership from family heritage; use of wood as building material and firewood, sale of firewood and wood chips.



Figure 25. Property 5 of S4G in Malsburg-Marzell (GER), LL Central (credit: Britta Hars).

Property 6: Near-natural old stock (Gerspach, GER)

The forest characteristics of property 6 are exemplarily shown in Figure 26.

- Near-natural forest managed for own use with mainly silver fir (*Abies alba*), maple (*Acer pseudoplatanus*) and beech (*Fagus sylvatica*); diverse forest; lying dead wood; partly old silver fir; coppice with natural regeneration of silver fir, maple, beech and some spruce; relatively well thinned.
- No planting, selection of mainly silver fir as valuable wood (local buyer available), beech and maple as firewood trees.
- Flat western slope to the summit, rather moist, stony ground.
- Forest owner: around 50, employee; forest as family heritage, leisure and passion; use of firewood & occasional sale of silver fir as round timber.



Figure 26. Property 6 of S4G in Gerspach (GER), LL Central (credit: Britta Hars).

2.3.4 Activities undertaken

Up to now, three workshops have taken place, as described below.

Workshop in Therwil, CH (01.03.2024)

The first workshop was organized by WaldBeiderBasel in Therwil in March 2024 in the Swiss part of the LL (Figure 27). The local organisations and region were introduced. Representatives of the local Citizens' Community, the cantonal forestry administration and participating research institutes from Switzerland and Germany were present. In total 18 people participated.

The following topics were discussed:

- Ownership in the Basel region, including the Swiss specific owner ship structure of citizens' community.
- Available forest related (geo) data.
- Local wood mobilization concept in private forests.
- Cantonal contributions for nature conservation in forests and protection forests.



Figure 27. Impressions of the workshops in LL Central in the Swiss area of Therwil (credit: Raphael Häner).

Workshop in Maulburg (22.07.2024)

The second workshop was organized by the Forstkammer in the German region of the LL, namely in Maulburg in July 2024 (Figure 28). The project Small4Good was introduced to local forest representatives (forest owners, forestry associations (Forstliche Zusammenschlüsse) and foresters). A total of 16 people attended.

The workshop also aimed to find out about the actual problematics and obstacles, the region is currently facing. In two smaller groups, the following topics were discussed:

- Expectations from the project.
- What are the current forest-related topics discussed in the region?
- What other measures and projects in the region should be considered?



Figure 28. Impressions of the workshops in LL Central in the German area of Maulburg (credit: Andreas Gabriel).

Cross-boundary silvicultural workshop (21.10.2024)

A third workshop with focus on silvicultural management took place on October 21st, including an excursion to four properties situated in both countries of the LL (Figure 17). In combination with the specific features of the visited areas, the following topics were discussed:

- Forest area at risk under climate change.
- Multifunctional forest management.
- Dealing with beetle-damaged areas.
- Shaping the forests of the future.

A total of 25 people attended the workshop. Besides the local forest authorities, the group consisted mainly of forest owners from the LL and was open not only to forest owners

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already involved in the project, but to a wider audience. By organizing a cross-border exchange between private forest stakeholders, the project was able to offer a new format in the region, which received a very positive response and is planned to be continued in a similar form in 2025.



Figure 29. Impressions of the workshop on October 21st, 204 in LL Central (credit: Clemens Blattert).

Besides these three official workshops, the LL coordinators visited 6 different properties and their small forest owners to have discussions with them, learn about their needs and how we can address them with the project S4G. More activities are planned.

2.3.5 Outlook for upcoming activities

In the near future, a couple of research activities and LL excursions are planned in the LL Central, all related to other WPs (see section 3) and/or planned for sustainable involvement and cooperation with local stakeholders in the private forest sector.

Based on the great response to the excursion organized on October 21st 2024, a series of similar events will take place over the course of the project. Possible topics for workshops shall be selected in collaboration with the participating forest owners and associations, and could be e.g.:

- Business models in small private forests

- Regional exchange between companies and forest owners / associations
- Influences of climate / management scenarios on forest development
- Good-Practice-Examples: how do other individuals / associations / regions deal with given obstacles?
- Visits to specific forest stands or companies.
- Managing forests together (“Gemeinschaftswald”).
- Other topics selected by forest owners / associations (“What keeps them busy?”).

2.4 LL South

2.4.1 Context

The LL South is located in the centre of the Iberian Peninsula (Spain), in the regions of Cuéllar (Segovia) and Montemayor de Pililla (Valladolid) and lead by the regional forest owner association FACYLE (Federación de Asociaciones Forestales de Castilla y León) and the University of Valladolid.

The main current managerial focus on these forests is on non-timber products (pine nuts for Stone pine and resin for Maritime pine), and, to a lesser extent, timber. The target of the LL is to broaden the multifunctional management of these forest by including PES schemes for carbon and biodiversity. Different local solutions, triggered by a bottom-up approach where forest owners’ association will play a predominant role, will be tested to improve operational and economic efficiency, responsibility, overcome forest equipment scarcity and legal restrictions, while coping with low access and low removal intensity extractions. The general low intensity management due to financial constraints, lack of managerial background and regulatory framework will be improved by using AI powered forest manager assistants.

2.3.2 Forests characteristics

Forests typically consists of pure stands of maritime pine (*Pinus pinaster*) and stone pine (*Pinus pinea*), with some areas where these species mix with holm oak (*Quercus ilex*). The associated vegetation includes riparian forests with species such as willows (*Salix sp.*) and ashes (*Fraxinus sp.*), along with understory shrub communities comprising rockrose (*Cistus sp.*), thyme (*Thymus sp.*), and *Retama sp.*. A typical forest picture is shown in Figure 30.



Figure 30. A typical forest in LL South (credit: FAFCYLE).

The current forest situation is that the small landowners have highly fragmented and scattered properties, making their management very challenging. Many landowners are unaware of the exact locations of their properties. Additionally, there are bureaucratic problems and a lack of information from the administrations. The desired state is that the association among landowners, locating their plots, facilitating their bureaucratic issues, providing incentives from the local administration for maintaining their plots clean, and providing them with more information on forestry related topics.

2.3.3 Properties to focus in S4G

The municipalities in which the properties will be located are Torrecárcela, Cogeces del Monte, Montemayor de Pililla, etc. (in Valladolid province) and Cuéllar, Samboal, etc. (in Segovia province). All affected municipalities are shown in Figure 31.

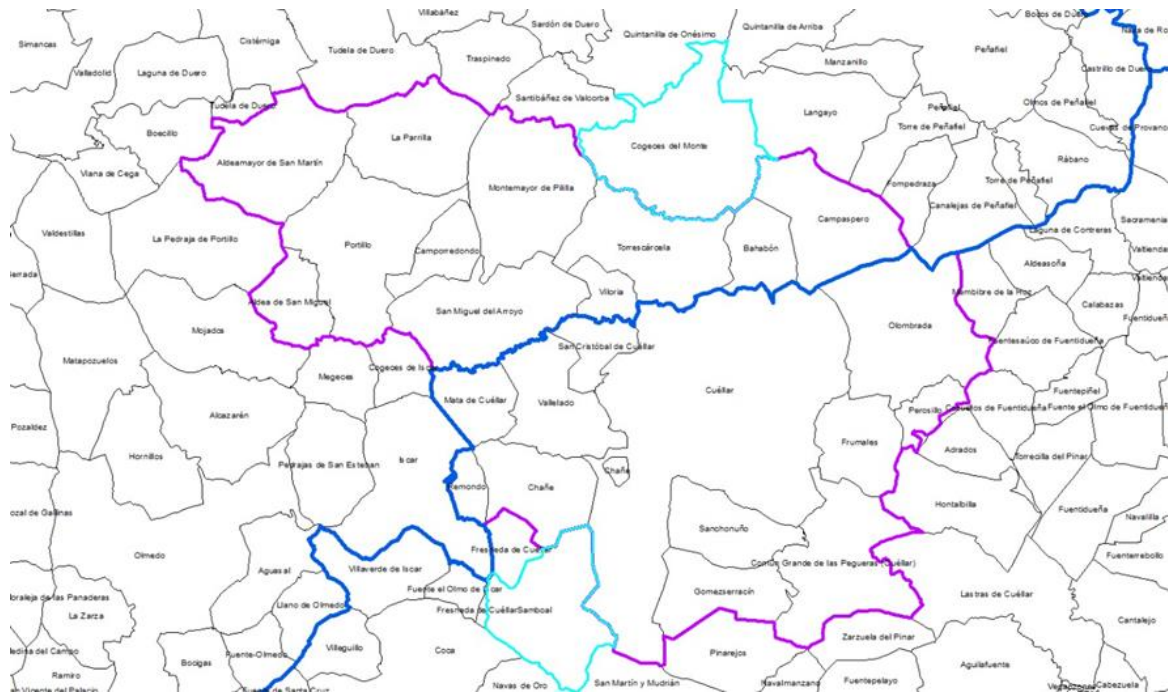


Figure 31. Locations of municipalities where the properties of the LL South are situated (credit: FAFCYLE).

The private forest area in the region is very fragmented which leads to a very difficult forest management.

As mentioned before, the most common forest types in the region are pine forests of stone pine (*Pinus pinea*) and resin pine (*Pinus pinaster*), focused on the production of pine nuts and resin, as well as wood. Further, there exist areas of degraded oak forest, productive poplar (*Populus sp.*) plantations and some mycorrhizal oak (*Quercus sp.*) plantations with black truffle, which could be a future use in many areas of the LL South.

SEGOVIA:

Property 1: El Henar, Cuellar SEGOVIA

The forest characteristics and the location of property 1 are exemplarily shown in Figure 32.

- Several forest plots from the same owner with a surface of 5.6 ha.
- The main species is stone pine (*Pinus pinea*).
- Silvicultural interventions have been carried out recently for damage prevention.
- The main exploitation is the harvest of pine cones.



Figure 32. Property 1 of S4G in in El Henar, Cuellar (Segovia) (ES) LL South. (credit: FAFCYLE).

Property 2: Dehesa Mayor, Cuellar SEGOVIA

The forest characteristics and the location of property 2 are exemplarily shown in Figure 33.

- Several forest plots from different owners.
- Each one with a surface smaller than 2.0 m².
- Total surface 9.3 ha.
- The main species is pine (*Pinus pinaster*).
- The main purpose of the exploitation is for resin extraction and wood production.



Figure 33. Property 2 of S4G in Dehesa Mayor, Cuellar (Segovia) (ES) LL South. (credit: FAFCYLE).

Property 3: Multiple plots from different owners with a total area of 100 ha.

The forest characteristics and the location of property 3 are exemplarily shown in Figure 34.

- There is a mixed forest mass of pine (*Pinus pinaster*, *Pinus pinea*).
- The main purpose of the exploitation is for resin extraction, wood and pine cones production.
- Prevention of silvicultural works have been carried out in some parts of the forest mass recently.



Figure 34. Property 3 of S4G in Valledado, Segovia (ES) LL South (credit: FAFCYLE).

Property 4: Torrecárcela VALLADOLID

Property 4 and its location is exemplarily shown in Figure 35.

- Area of action: 724 ha.
- Number of plots: 1200.
- Number of owners: 400-450.
- Average plot area (ha): 1.66.
- Average area per owner: 2.66 ha.
- Type of forest: mixed stone pine (*Pinus pinea*), resin pine (*Pinus pinaster*), holm oak (*Quercus ilex*) and juniper (*Juniperus* sp.) forest.
- Current use: generally in disuse except for very specific small tasks of self-consumption of firewood and use of pine cones.
- Potential uses: collection of resin, pine cones and wood.

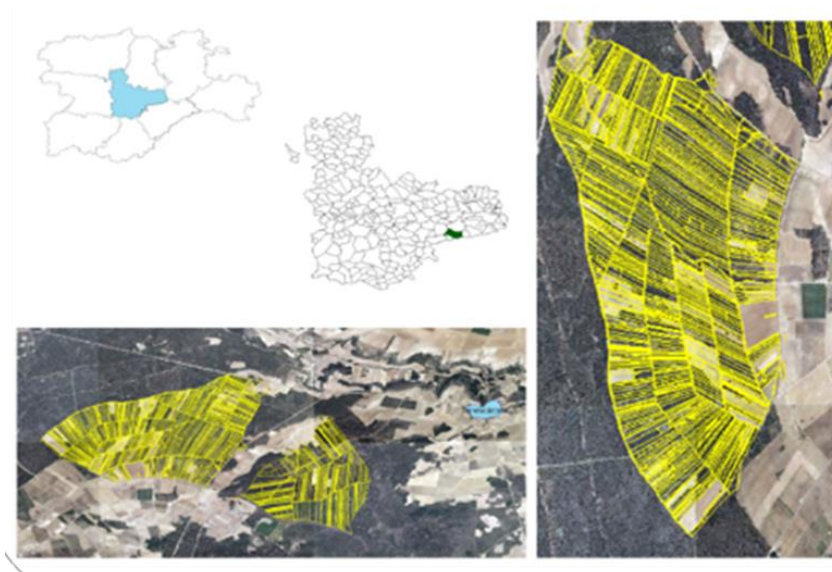


Figure 35. Property 4 of S4G in Torrecárcela, Valladolid, Segovia (ES) LL South (credit: FAFCYLE).

2.3.4 Activities undertaken

A kick-off workshop took place in Cuellar (Segovia) in July 2024 (Figure 36, Figure 37) with 37 participants from FACYLE, University of Valladolid, ASFOSE, ASFOVA, Junta de Castilla y León, Cuellar council, timber and resin companies, forest owners and forestry engineers.

The following topics were discussed:

- Presentation of the Small4Good project.
- Presentation of FACYLE and ASFOSE.
- Presentation of the participants in the living lab and the organizations they come from.
- Sharing and discussion of problems identified by small forest owners in the area.
- Discussion of proposals and possible courses of action to address the identified problems.



Figure 36. Participants of the first workshop in LL South (credit: FACYLE).



Figure 37. Sharing and discussion of forest owner's problems in LL South (credit: FACYLE).

The main goal of this workshop was to get to know the perspectives of small forest owners regarding the forest management of their territory and to create synergies that could be developed within the project. The excessively small size of the plots and the disengagement of a large part of the forest owners were unanimously identified as major issues in the area. Communal management, machinery collectivization, and increased association were common synergies that emerged to tackle the problem of forest management.

The main findings that come up from the sharing experiences and discussions among forest owners are:

- Disengagement by many small forest owners. Many forest owners live in other cities and have lost contact with their own forests. Some do not even know where their plots are located.
- Small size of plots makes forest management problematic and not profitable at all.
- Concentration of plots is the major demand of forest owners.

Additionally, six interviews took place with forest owners and local stakeholders to know deeper their situation and to analyse together the area potentials in forest uses and management (see exemplarily Figure 38).



Figure 38 a) and b). Segovia Forest Association and smallholding owners (credit: FAFCYLE).

A second workshop took place on October 8th and 9th focusing on international exchange of knowledge as well as the reinforcement of internal cohesion among local stakeholders, forest owners, and the Small4Good consortium. Additionally, plans were made for the occasion of the Small4Good annual meeting in Cuellar (Segovia). In total 47 people participated at this two day event (see Figure 39 to Figure 44). The program was as follows:

October 8th

The Small4Good consortium and the LL members in Cuéllar visited the stone pine forest and the resin pine forest. Two industries linked to the forest were also visited during that day: Pallet Tama company and Nature pellet.

October 9th Samall4Good Consortium meeting at iuFOR University of Valladolid (Palencia Campus “La Yutera”) where general updates and issues related to project management were discussed during the morning session:

- Status of current and upcoming deliverables, achievement of milestones etc.
- Issues regarding reporting to the EU.
- Miscellaneous to be addressed to management from the consortium partners.
- DEC plan, tasks/obligations, requirements.
- Social media and project representation/promotion.
- Presentation of all 4 established LLs and joint discussion on how to get forest owners involved.

Afterwards, a breakout session took place for the work packages in 2 parallel sessions, first for the WP3 and WP4 and later for the WP2 and WP5. At the end of the day, a general assembly was held to present the main results and the next steps.



Figure 39. Participants of the second workshop in LL South, Cuéllar, October 8th (credit: Marta Cebrián-ASFOSE).



Figure 40. Visiting the properties in Segovia - workshop on October 8th in LL South (credit: Fátima Cruz - UVa).



Figure 41. Visiting the properties in Segovia - workshop on October 8th in LL South (credit: Fátima Cruz - UVa).



Figure 42. Visiting the properties in Segovia - workshop on October 8th in LL South (credit: Fátima Cruz -UVA).



Figure 43. Visiting the Naturpellet factory - workshop on October 8th in LL South (credit: FAFCYLE).



Figure 44 a) and b). Visiting Pallet Tama factory- workshop on October 8th in LL South (credit: FAFCYLE).

Beside, the LL coordinators visited different properties and their small forest owners to have discussions with them and learn about their needs.

2.3.5 Outlook for upcoming activities

A meeting in the LL South will take place in Torrecárcela (Valladolid) in spring 2025 to bring together small forest owners and Small4Good partners. It intends to promote the exchange of experiences and the joint search for solutions to the problems identified in forest management in the area. Knowledge exchange will be promoted between the University of Valladolid team and forest owners testing new AI tools for supporting sustainable forest management and silviculture models aiming to increase forest multifunctionality in LL South area.

LL South wants to increase visibility of female forest owners and to promote gender balance in the forest sector. To this purpose we will hold a focus group with local women in the forest sector - owners and technicians - to gather their experiences and demands, analysing the situation from a gender perspective.

3. Future activities in the LLs, planned by WP2-6

3.1 Forest owners' motivations and barriers for multifunctional forest management

WP2 aims to understand the motivations and barriers of small forest owners to manage their forests for multifunctionality. For this purpose, five to six interviews took already place with stakeholders of small-scale forest holdings in each LL from May -July. The process of identifying relevant stakeholders and conducting the interviews was supported by the local LL coordinators. The results of these interviews build the basis for an upcoming survey of forest owners, which will be launched by the end of November 2024. The survey will be distributed at a national and at LL-level. The distribution at LL-level is supported by the LL-coordinators to facilitate a better coverage of different types of forest owners (e.g. traditional, non-traditional, absentees). This will allow to gain a more comprehensive understanding of their drivers and challenges. WP2 further aims to simulate the decision-making processes of small forest owners regarding forest management. To inform the decision model, a discrete choice experiment (DCE) survey will be conducted within the living labs. The DCE is designed to provide quantitative insights into the decision behaviour of small forest owners, including their preferences and trade-offs when faced with various management options and their costs and benefits. Additionally, the DCE will explore the role of key actors influencing these decisions. The

findings from the initial survey will serve as the foundation for the DCE, ensuring it reflects the real-world motivations and barriers identified.

3.2 Business models

PES schemes and institutional network

The University of Göttingen plans to conduct a series of business model workshops and expert interviews within the LLs to better understand small-scale forest owners and their stakeholders regarding their collaboration and current business models. These insights will help to develop an institutional network map which lays the foundation to identify challenges and opportunities for novel business models in small-scale forestry in support of bioeconomy, biodiversity and climate.

To prepare for these activities, the task aims for a one-hour call with the LL coordinators in January 2025. In this call, context information from the different LLs will be collected before interviews are conducted; the interview questions will be discussed to understand potential challenges/ contextual nuances when conducting the interviews.

Business Model Workshops

The business model workshop will involve four participants, and it will last approx. 4 hours.

The following topics are planned to be covered:

- Discussion on factors that help or hinder business model adoption and collaboration needs.
- Interactive group exercises using the Value Mapping Tool and the Business Model Canvas to create and assess potential business models and desired future practices in small-scale forestry.
- Presentation of example business models to spark ideas and discussion.
- Identification of reasons why forest owners are not yet doing what they aspire to do.
- Language will be either German or English, with translation support from local institutions, where necessary.
- Workshops are planned for March (2 workshops in LL Central), April (1 workshop in LL South), May (1 workshop in LL East), and June (1 workshop in LL North).

Minimum requirements for the participants are:

- 4 participants from the LL (e.g., 3 small-scale forest owners and 1 stakeholder) without any specifications,
- Additionally, a balance is aimed regarding age and gender.

Expert Interviews

Additionally, one hour “1 on 1” expert interviews are planned a. The interviews will be conducted in a semi-structured manner. The following topics will be covered:

- Background on the participant's forest: current management practices, and historical uses.
- Their interaction with various stakeholders.
- Values, norms, and views on forest ownership and management.
- Participant's short- and long-term visions for the future of their forest.
- The interviews will be conducted online from February to April.

It is aimed to have the following participants per country, i.e. LL North: 10, LL West: 10, LL South: 10, LL Central: 20

Links to payment for ecosystem service schemes (PES)

The business model workshops, and expert interviews described above will draw on key lessons and results from the review of relevant properties for acceptances of PES schemes in Europe (Task 2.2), results from the surveys of forest owners (Task 2.3) and (preliminary) recommendations on potential carbon farming and biodiversity PES schemes (Task 3.1) and respective monitoring, reporting and verification (MRV) systems (Task 3.3). To achieve synergies and limit the strain on forest owners in the LLs, discussions on key elements of PES schemes will be sought included, to the extent possible, in other planned LL activities and meetings, e.g. in the business model workshops.

3.3 Silviculture

LLs participants will define silvicultural targets adequate for local conditions and operational business models that will be applied at small-forests scale to facilitate the implementation by active forests owners. Concrete recommendations for adapted silviculture and operation systems and technologies will be provided, but the role of LLs will be crucial to define the operational set-up by approaching lean forestry paradigm. Lean forestry practices will focus on do cost effectively only what is needed to fulfil the ownership goals avoiding unnecessary investments. Selected silvicultural path will be assessed by available simulation platforms and the outcomes evaluated by small-scale owners to define business models.

3.4 Harvesting

The implementation of adapted silvicultural practices to enhance forest multifunctionality, usually also requires an adaptation of the harvesting system. This includes the planning and management of the operation, but also the used equipment and workflow. Based on the previously identified silvicultural needs within the LLs, we plan to make use of locally established harvesting equipment, by adapting their implementation with a focus on the system workflow and an economic evaluation. This

requires mainly work studies, which should be integrated in real world operations within the properties:

- **LL North:** As an alternative to the established clear-cut operations with large scale CTL (cut-to-length) equipment, the efficiency of available downscaled CTL equipment will be surveyed in thinnings and other selective cutting operations and benchmarked against the use of conventional CTL equipment.
In addition to harvesting, the LL North will serve as the trial area for the semi-autonomous mini-crawler “Moritz”. Despite not being involved in harvesting operations, the diverse properties enable it to test the crawler’s autonomous navigation abilities among various forestry scenarios outside the controlled lab environment.
- **LL Central:** Versatile mini-crawlers are already intensively used in Central Europe, but lacking scientific operational studies regarding their performance in costs and suitability for complex silvicultural systems. The aim is to develop performance figures for operational planning, for the use of mini-crawlers within improved small-holder operations under central European conditions.
It is envisaged to transfer the sensor platform of the Norwegian “Moritz” to a “Moritz” available in the LL Central and to evaluate its navigation skills under the more complex conditions within a Central European Forest (if the results of the LL North have turned out being satisfying). Ideally, a path repetition of one of the previously conducted mini-crawler work study sites will be used to conclude on prevailing shortfalls of the semi-autonomous drive compared to the conventional manual one. Outcomes are planned to present at stakeholder workshops.
- **LL East:** Harvesting systems with farm tractors using winches are still among the most commonly used machines in Romania. Work studies with farm tractors and mini-crawlers are planned to be conducted in the LL East to compare their performance under Romanian conditions or fulfilling the adapted silvicultural systems and improving BES values. Apart from costs, especially environmental performance of the farm tractor, as a non-purpose forestry machine is of concern and auxiliary equipment, e.g. log trailers will be considered as well to mitigate residual stand impact. This is of high relevance, since from the socio-economic situation in Romania, it is expected that farm tractors will continue to play an important role among small forest owner’s operations in the near future.
- **LL South:** Currently, harvesting is a neglected stage of the forest management objectives and serves more the purpose of clearing the site for the establishment of new trees for NTFP production. However, the timber is locally utilized for industrial pallets and pellet production. Thus, continuous timber supply is crucial under consideration of uprising demands. Improving the efficiency through alternative harvesting systems is necessary supporting the silvicultural needs. Therefore, based on an expert interview (e.g. a forest operations expert from the Universidad Politecnica de Madrid), current harvesting systems established in Spain will be identified. Their ability to be theoretically transferred in the LL South

is evaluated for modelling and various supply chain options based on the newly implemented silvicultural models.

Availability of machines and contractors is often a limiting factor for the introduction or widespread acceptance of newly introduced operational systems. Thus, machine management concepts will be developed for the selected and beneficial operational systems in each LL, such as joint ownership and machine rings supported by forest owners

3.5 Technology development

Often, small forest owners have limited knowledge and skills related to forests, their features, management, and benefits that they may provide. This prevents effective forest management in small properties, which may hinder the economical, ecological and societal functions of those forests. Advanced and specialized forestry-related training takes time, costs money and requires experts to provide it. Therefore, accessible solutions able to provide essential information and visualization of the forests, are a promising alternative to actively involve small owners in managing their forests.

By task 5.2, S4G project will develop a smartphone AI-based app able to detect and characterize the main features of forests and their management. While the IT infrastructure for data documentation and deposition was developed, further activities following the app development, such as testing, will be implemented in the living labs.

In each LL, data to develop the different tools are being captured as 3D pictures and laser scanning. Besides that, by several meetings with local LLs small-forests owners a community of practice is being structured to test first the AI assistant and the small-forests dashboard and later work at operational level with AI assistant and AI photo interpreter.