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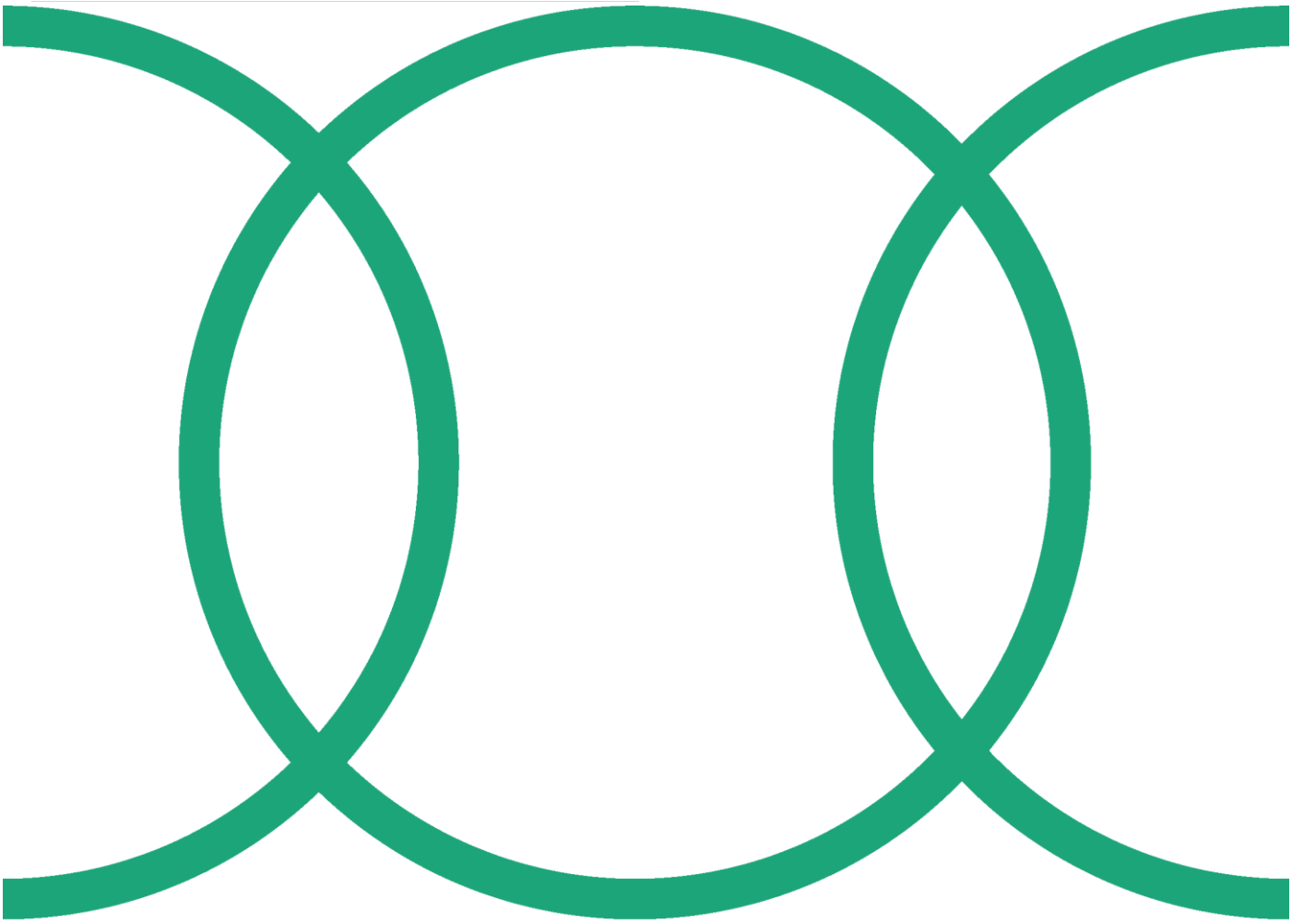
D1.2 Extended summaries of practical knowledge from selected EIP-AGRI OGs

FOREST4EU



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Work Package Leader	Steinbeis 2i GmbH - S2i
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Executive Summary

This document represents deliverable D1.2 prepared in the frame of Task 1.2 of Work Package 1 of the FORESTS4EU project. This document, elaborated by partner S2i (WP1 leader), presents in detail the activities carried out by the members of the five established ITHubs for the collection of existing practical knowledge (innovations) coming from EIP-AGRI Operational Groups (OGs) around Europe and the preparation of the corresponding extended summaries.

In the first part of T1.2, by analysing different sources of information, the members of the ITHubs identified the main challenges and needs faced by the foresters and other practitioners regarding the five ITHub topics. Based on that, the five ITHubs collected existing innovations generated by the different EIP-AGRI OGs able to solve the identified challenges and needs. The collection of those innovations was carried out through the dedicated analysis of the outcomes of the identified OGs in the specific ITHub. For each of the collected innovations, the members of the five ITHubs elaborated extended summaries (abstract with 2-4 pages) in English to be disseminated at the EU level with different formats (e.g. practice abstracts, factsheets, videos, etc.).

Based on the collected innovations coming from 86 identified OGs, a total of **175 extended summaries** were prepared. These extended summaries can be found at the end of this document.

Abbreviations

The list below present a lit of abbreviations used in the main part of this document. Abbreviations used in the Practice Abstract which are in Annex to this document are explained directly in the texts.

ITHub – Innovation Topic Hubs
OG – Operational Group
FES – Forest Ecosystem Service
NWFP – Non Wood Forest Product
FOA – Forest Owner Association
ES – Executive Summary
EIP AGRI - European Innovation Partnership 'Agricultural Productivity and Sustainability
NGO – Non Governmental Organisation

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1. Introduction

The main goal of T1.2 "Collection of existing practical knowledge coming from selected EIP-AGRI OGs" was the elaboration of at least **150 extended summaries (30 for each ITHub) based on practical knowledge (innovations) coming from selected Operational Groups (OGs)** related to the topics of the five established ITHubs ((1) wood mobilisation, (2) adaptation to climate change, (3) sustainable forest management & ecosystem services, (4) non-wood forest products and (5) agroforestry. These extended summaries prepared in English by the members of the five ITHubs will support and improve the transfer of practical knowledge from the local/national level to the EU level. As explained in D1.1 (section 3), six types of innovations are considered: (1) technological, (2) process, (3) product, (4) service, (5) organisational or (6) social.

Following the methodology developed by S2i (WP1 leader) and presented in D1.1. "Methodological approach for the management of the five ITHubs" (section 4.1), in the first part of T1.2, the members of the five ITHubs identified the main challenges and needs faced by the foresters and other practitioners regarding the five chosen topics. For this purpose, reports and deliverables from previous related H2020 projects (e.g., INNOFOREST, SINCERE), Thematic Networks (e.g. AFINET, ROSEWOOD4.0) and other sources of information (e.g., information from EIP-AGRI seminars) were analysed by the members of the five ITHubs.

Based on these findings, the ITHubs collected practical knowledge on the innovations generated by selected EIP-AGRI OGs. These innovations tackle identified problems and needs. The collection of the innovations was carried out through the dedicated analysis of the outcomes (e.g., reports, deliverables, dissemination material, etc.) of the corresponding OGs belonging to each ITHub. Taking into account that most of the results from forest and agroforestry OGs are only available in the national language of the countries where the OGs were or are established, within each ITHub, members from the same countries or able to speak the specific language were responsible for the collection of the knowledge and the elaboration of extended summaries in English. In that way, FOREST4EU make this practical knowledge on innovations available to a broader public across Europe. For the elaboration of the extended summaries, S2i prepared, as indicated in D1.1, a dedicated template available on TEAMS for each ITHub.

2. Identification of the main challenges and needs faced by the five ITHub topics

To ensure an efficient and useful collection of innovations coming from different EIP AGRI OGs dealing with the topics of the five ITHubs, firstly the FOREST4EU consortium wanted to clearly identify the main challenges and needs faced by the foresters and other practitioners concerning these specific topics. Considering the identified challenges and needs, matching innovations from forest and agroforestry OGs were collected in the following step (section 3) trying to address and solve them.

At the beginning of T1.2 (M4, April 2023), coordinated by each of the corresponding ITHub Managers, each ITHub collected reports, deliverables from past Thematic Networks & H2020 projects (e.g. ROSEWOOD4.0, SINCERE, INNOFOREST, AFINET) and other material to identify the main challenges, barriers and needs that each of the five selected innovation topics are currently facing. For the collection and sharing of this material, a dedicated folder ("Literature") in each of the specific ITHub channels on TEAMS was created.

Based on the collected information, each ITHub Manager prepared a list with a maximum of up to 10 challenges and needs for the concrete innovation topic. After sharing the list via email with the FOREST4EU partners involved in the specific ITHub, based on the collected input and comments, a final list for each ITHub was agreed by the end of April. **Table 1** shows the list of the identified challenges and needs for each of the ITHub topics.

Table 1. Identified main challenges and needs for the five ITHub topics.

ITHub 1	ITHub 2	ITHub 3	ITHub 4	ITHub 5
Wood mobilisation	**Adaptation to climate change**	**Sustainable forest management & ecosystem services**	**Non-wood forest products**	**Agroforestry systems**
Forest fragmentation (small sizes of forest properties, large size of owners)	New adapted sylvicultural practices (tree diversity, management, migration, ...)	Forest Ecosystem Services markets absent/Voluntary market not standardized	Securing the conservation and sustainable supply of NWFP (Enhance the resource base and ensure sustainable harvest levels and fair	Soil conservation
Growing disconnection of owners to their forests (spatial and emotional) and age of owners (typically 50+ and older)	Abiotic risks management (storm, fire, drought, ...)	Absent or very few example of standardized methods to quantify Forest Ecosystem Services (e.g. Carbon Stock, Water, Turistic activities ....)	Set up and improve monitoring systems and inventories and facilitate access to data and market information for all the stakeholders	Climate changes adaptation
Lack of forestry knowledge and skills among owners	Biotic risks management (monitoring and crisis management)	Improve information to monitor FES supply and demand	Building competitive and equitable value chains	Optimization of the relationship between agriculture and forest
Income from timber harvesting is significant for wood mobilisation in many regions	Prevention of desertification and land degradation (promotion of afforestation)	Support innovation and experimentation through bottom-up participation	Increase policy coherence across all relevant policy domains and design and adopt innovative fiscal and labour regimes	Increasing value in diversification agro-forestry products
Existence of markets for timber (underdevelopment of hardwood markets in some EU regions) and volatile markets for softwood and hardwood	Financial tools and incentives allowing foresters to adapt their forests	Digital solution for the monitoring of FES	Improve visibility of NWFP	Find suitable business models to accommodate a multifuntional farm
Better interaction among industries and forest operators as means to increase efficiency of value chain	Data collection of experimentations for better practical knowledge	Enhance policy integration to align policy targets and financial means	Ensure traceability and encourage innovative labelling	Labor availability and management
Logistics (non-sufficient accessibility and high harvesting costs) and lack of efficiency in logging systems/enterprises	Raise climate change awareness among actors (upstream and downstream sectors, decision	Flexible and adaptive education system to enanche trought new selvicolture system all the FES	Simplify administration / procedures related to production, processing and export	Tools for innovation uptake, incl. scientific knowledge and management techniques ready to
Forest management affecting wood mobilisation (composition and structure of forest; silvicultural schemes; hazard risks)	Reinforce dialogue, consultation, animation and mediation between actors within territories	Small forest proprieties can increase the abandoned of forest (That can have an impact on biodiversity, water regulation mantanence, increasing fire risk)	Foster innovation, knowledge transfer and extension capacity locally, regionally, nationally and between regions in Europe and outside Europe, facilitating communication between practitioners and policy makers	
Forest governance affecting forest management (lack of forest owner associations; ineffective communication, weak relationships, lack of trust; under-resourced state forest services and lack of expertise among forestry professionals; the complexity of regulations and impact on forest management planning; weak supply chains in	Extension activities and dissemination of practical knowledge and decision support tools for adaptation	Closer collaboration of research and practice (scientists and researchers have expierece in quantification of FEs, however there is a need for the implementation of results of reseach at the operational level)	Improve financial support	
		Missing political support for FES incentives		

Based on a content analysis of the identified challenges and needs faced by the five ITHubs, partner StMELF-LWF elaborated a list of transversal challenges for the transversal Hub. **Table 2** shows the agreed list, indicating which ITHubs face those common challenges and needs.

Table 2. Identified transversal challenges.

Transversal Hub		
Transversal challenge	**ITHubs related to the challenge**	**Further comments**
KNOWLEDGE: Lack of knowledge and expertise, needs for specific types of knowledge, knowledge transfer and uptake of research evidence among practitioners are limited	mainly in ITHubs 1, 2, 3 (more or less throughout an issue but not in ITHub 5)	Need for specific types of knowledge incl. management, know-how for wood production and sustainable supply of NWFP, adapted silviculture practices, decision-support tools, and methods for quantification of Forest Ecosystem Services (FES). Beyond that, knowledge transfer and existing capacities need to be improved.
MARKETS: timber = income, weak hardwood markets, volatile timber prices, weak supply chains in forest-based industries, low efficiency of logging companies, markets for FES lacking/underdeveloped, NWFP = potential source of monetary income, limited competitiveness of Non-Wood Forest Products (NWFP) value chains and visibility, valuation agro-forestry products	more in ITHub 1, 4 and 5 (products from forests, new business models), but also in 3	Income from timber and NWFP is or can be significant for owners. It may not be realised, however, because owners are faced with volatile prices, weak position in the market, and limited ability to diversify their products
COMMUNICATION & COOPERATION: Fragmented forest ownership, lack of Forest Owner Associations (FOAs), ineffective communication, lack of support for bottom-up participation, no dialogue btw policymakers and practitioners, no cooperation between forestry and agriculture	mainly in ITHub 1 but also in others (fragmented ownership and uneven relationship btw small owners and timber processing industries)	Lack of or ineffective communication between individual owners and between different groups is major issue. Supportive structures are lacking, private ownership tends to be small-scale and fragmented, forestry and agriculture do not collaborate well
GOVERNMENT & POLICY: Under resourced forest services, complexity of regulations, policy targets not aligned with financial means	greater issue in ITHub 3 and 4 (future products from forests)	In some countries, policy frameworks seem to constrain the provisioning FES. Regulations affecting timber production and NWFP may be too complex. Regulations affecting other services are not aligned with financial support schemes
ENVIRONMENT: Climate change affects both forest management and agriculture. In forestry, abiotic and biotic risks increase. In both sectors, lands are degrading, and issues of soil conservation become more important	ITHub 2 and 5	Climate change affects both forestry and agriculture. In forestry, abiotic and biotic risks increase. In both sectors, lands are degrading, and issues of soil conservation become more important
TECHNOLOGY: Collect practical knowledge from experiments, set up and improve FES monitoring systems, use digital means	ITHub 2, 3 and 4	Digital tools and solutions should be promoted to better monitor forests and use the collected data for FES-oriented management
VALUES & ATTITUDES: Forest owners might be disconnected from their properties, lack of identification with forest ownership can lead to abandoning of forest land	ITHub 1 and 3	Values and attitudes refer primarily to forest owners and how they relate to their forests. It becomes more difficult to achieve multi-functional forestry if owners are absent and/or disconnected from their forests

RESOURCES: Forest owners need financial resources to adapt forests to climate change and secure sustainable supply of NWFP	ITHub 2 and 4	Need for people and financial resources, in order to adapt forests to climate change and secure sustainable supply of agroforestry products and NWFP

3. Collection of existing practical knowledge (innovations) from EIP-AGRI OGs able to solve the identified challenges and needs

Initially, the collection of innovations was supposed to be exclusively conducted by ITHub partners (ITHub managers, NSPOCs and members from Spain, Portugal, Italy, France, Latvia and Slovenia) who were or are directly involved in selected OGs from their own countries dealing with the five ITHub topics. The list of these selected OGs can be found in D1.1 (section 4.1, table 2). However, since ITHub partners from other countries were strongly interested in participating in this task, it was decided to expand the selection of OGs. In that way, all ITHub partners could collect innovations from any European forest and agroforestry OG, even if the partner was/is not directly linked to the corresponding OG. Considering that most of the results are only available in the national language of the countries where the OGs were or are established, the only limitation was that the ITHub partner collecting innovations from a foreign OG needed to be able to speak/understand the corresponding language.

For the collection of the innovations generated by European forest and agroforestry OGs, the different ITHub partners contacted the corresponding OG coordinators. In a first contact via e-mail, the FOREST4EU partners introduced the project and explained the general objective, highlighting the essential role of the innovations generated by the forest and agroforestry OGs. In some cases, a meeting or a phone interview was set up for a further discussion on the corresponding OG and its innovations. In that way, the FOREST4EU partner collected first-hand information to better understand all generated innovations, also kindly requesting existing supporting documents and material (e.g. reports, dissemination material, etc.). On the project TEAMS, all these documents (mainly in the corresponding national language) were stored in the specific ITHub channels (e.g. “OGs documents” for ITHub1).

A consent form was put in place to be completed by all the coordinators of the contacted OGs. With this consent, the coordinators allowed the FOREST4EU project to use their generated innovations and knowledge to be disseminated at the EU level through different types of material (e.g. practice abstracts, videos, etc.) and channels (e.g. existing online repositories). It is necessary to have a filled consent form for each of the reached OGs. The filled consent forms (with the short name of the OG as the name of the file, e.g. SURF, SPNA, NUTRISUBER) were stored on Microsoft TEAMS in the corresponding ITHub folder (e.g. Consent forms – ITHub 1).

4. Elaboration of extended summaries in English of each collected innovation

Coordinated by the ITHub managers and S2i, between August and October 2023, the ITHub partners (ITHub managers, NSPOCs and members) involved in the collection of innovations elaborated the **extended summaries in English**. For this purpose, a dedicated template (excel file) prepared by S2i was used. For each collected innovation, matching any of the previously identified challenges and needs (section 2), one extended summary was produced by the corresponding ITHub partner. The five templates are available in the specific ITHub channel on the FOREST4EU TEAMS.

Each of the five Excel files (one for every ITHub) included (1) a first sheet with the instructions for use and a table with the overview of the extended summaries, (2) a second sheet with a list of keywords used for the EIP AGRI common format and EIP AGRI projects, and (3) the sheets for each of the extended summaries including the following fields:

- Title of innovation
- ITHub (1 to 5)
- FOREST4EU partner (short name)
- Operational Group (short name)
- Operational Group (name)
- Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)
- Link from OGs database
- Country, region, city
- Type of innovation (technological, process, product, service, organisational or social)
- Keywords (please see annex 1)
- Approach and main results (4000 characters max.)
- Lessons learned (1200 characters max.)
- Contact information
- Links to website/report/video (if applicable)
- Link to pictures (if applicable)

To facilitate the identification of the different extended summaries, keywords used for the EIP AGRI common format and EIP AGRI projects were associated with each of the prepared extended summaries. An analysis of the most used keywords can be found in the following section of this report.

As indicated in the FOREST4EU Grant Agreement, at least 150 extended summaries describing OG innovations should be prepared by the ITHub partners (ITHub managers, NSPOCs and members), 30 ones per ITHub. Finally, thanks to the effort and engagement of the partners, a total of **175 extended summaries were elaborated from 86 forest and agroforestry OGs**. The ITHub Managers were responsible for checking the quality of all produced "extended summaries" within their corresponding ITHub.

The elaborated "extended summaries", available for the whole consortium in the corresponding ITHub channels on TEAMS, are essential for the whole implementation of the project, as contain all innovations generated by European forest and agroforestry OGs dealing with the five ITHub topics in English, being key for the preparation of "practice abstracts" to be delivered to EIP AGRI (T1.3), factsheets for their international dissemination through existing online repositories (T1.4), but also for WP2 (Capacity building), WP3 (Policy learning from OGs) and WP4 (Communication, dissemination and exploitation).

5. Overview of the OGs, extended summaries, types of innovations and keywords

This section shows an overview and analysis of all contacted forest and agroforestry OGs related to the five ITHub topics, the elaborated extended summaries, their types of innovations and all associated keywords.

A total number of **175 extended summaries** were elaborated by the ITHub partners based on collected innovations coming from **86 European forest and agroforestry OGs**.

Figure 1 shows the number of OGs per ITHub and per country. Some OGs have been included in more than one ITHub, as their different innovations fit several ITHubs/topics. However, it is important to highlight that no extended summary is repeated in more than one ITHub. Each extended summary has been produced for a specific innovation and for one concrete ITHub topic.

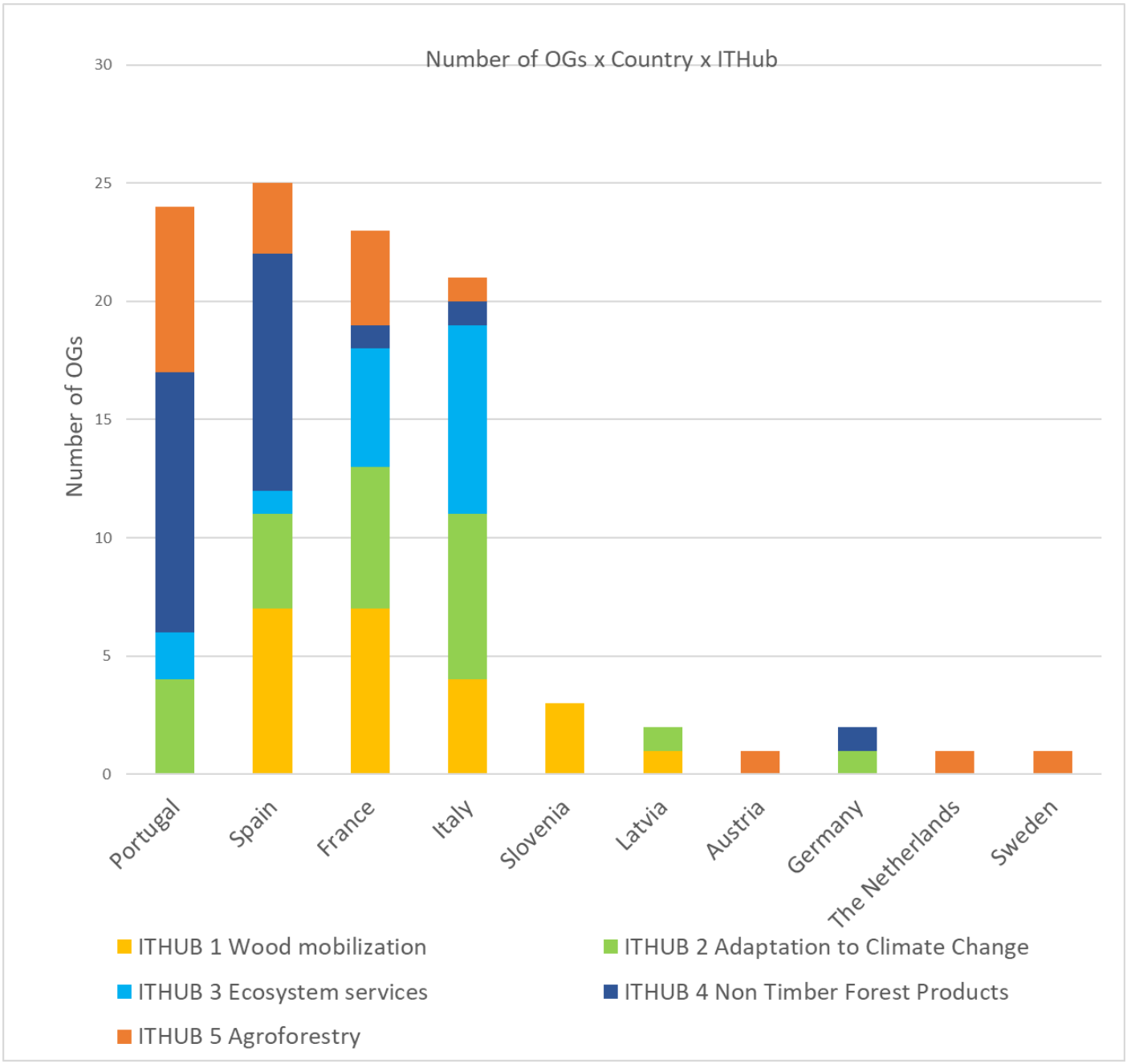


Figure 1. Number of OGs x country x ITHib (some OGs have been included in more than one ITHub).

The total number of contacted OGs who provided support for the elaboration of ES based on their innovations and their distribution between European countries can be found in the below list. As previously mentioned, a total number of **86 forest and agroforestry OGs** collaborated with FOREST4EU. The larger number of OGs were/are located in Spain (24 OGs), Portugal (24 OGs), France (19 OGs) and Italy (11 OGs). Moreover, the topical innovation fields vary across countries. For example, whereas innovation in wood mobilization is substantial in Spain, France, Italy and Slovenia, innovations related to non-timber forest products are frequent in Portugal and Spain but negligible in the other countries.

- Spain: 24 OGs
- Portugal: 24 OGs
- France: 19 OGs
- Italy: 11 OGs

- Slovenia: 3 OGs
- Latvia: 1 OG
- Austria: 1 OG
- Germany: 1 OG
- The Netherlands: 1 OG
- Sweden: 1 OG

Regarding the types of innovations collected from the 86 OGs, **Figure 2** presents their distribution within the five ITHubs. FOREST4EU partners collected 175 innovations: technological (58), product (17), process (47), service (34), organisational (5) and social (14). A lot of times, different innovations go hand in hand. For example, technological innovations enable the introduction of novel processes and/or services.

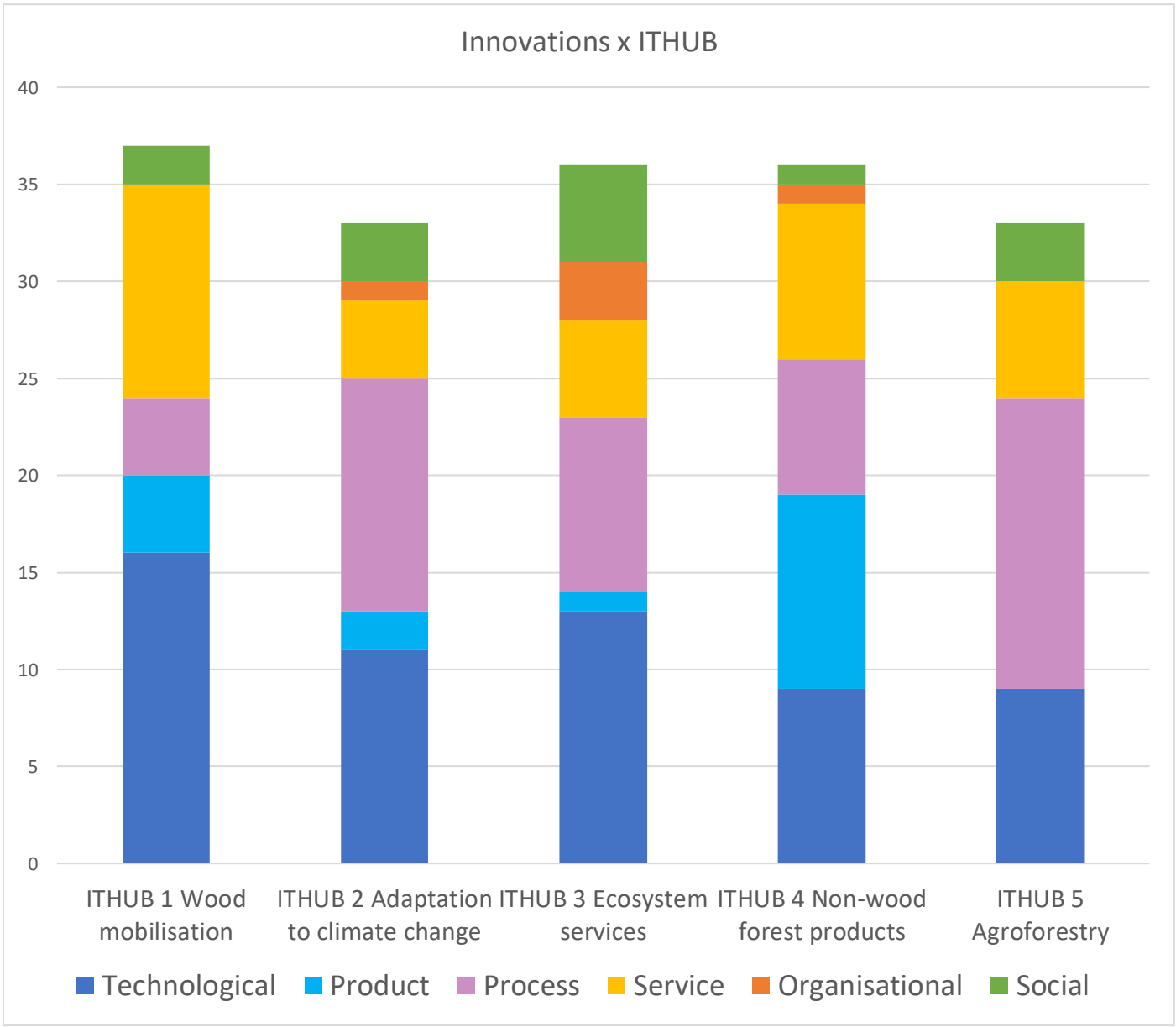


Figure 2. Types of innovations x ITHub.

Tables 3 to 7 show the different OGs involved in each of the five ITHubs, their locations and the number of extended summaries based on their concrete innovations.

Table 3. ITHub 1: Involved OGs, locations and number of related extended summaries.

ITHub 1				
OG	Number ES per OG	ES ID (rel. Table 8)	Type of Innovation	Country
OG Do.Na.To	1	22	Technological	Italy
OG FOR.TRACK	1	25	Process	
OG SURF	3	1	Service	
		24	Technological	
		27	Technological	
OG PRI.FOR.MAN	4	2	Service	
		3	Technological	
		17	Technological	
		26	Technological	
OG DIGIGOZD	2	18	Service	Slovenia
		19	Service	
OG Di-Gozd	2	28	Service	
		29	Service	
OG eGOZD	5	4	Service	
		5	Service	
		6	Technological	
		20	Service	
		21	Service	
OG IR_MP3	2	7	Process	Latvia
		37	Technological	
OG Silver Fir	1	8	Product	France
OG RAISON	1	9	Process	
OG CooldWood(r)	1	10	Technological	
OG Sylviconnect	1	11	Social	
OG Noir&Sens	1	12	Technological	
OG Normandy Wood Building	1	23	Product	
OG SPNA	1	12	Technological	
OG SIGCA	1	14	Process	Spain
OG FAGUS	2	15	Product	
		16	Technological	

OG PROMINIFUN	2	35	Technological	
		36	Service	
OG Calor Rural	1	30	Social	
OG SINGULARWOOD	1	31	Product	
OG LOGGFORCAT	1	32	Technological	
not found	1	33	Technological	
OG MUCAS	1	34	Technological	
	37			

Table 4. ITHub 2: Involved OGs, locations and number of related extended summaries.

ITHub 2				
OG	Number ES per OG	ES ID (rel. Table 9)	Type of Innovation	Country
OG SPNA	1	1	Technological	France
OG RAISON	2	2	Product	
		3	Process	
OG EUROFORNORM	3	9	Service	
		10	Social	
		12	Social	
OG Douglas	1	13	Process	
OG Futur Forest	1	14	Process	
OG Mont Beuvray	1	31	Organisational	
OG IR_MP3	1	4	Technological	Latvia
OG Do.Na.To	1	5	Process	Italy
OG CASTANI-CO	1	7	Process	
OG Castagni Parlanti	1	8	Process	
OG SURF	2	11	Technological	
		15	Service	
OG NEWTON	1	16	Process	
OG BIOSEIFORTE	1	17	Technological	
OG CO2MARCHE	1	19	Process	
OG Aleppo Pine	1	6	Product	Spain
OG PINEA	1	18	Service	
OG SPASB	1	32	Technological	
OG SISE	1	30	Technological	
OG GEOSUBER	2	20	Process	Portugal

		21	Technological	
OG REGACORK	3	22	Process	
		23	Process	
		24	Social	
OG +PINHÃO	3	25	Technological	
		26	Technological	
		27	Service	
OG UNDERCORK	2	28	Technological	
		29	Technological	
OG Bienenwald (bee forest)	1	33	Process	Germany
	33			

Table 5. ITHub 3: Involved OGs, locations and number of related extended summaries.

ITHub 3				
OG	Number ES per OG	ES ID (rel. Table 10)	Type of Innovation	Country
OG SPNA	4	3	Technological	France
		4	Social	
		5	Technological	
		6	Service	
OG PIF	3	21	Process	
		22	Technological	
		23	Technological	
OG FPP-EGG	1	24	Organisational	
OG OUI-GEF	1	25	Social	
OG Douglas	1	36	Technological	
OG GO-PRI.FOR.MAN	3	9	Service	Italy
		10	Organisational	
		11	Social	
OG Do.Na.To	2	12	Process	
		13	Service	
OG SURF	5	1	Technological	
		2	Technological	
		8	Service	
		14	Social	
		26	Technological	
	2	15	Process	

OG Biodiversamente Castagno		16	Social	
OG INGECA	1	17	Technological	
OG FOR.TRACK	2	18	Technological	
		27	Technological	
OG BIOSEIFORTE	2	19	Process	
		29	Technological	
OG CO2MARCHE	6	28	Organisational	
		30	Service	
		31	Process	
		32	Process	
		33	Product	
		34	Process	
OG +PrevCRP	1	35	Process	Portugal
OG GI (PIN)	1	20	Technological	
OG SIGCA	1	7	Process	Spain
	36			

Table 6. ITHub 4: Involved OGs, locations and number of related extended summaries.

ITHub 4				
OG	Number ES per OG	ES ID	Type of Innovation	Country
OG BIJOU	1	6	Product	France
OG RESINLAB	2	1	Service	Spain
		2	Process	
OG PINEA	1	10	Service	
OG MIKOGEST	4	11	Technological innovation	
		12	Service	
		13	Organisational innovation	
		14	Service	
OG SUBER	3	23	Process	
		24	Product	
		28	Process	
OG ACREMA	4	25	Process	
		26	Product	
		27	Technological	
		30	Service	

OG TEb Verd / BoletBenFet	1	32	Product	
not found	1	33	Product	
OG CLIM'AGIL	1	34	Technological	
OG TCA	1	35	Product	
OG OTR	1	36	Product	
OG Pinus Resina	1	3	Technological	Portugal
OG Micocoating	1	4	Technological	
OG VolorCast	1	5	Process	
OG NUTRISUBER	2	7	Service	
		8	Service	
OG FERTIPINEA	1	9	Service	
OG EGIS	1	16	Process	
OG Bio-Chestnut- IBM	1	17	Technological	
OG PLATISOR	1	31	Technological	
OG ClimCast	1	20	Process	
OG SambucusValor	1	21	Product	
OG ValNuts	1	22	Product	
OG Bienwald (Bee forest)	1	29	Product	Germany
OG INGECA	3	15	Social	Italy
		18	Technological	
		19	Technological	
	36			

Table 7. ITHub 5: Involved OGs, locations and number of related extended summaries.

ITHub 5				
OG	Number ES per OG	ES ID	Type of Innovation	Country
OG Oak Regeneration	1	1	Service	Portugal
OG Solo	1	2	Process	
OG Fósforo	3	3	Technological	
		8	Technological	
		9	Technological	
OG EcoMontadoXXI	3	4	Process	
		6	Process	
		7	Process	
OG SILVPAST	2	5	Process	

		10	Technological	
OG GOTECFOR	1	15	Technological	
OG Olival	1	33	Process	
OG FORESTCELTA	1	11	Technological	Spain
OG CASTANEA	4	21	Process	
		22	Service	
		25	Process	
		28	Technological	
OG GRASSEN	1	30	Technological	
OG Agroforst in Österreich	3	12	Organisational	Austria
		13	Service	
		14	Service	
OG Commercial productive apple growing in a northern climate	1	16	Process	Sweden
OG BUCHDENS	1	17	Organisational	France
OG ARBRE	2	18	Service	
		19	Process	
OG TCR	1	31	Technological	
OG AGROSYL	1	20	Process	
OG NEWTON	5	23	Organisational	Italy
		24	Process	
		26	Process	
		27	Process	
		29	Process	
OG Experiment Agroforestry Noord-Holland	1	32	Service	the Netherlands
	33			

As indicated in section 4, to facilitate the identification of the different extended summaries, keywords used for the EIP AGRI common format and EIP AGRI projects were associated with each of the prepared extended summaries. **Figures 3 to 7** present the most used keywords for the produced extended summaries in each of the five ITHubs.

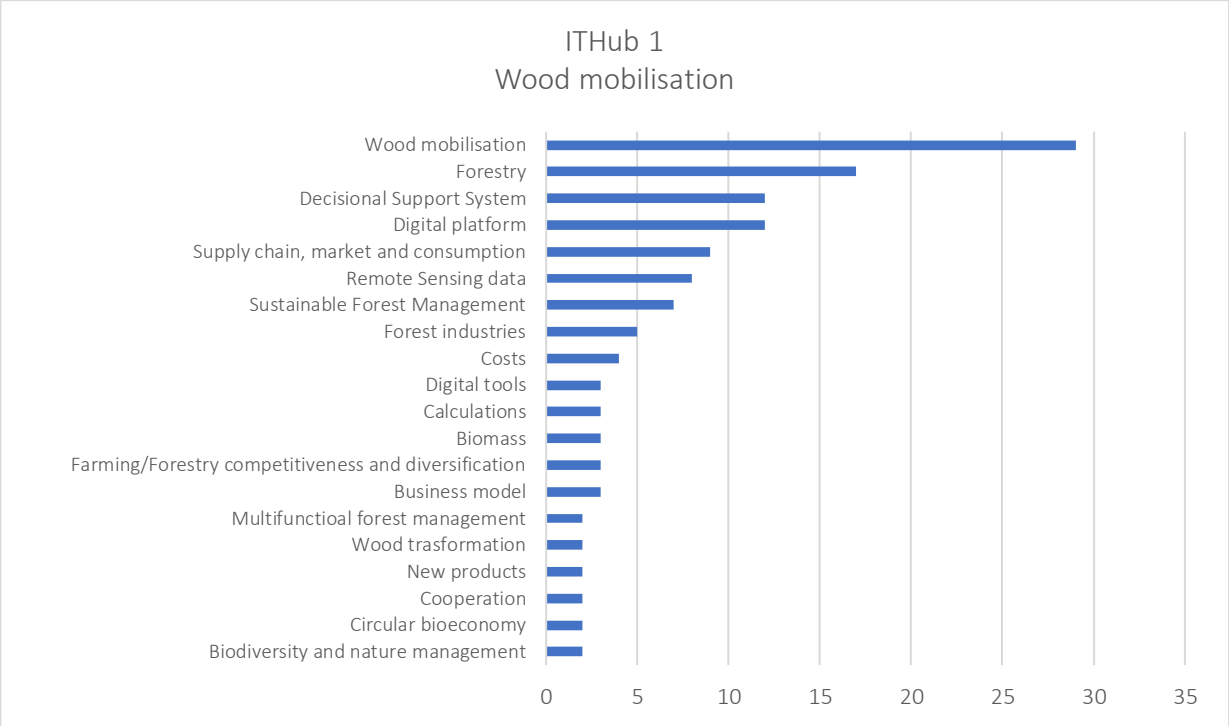


Figure 3. Most used keywords for ITHub 1.

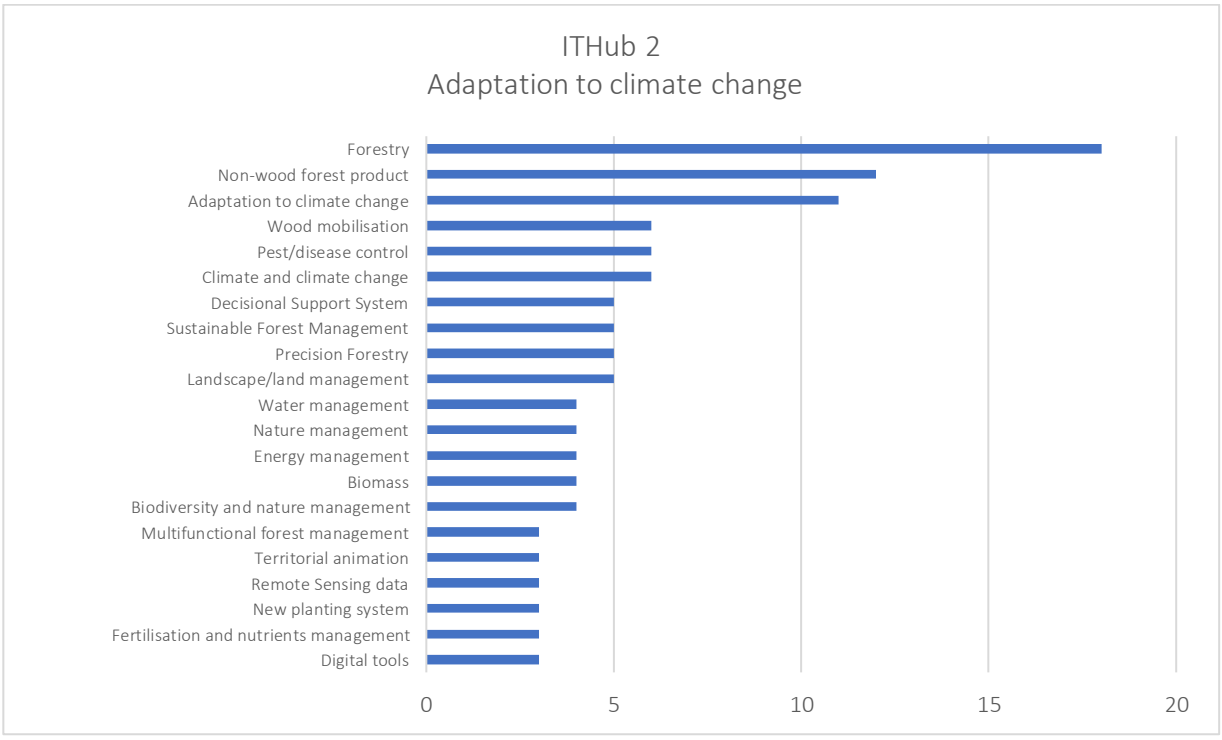


Figure 4. Most used keywords for ITHub 2

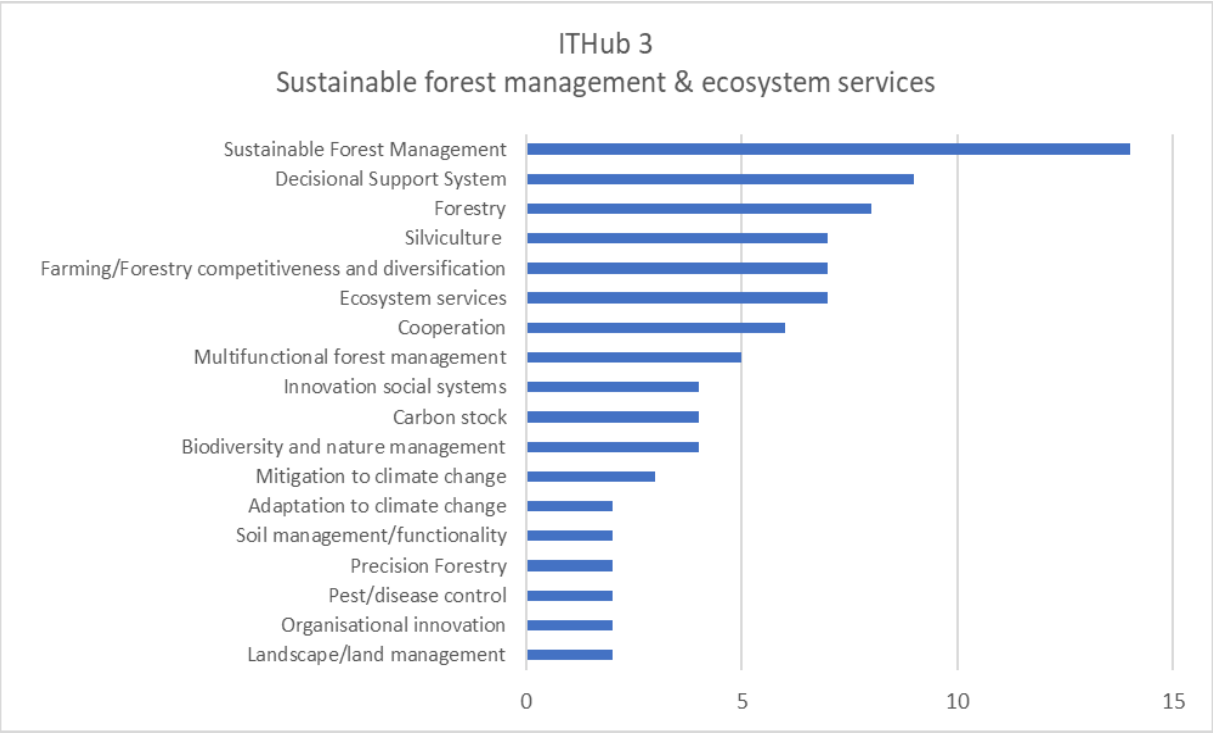


Figure 5. Most used keywords for ITHub 3

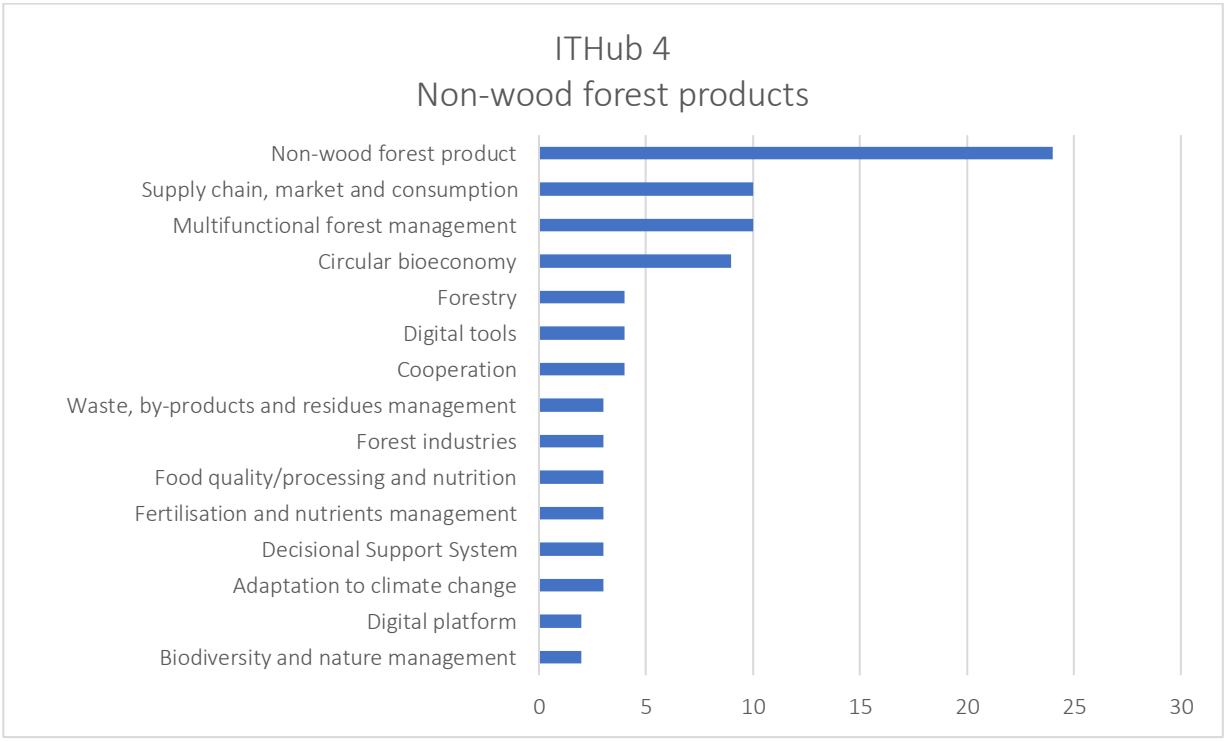


Figure 6. Most used keywords for ITHub 4

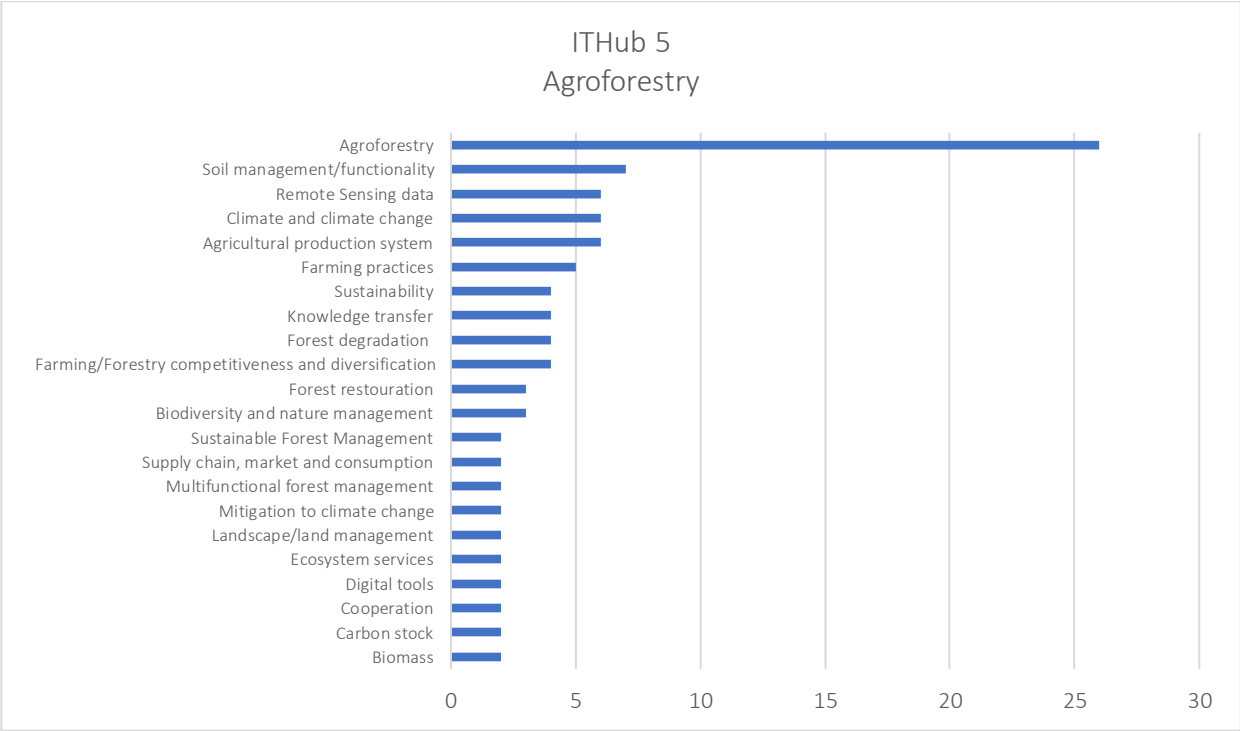


Figure 7. Most used keywords for ITHub 5

6. Extended summaries

This section presents the **175 extended summaries** prepared by the members of the five ITHubs based on the identified innovations from a total of 86 forest and agroforestry OGs. As previously mentioned, these elaborated "extended summaries" will be essential for the preparation of "practice abstracts" to be delivered to EIP-AGRI (T1.3), factsheets for their international dissemination through existing online repositories (T1.4), but also for different activities with WP2 (Capacity building), WP3 (Policy learning from OGs) and WP4 (Communication, dissemination and exploitation).

ITHub 1 – Wood mobilisation (37 extended summaries)

Table 8. Overview of the extended summaries of ITHub 1.

	Title of innovation	Operational Groups (short name)	Type of Innovation	Country
1	Growing Stock Volume Map to support forest operation planning	GO-SURF	Service	Italy
2	Standardization of available forest data: the first step to support wood mobilization in Friuli Venezia Giulia	GO-PRI.FOR.MAN	Service	Italy
3	PRI.FOR.MAN Dashboard: Overview of Wood Resources at NUT3 Level to Support Wood Mobilization and Value Chain	GO-PRI.FOR.MAN	Technological	Italy

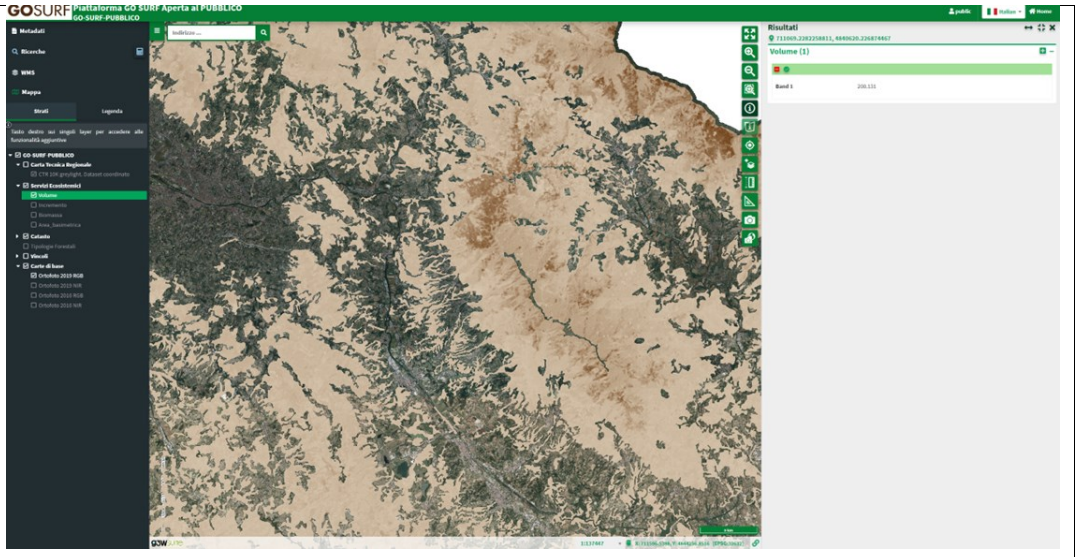
4	Assessment of Costs in Harvesting Systems using an Web-based Tool (WoodChainManager)	eGOZD	Service	Slovenia
5	A system for Quality assessment of Forestry Contractors	eGOZD	Service	Slovenia
6	Creating Your Own Estate Plan Via The Online Portal (MojGozdar)	OG eGozd	Technological	Slovenia
7	Software for mobilisation and efficient use of resources involved in transportation of timber from forest to destination location	OG IR_MP3	Process	Latvia
8	New market for Silver fir products (LVL)	OG Silver Fir	Product	France
9	Implementation of innovative forestry trials: improvement at lower cost (under revision by the coordinator)	OG RAISON	Process	France
10	Innovative process for storing and preserving lumber in logs or transformed by temperature control	OG CooldWood(r)	Technological	France
11	Laforêtbouge web platform (for connecting owners and professionals)	OG Sylviconnect	Social	France
12	Technique for superficial heat treatment on wood product	OG Noir&Sens	Technological	France
13	Sylv'éclair a decision support tool for thinning in pine plantation	OG SPNA	Technological	France
14	Mechanical structural classification for Pinus pinaster ssp atlantica in the northern Iberian Peninsula approved by the European Normailzation Committee.	OG SIGCA	Process	Spain
15	LVL (Laminated Veneer Lumber) of fagus silvatica	OG FAGUS	Product	Spain
16	Visual structural grading tool and a mechanical structural grading tool	OG FAGUS	Technological	Spain
17	Wood potentially available for harvesting activities	GO-PRI.FOR.MAN	Technological	Italy
18	MOTI	DIGIGOZD	Service	Slovenia
19	SiWaWa	DIGIGOZD	Service	Slovenia
20	Online tool for quality classification of round-wood	eGOZD	Service	Slovenia
21	Web-based due diligence and traceability system for forest timber assortments	eGOZD	Service	Slovenia
22	New methodology for Douglas-fir timber qualification	Do.Na.To	Technological	Italy
23	Prefabricated modular construction system made from Normandy hardwoods	Normandy Wood Building	Product	France
24	Map accessibility of forest parcel to support wood mobilization	GO-SURF	Technological	Italy
25	Growing Stock Volume mapping using Remote Sensing Data	GO.FORTRACK	Process	Italy
26	UAV to map growing stock volume for sharing forest management plan	GO-PRI.FOR.MAN	Technological	Italy
27	Mapping forest assortment at parcel level to support wood mobilization	GO-SURF	Technological	Italy
28	Di-Gozd Digital Forest Inventory - Mobile app	Di-Gozd	Service	Slovenia
29	Di-Gozd Digital Forest Inventory - Internet app	Di-Gozd	Service	Slovenia
30	Social network of sustainable forest use for the production of biomass for thermal purposes	Calor Rural	Social	Spain
31	Innovation in products, processes and marketing to introduce local woods with special, greater value-added characteristics to the Catalan market	SINGULARWOOD	Product	Spain
32	Development of an efficient logging system using the LOGGFORCAT boom harvester	LOGGFORCAT	Technological	Spain

33	Development of a prototype crosslaminated timber panel made from local timber to improve the construction of buildings in terms of sustainability	not found	Technological	Spain
34	Improving the bond between steel and synthetic cable (MUCAS)	OG MUCAS	Technological	Spain
35	Rural propierty management platform	GO PROMINIFUND	Technological	Spain
36	Methodology for assessing the economic-financial sustainability of forest holdings	GO PROMINIFUND	Service	Spain
37	Logging trailer - solution for efficient use of transportation resources of farmers out of agricultural season	IR_MP3	Technological	Latvia

ITHub 1 - 1

Title of innovation	**Growing Stock Volume Map to support forest operation planning**
ITHub	1
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-SURF
Operational Group (name)	DECISION SUPPORT TO SUSTAINABLE FOREST PLANNING
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company, NGOs, research institutions, advisor
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/supporto-decisionale-alla-pianificazione-forestale
Country, region, city	Italy, Tuscany
Type of innovation	Service
Keywords	Forestry, Remote Sensing data, digital platform,Decisional Support System, wood mobilization
Approach and main results (4000 characters max.)	To effectively plan forest operations and optimize resource allocation, it is of utmost importance to map the Growing Stock Volume (m3/ha) within a specific area. This information plays a critical role in conducting economic evaluations of forest operations and supporting forest management planning. Traditionally, acquiring such data has involved labor-intensive and expensive fieldwork, posing a significant burden, especially for small-scale forest owners. However, recent advancements in research have yielded remarkable progress in developing modeling and prediction techniques that leverage freely available data sources like the National Forest Inventory and Remote Sensing Data. These approaches enable the creation of accurate and detailed maps of Growing Stock Volume. These maps hold tremendous value for forest operation planning and have been successfully implemented throughout the Tuscany Region as part of the GO-SURF initiative. By utilizing data from the National Forest Inventory plots and open-access Landsat imagery, a high-resolution map of Growing Stock Volume has been generated for all regions in Tuscany, boasting a spatial resolution of 23 m x 23 m. This technological leap not only reduces the costs associated with data acquisition but also grants small forest owners, who typically face limited budgets for field campaigns, access to this invaluable information. Additionally, forest companies seeking suitable forests for logging purposes can benefit significantly from these comprehensive maps.

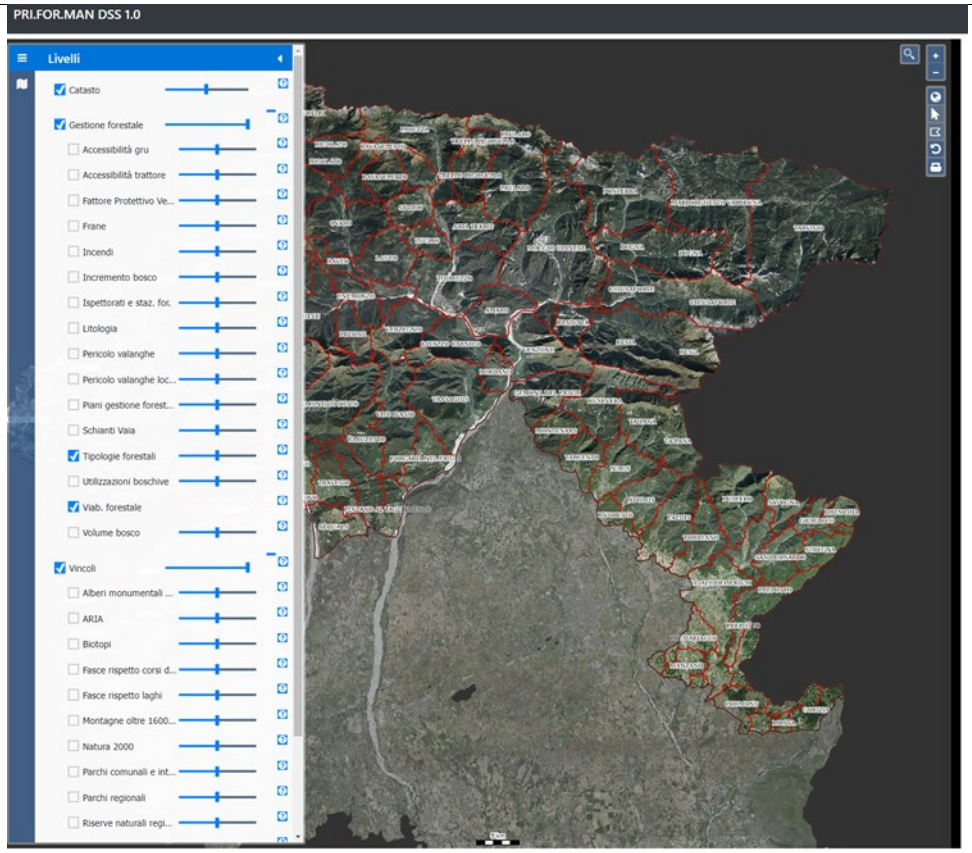
	The resulting map is conveniently accessible through a Decision Support System Platform, empowering users to query the data through interactive tools like drawing or uploading polygons. The way to query the data was co-designed with farmers, forest owners, forest managers and forest company in order to be sure to fit their needs. This type of query the Growing Stock Map though the platform facilitates direct extraction of reports and geographic data, streamlining decision-making processes and elevating overall forest management practices. By leveraging these advancements, stakeholders can make informed choices and ensure the sustainable management of forest resources. The access to the Growing Stock map though the DSS can bring several benefits for Tuscany Forest Sector, including improved resource allocation, enhanced operational efficiency, better risk management, and the ability to plan and implement sustainable forest management practices also in small forest owners proprieties that usually are abandoned. In this sense the map in the next years can be used to develop efficient and sustainable wood mobilization practices that are essential to ensure a continuous supply of timber and wood products while minimizing environmental impacts. The maps can be used also to identify productive areas that can be used to build new wood value-chains that are not well organized in Tuscany forest sectors.
Lessons learned (1200 characters max.)	An interesting lesson learned from GO-SURF is that it is possible to introduce digital tools in the forestry sector of Tuscany. The introduction of the GO-SURF Growing Stock map occurred in a context where stakeholders were not accustomed to using digital tools. However, the co-designed platform has facilitated access to the Growing Stock Map. Moreover, analyzing the daily access to the DSS platform, we have observed a continuous increase in usage (from an average of 10 users per month in the first month to 40 users per month currently). Accessing the map does not require users to have knowledge of complex models and algorithms used in its generation. In fact, users are not required to have knowledge of remote sensing data or national inventory data. Users are provided with the specific product they need and are interested in, which is the map of Growing Stock Volume. As suggested by forest owners, managers, and companies involved in the co-design of the platform, the Growing Stock Volume map allows for a better understanding of wood resources within an area and is useful for assessing forest operations and management activities in a sustainable way.
Contact information	Francesca Giannetti (francesca.giannetti@unifi.it)
Links to website/report/video (if applicable)	Video: https://youtu.be/tIyNjOTKPXY - Website: https://www.go-surf.it/

Pictures (if applicable)	

ITHub 1 - 2

Title of innovation	**Standardization of available forest data: the first step to support wood mobilization in Friuli Venezia Giulia**
ITHub	1
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	PRI.FOR.MAN
Operational Group (name)	Shared PRIvate FORest MANagement in Eastern Alps
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest companies, advisors, research institutions
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/gestione-condivisa-delle-proprieta-forestali
Country, region, city	Italy, Friuli Venezia Giulia
Type of innovation	Service
Keywords	Forestry, Remote Sensing data, digital platform,Decisional Support System, wood mobilization, new value chain, Sustainible Forest Managment
Approach and main results (4000 characters max.)	In Friuli Venezia Giulia, located in the eastern Alps of Italy, approximately 32% of the region is covered by forests. However, their utilization is much lower than their growth. Sustainable forest management in this region faces challenges due to depopulation in the mountains and various other factors, including inadequate forest roads, a limited number and size of logging and primary processing companies, and excessive fragmentation of land ownership. In fact, the majority of regional forests are privately owned (60%), with highly fragmented parcels of land, some smaller than 1000 m2. Furthermore, it is important to note that a single parcel often has multiple owners, some of whom may not be reachable due to their non-residency in the area. In this context, PRI.FOR.MAN OG is working towards addressing these issues and implementing a new collaborative approach to managing small forest properties. However, to achieve this goal, standardized information on forest parcels is crucial. Although many pieces of information on forest parcels were already available in Friuli Venezia Giulia, they were scattered across various administrative portals. As a result, even if the information were accessible, it was often not organized in a standardized and uniform format. This poses challenges for forest stakeholders and owners who require consistent and reliable information. To improve the situation, PRI.FOR.MAN has focused its efforts on centralizing and standardizing the information on forest parcels, making it easily accessible and facilitating collaborative forest management

	initiatives. For the first time in the region, a geodatabase was created to centralize the forest-related data from different administrative portals into a single, comprehensive database. This allows streamlined access to information and facilitates standardized data management. The collected and standardized geographic layers can be categorized into three types: (1) Basic cartographic layers, including cadastral parcels, the regional technical map at a scale of 1:5000, public roads, and regional orthophotos with a resolution of 10 cm; (2) Forest management layers, including forest categories, existing forest management plans, forest roads, presence of disturbances, and information related to past harvesting areas; (3) Environmental constraints, including an estimation of the protective role exercised by forest vegetation, the location of biotopes, regional or state parks and reserves, and Natura 2000 sites with specific connections to current regulations (e.g., conservation and development measures) and/or management plans. PRI.FOR.MAN ensures that the available geographic layers have been verified to resolve any topological errors, standardized, and, if necessary, converted/transformed into the RDN2008/UTM zone 33N reference system (EPSG 6708). The standardized layers were then organized using a systematic approach to structure and categorize the forest data based on relevant parameters such as location, ownership, forest type, and ecological features. Finally, the data were published in the Decision Support System Platform developed within the context of PRI.FOR.MAN. This platform enables the sharing of forest-related data among stakeholders, including forest owners, management agencies, researchers, and other interested parties. It provides user-friendly access to standardized data within a unified environment. Moreover, the classification of the layers allows users to quickly access the necessary information without getting lost in various administrative portals.
Lessons learned (1200 characters max.)	Organizing the geographic data related to the available information from various administrative portals in the Friuli Venezia Giulia region required a significant amount of work in terms of man-hours dedicated to data standardization. Furthermore, it was not always easy to quickly find the information needed. Some information was not standardized in databases or in a rational manner, necessitating the process of digitization. In the organization of the layers within the categorized strata, the input of technicians and end-users was crucial, as it allowed for proper categorization that reflects their specific needs
Contact information	Giorgio Alberti giorgio.alberti@unud.it - Luca Cadez luca.cadez@uniud.it - Francesca Giannetti francesca.giannetti@unifi.it
Links to website/report/video (if applicable)	https://www.legnoservizi.it/attivita/innovazione/

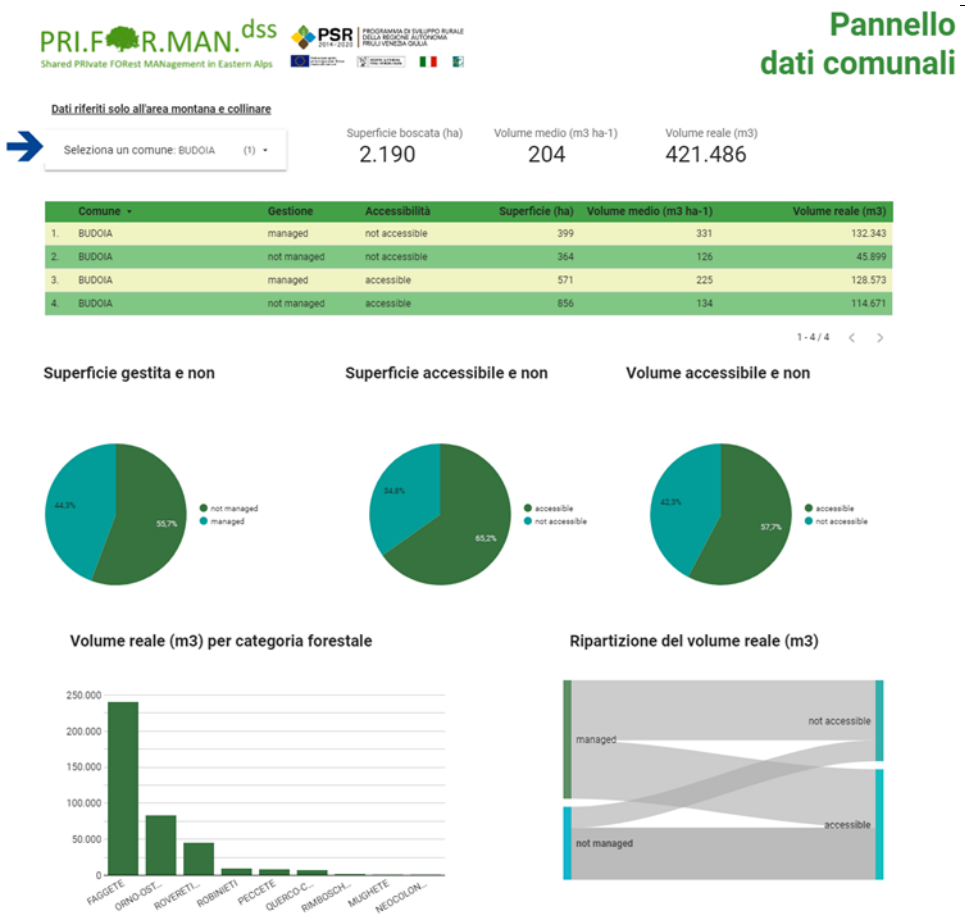
Pictures (if applicable)	

ITHub 1 - 3

Title of innovation	**PRI.FOR.MAN Dashboard: Overview of Wood Resources at NUT3 Level to Support Wood Mobilization and Value Chain**
ITHub	1
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	PRI.FOR.MAN
Operational Group (name)	Shared PRIvate FORest MANagement in Eastern Alps
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest companies, advisors, research institutions
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/gestione-condivisa-delle-proprieta-forestali
Country, region, city	Italy, Friuli Venezia Giulia
Type of innovation	Technological innovation
Keywords	Forestry, Remote Sensing data, digital platform,Decisional Support System, wood mobilization, new value chain, Sustainible Forest Managment
Approach and main results (4000 characters max.)	Supporting wood mobilization and establishing new value chains in a forest area involves the development of a comprehensive framework and system to optimize the utilization of forest resources, enhance economic value, and promote sustainable forest management practices. The setup of a new value chain focused on wood mobilization in a forest area requires a holistic approach that considers various aspects such as forest management, stakeholder collaboration, market dynamics, and sustainability principles. Through strategic planning and implementation, a well-designed value chain can contribute to the economic growth, environmental protection, and social well-being of the forest area and its surrounding communities. One of the initial steps in establishing a value chain and improving wood mobilization is analyzing the existing wood resources and assessing their potential for value-added products and services. In this context, PRI.FOR.MAN has developed different forest geographic layers that describe forest resources, including the Growing Stock Volume map and Forest Types maps. Additionally, the OG has developed additional geographic layers, such as the Accessibility map of forest parcels and forest roads, which are important for analyzing the resources for wood mobilization. All these maps have been implemented in a Decision Support System accessible through the internet.

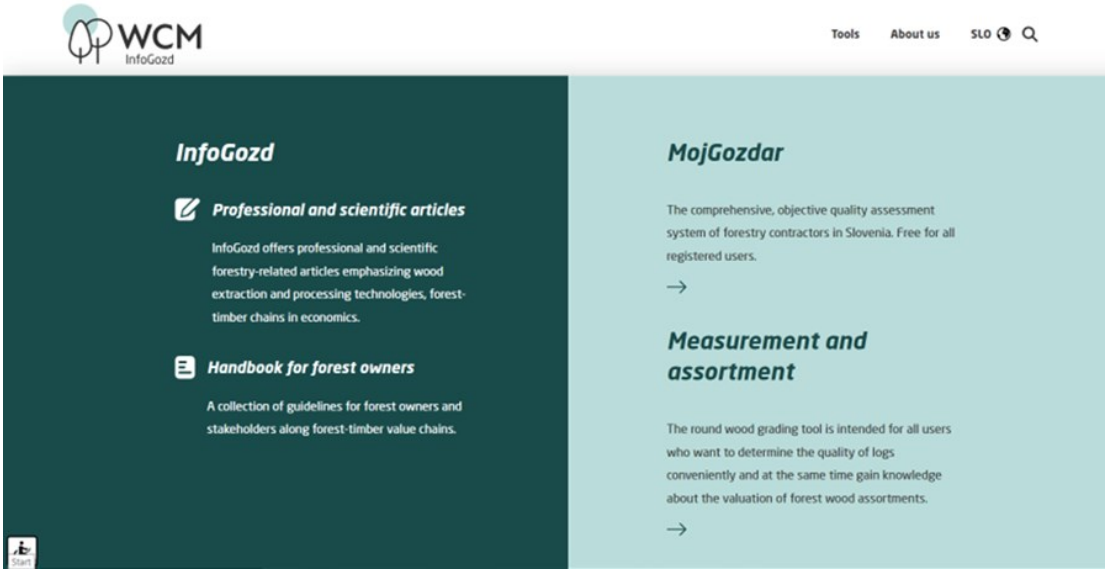
	To provide forest stakeholders at the NUT3 level with an overview of forest resources, PRI.FOR.MAN has also developed an easy-to-use dashboard that provides summarized information. This dashboard utilizes the forest geographic layers to present valuable insights and information on forest resources in a specific major area (NUT3). It features easily understandable graphs and tables that provide data on the forest area managed under forest management plans, the area accessible through two specific harvesting systems (tractor and cable yard, the most commonly used systems in the Friuli Venezia Giulia Alps), and the Growing Stock Volume accessible for the two harvesting systems. Furthermore, the dashboard provides the Growing Stock Volume accessible for each forest type, enabling an understanding of the potential wood products that can be obtained. The dashboard serves as a tool to identify areas in the region where new value chains linked with wood mobilization can potentially be established. Moreover, the data can be easily updated when new maps of forest resources are designed. The dashboard is intended for use by public bodies and forest companies to monitor the state of forests in Friuli Venezia Giulia. The availability of such comprehensive and accessible data was not present at the regional level before the establishment of PRI.FOR.MAN OG. The dashboard developed by PRI.FOR.MAN represents a crucial first step in identifying potential wood mobilization areas, which in turn aids in the development of value chains. Additionally, the dashboard, by providing information on the Growing Stock Volume accessible through two harvesting systems, can be utilized to identify areas where the road network is not well established, thus highlighting the need for investments in road planning.
Lessons learned (1200 characters max.)	Creating user-friendly dashboards that provide useful information in the form of graphs or tables for identifying areas where new value chains can be established and promoting wood mobilization is not technically challenging when the maps developed within the PRI.FOR.MAN project are available. However, it requires a significant coordination effort among public administrators and developers. Access to the necessary data for generating the forest maps, which serve as the foundation of the system, is crucial and requires coordination between different stakeholders. Furthermore, it would be desirable for this type of activity to be carried out by the public administration, as they can play a key role in incentivizing the emergence of new value chains through policies and measures. The members of the OG strongly believe that such dashboards should be developed for public utility, providing support to the forest sector. PRI.FOR.MAN has successfully demonstrated that the development of dashboards is feasible and can be easily implemented, even within Forest Information Systems.
Contact information	Giorgio Alberti giorgio.alberti@unud.it - Luca Cadez luca.cadez@uniud.it - Francesca Giannetti francesca.giannetti@unifi.it
Links to website/report/video (if applicable)	https://lookerstudio.google.com/u/0/reporting/2f6c2f81-b78f-446c-ab07-96571d7b6984/page/p_w5k3gvls6c

Pictures (if applicable)	



ITHub 1 - 4

Title of innovation	**Assessment of Costs in Harvesting Systems using an Web-based Tool (WoodChainManager)**
ITHub	1
FOREST4EU partner (short name)	GIS
Operational Group (short name)	eGozd
Operational Group (name)	Electronic management of agricultural holdings with emphasis on forestry activity
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	farmers, forest owners, researchers, advisors, businesses, environmental groups
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/elektronsko-poslovanje-kmetijskih-gospodarstev-z.html
Country, region, city	Slovenia
Type of innovation	Service
Keywords	Calculations, costs, harvesting system, norms, web-tool, optimization, model, wood mobilization
Approach and main results (4000 characters max.)	Streamlining work processes is increasingly important in a difficult market environment. Rational production requires that we are always aware of what and how much needs to be invested in a business process to deliver the desired products or services without economic loss. The Slovenian Forestry Institute has developed a tool for estimating the costs of forest timber supply. WoodChainManager is a web-based tool consisting of three user modules designed to estimate the material costs of individual machines or the total costs of all selected machines in a timber harvesting system. Users can test the impact of individual technologies on the total material costs of a harvesting system and thus optimise work processes. The basic tool for describing harvesting systems is a matrix that visualises the felling and harvesting process from the standing tree in the stand to the forest products at the end user. The method chosen to calculate the cost of each machine is simple, but still reflects the actual costs incurred. WoodChainManager offers cost calculations for a wide range of technologies, machines and associated attachments. The authors of this innovation want to increase awareness and understanding of costing and to offer the possibility to directly compare different harvesting systems.

Lessons learned (1200 characters max.)	Cost is an important issue in the selection of individual machines and the integration of individual links in production process chains. The development of the web tool focused on the visualisation of forest-wood production chains with a simple method for cost calculation. The costing tool makes users aware that the choice of appropriate technology can have a significant impact on production costs. It allows users to determine which timber extraction operations will be included in the production chain (logging, harvesting, felling/sawing, chip production, harvesting/transport) and the location where the operations will be carried out (forest stand, logging, forest train, etc.). The user can choose between several different machines and associated accessories. Currently, the database contains data for more than 100 different machines or equipment for forestry activities. In addition to direct material costs, the calculations also include information on the effects of the machines, allowing a calculation per unit of product (e.g. €/m3). The application allows an easy selection of the technological model for the production of roundwood and green wood chips.
Contact information	gteinfo@gozdis.si
Links to website/report/video (if applicable)	https://wcm.gozdis.si/sl/orodja/
Pictures (if applicable)	

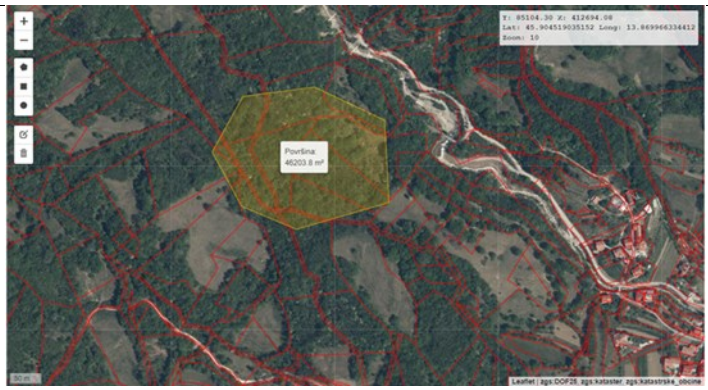
ITHub 1 - 5

Title of innovation	**A system for Quality assessment of Forestry Contractors**
ITHub	1
FOREST4EU partner (short name)	GIS
Operational Group (short name)	eGozd
Operational Group (name)	Electronic management of agricultural holdings with emphasis on forestry activity
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	farmers, forest owners, researchers, advisors, businesses
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/elektronsko-poslovanje-kmetijskih-gospodarstev-z.html
Country, region, city	Slovenia
Type of innovation	Service
Keywords	Services, operations, quality, evaluation, management, wood mobilization
Approach and main results (4000 characters max.)	The forestry services market is dynamic. Skilled forestry contractors are needed to meet the increased demand for wood and to maintain a competitive edge in forestry. There is often limited knowledge about how well they fulfil demands about resource efficiency, social responsibility and environmental protection. The problem is particularly apparent when there is an increased demand for services in the event of large-scale disturbances (eg ice and wind storms, bark beetle attacks, etc.), when individual forest owners do not have information about service providers and their quality and reliability. Clients of services, especially small forest owners who need services less often and have no experience with forest management, make their decisions mainly based on intuition and personal acquaintances. That is why an online system was developed for the assessment of forestry contractors following sustainability principles. A system for assessing the quality of forestry contractors in Slovenia “MojGozdar” consists of three levels: (1) Formal suitability of forestry contractors based on available data sources on business entities; (2) Expert assessment of suitability of forestry contractors; (3) Customer rating on service quality. In addition to the requirements for professional competences and legislative obligations, the system proposes a number of additional requirements such as corporate social responsibility, participation in the local community and greater environmental responsibility. The forestry contractor and the certification body sign a cooperation agreement to obtain the expert assessment. The expert assessment is performed by an

	evaluator authorised by a certification body. A web service has been introduced with the purpose of serving as a communication tool between professional evaluators and forestry contractors, as well as providing a new possibility for forest owners to get direct contact with forestry contractors. The system enables its users to exert influence on the assessment of forestry contractors by assessing the quality of their services. Private forests greatly benefit from customer feedback information on the service quality.MojGozdar offers users support in searching for skilled forestry contractors: Cutting with a chainsaw, Skidding, Silviculture works, Fully mechanized harvesting, Production of wood chips (chopper), Forest construction, Transport of round wood and wood chips, Purchase of wood on the truck road.
Lessons learned (1200 characters max.)	The MojGozdar online system is an important connecting link between Slovenian forest owners and other forestry service seekers on the one hand, and forestry contractors on the other. The reaction to MojGozdar is positive both from the part of the contractors and users. The user provides a wide range of options, from searching for contractors and establishing contacts with them, to digital management of key documentation related to the implementation of forestry works. Such tools are also very interesting from a statistical point of view. When the majority of contractors in a country are included in such a system, it will also give a good overall statistic about the number and size of contractor companies as well about the kind of services that they provide. The online information system MojGozdar represents the beginning of the establishment of modern information and communication flows and as such raises the level of digitization in the field of efficient and economically sustainable forest management and directly affects the increase in productivity and added value in the entire forest and wood production chain.
Contact information	gteinfo@gozdis.si
Links to website/report/video (if applicable)	https://www.mojgozdar.si/
Pictures (if applicable)	

ITHub 1 - 6

Title of innovation	**Creating Your Own Estate Plan Via The Online Portal (MojGozdar)**
ITHub	1
FOREST4EU partner (short name)	GIS
Operational Group (short name)	eGozd
Operational Group (name)	Electronic management of agricultural holdings with emphasis on forestry activity
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	farmers, forest owners,
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/elektronsko-poslovanje-kmetijskih-gospodarstev-z.html
Country, region, city	Slovenia
Type of innovation	Technological innovation
Keywords	estate plan, model, web- tool, system, wood mobilization
Approach and main results (4000 characters max.)	The project eGOZD has presented a web-based solution for developing a forest management plan. The solution enables the collection and interpretation of data on forest tenure, forest infrastructure and other data published on different publicly available platforms in one place using interoperability. Introducing the plans on farms owning forests promotes increased planned work with private forests and provides professional support for sustainable, nature and multifunctional forest management. It is coordinated with forest management plans, which ensures the sustainable conservation of forests and all their functions. A well-prepared management plan will ensure that the potential of the timber is properly exploited, contributing to the modernisation and sustainable development of the rural areas. The project "eGozd" has developed new and simplified options for planning, monitoring and carrying out work and for more efficient private forest management (FM). The forest estate plan provides the forest owner with an overview of forest data and the possibilities for future forest management. The FM plan is linked to current prices for forest timber and tools for calculating the costs of timber extraction. Forest owners can monitor the performance of their forest estate and decide on the measures to be taken in the plan. The plan considers nature conservation guidelines and promotes habitat types' conservation or even improvement.

	A well-prepared management plan will ensure that the potential of the timber is properly exploited, contributing to the sustainable development of the rural areas. Using technical information systems, business processes can be digitised. By visualising and economically evaluating individual production processes, private owners gain better control over the costs of producing forest wood sorts. Forest owners can thus optimise their own different production processes on the same site, or the same production process on different sites, or even replace their own implementation by hiring a contractor due to their own costs being too high; this serves to decide on the most optimal implementation of the works.
Lessons learned (1200 characters max.)	The estate plan will help agricultural holdings become aware of any constraints on forest management at the expense of management and the possible sources of funding or reimbursement of costs incurred due to the restrictions management options. The estate plan will specify/advise on and concretise the measures to be taken. The estate plans allow the owners to have an overview of the state of the estate with the existing forestry potential. It is an information system that is continuously adapted to forest management plans. It contributes to the conservation of biodiversity. One of the key advantages of interactive estate plans is the possibility to organise work, choose technologies and operators, and estimate production costs from forest to timber storage. This allows the forest owner to optimise the activities selected to implement the measures. Not only does the introduction of management plans ensure the transfer of new knowledge, but it also updates and optimises existing on-farm activities.
Contact information	gteinfo@gozdis.si
Links to website/report/video (if applicable)	https://www.mojgozdar.si/
Pictures (if applicable)	

Posestni načrt

1. Opis gozdne posesti

1.1. Splošni opis posesti

Posestvo

Ime posesti	Gozd Predmeja privatna parcela
Površina posesti	17048 m^2

Parcele na posestvu

Parcelna številka	Katastrska občina	Površina na posesti [m^2]	Delež glede na celotno posest [%]
1625/222	2370	16657	97.7

Revirni gozdarji

Naziv revirja	Revirni gozdar	Sedež pisarne	Kontaktni telefon	Površina na posesti [m^2]	Delež glede na celotno posest [%]
OTLICA	Muznik Damijan	Gregorčičeva 44	05 366 14 88	16657	97.7

Gozdnogospodarske enote

Gozdnogospodarsko območje	Gozdnogospodarska enota	Ime Gozdnogospodarske enote	Površina na posesti [m^2]	Delež glede na celotno posest [%]
01	14	OTLICA	16657	97.7

ITHub 1 - 7

Title of innovation	**Software for mobilisation and efficient use of resources involved in transportation of timber from forest to destination location**
ITHub	1
FOREST4EU partner (short name)	LLA
Operational Group (short name)	IR_MP3
Operational Group (name)	Innovative solutions in planning and organization of agricultural and forestry produce transportation
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Seven (7) private agricultural, forestry and transport companies agricultural and forestry sector, one researcher (Riga Technical university), two NGOs (Latvian Logistics association and Latvian Association of Agricultural Cooperatives)
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/inovat%C4%ABvi-risin%C4%81jumi-lauksaimniec%C4%ABbas-un.html
Country, region, city	Latvia
Type of innovation	Process
Keywords	Wood mobilization, ITC technology, Decisional Support System, Business model, Cooperation, Organisational innovation
Approach and main results (4000 characters max.)	OG has developed software for mobilisation and efficient use of resources involved in transportation of timber from forest to destination locations - processing facilities, sea port etc. Furthermore, software, when used by forest owner, can be used to estimate and map amount of timber in the forest locations and manage this asset. Transportation of timber from forest to production mostly is made by local transportation companies (logistics services). Usually they are small businesses and not able/interested to invest in developing complex logistical systems. They use "reporting approach" of what has been transported. That does not help planning of logistics. Problem that has been addressed by this software tool is complexity of logistics where task is to transport numerous different kinds of timber from different locations to multiple destinations while often one pick-up point does not contain full truck load of one type of timber. Provided solution is a database that is accessible on-line to all involved parties over GSM network. First input is made when felling survey is done, then by a harvester stating actual dimensions and amount of cut trees, next input is made by transporter who delivers cut timber from forest to a stack on road side stack. There detailed amounts of each assortment becomes known (can reach up to 16 names of assortment in Latvia). GPS location on the map can be seen for each stack (including amount of each kind of timber

	there) as well as for each transportation unit. Customers (owners of cut timber) input request stating what kind of timber and what amount needs to be delivered where. Dispatcher can see available transportation resources with detailed technical capabilities that have been put into database by owners of trucks. Dispatcher then can plan most economical routs and tasks for every truck, issue documentation and electronically send it to truck drivers. Truck driver, while uploading the timber, updates status of the stack by recording quantities of each kind of timber been uploaded. Final input is made after unloading timber at final destination.
Lessons learned (1200 characters max.)	Software has been tested in Latvia and neighbouring areas of Lithuania and Estonia. Proof of efficiency is sufficient decrease of no-load truck kilometres. Local adaptation of the software is linked with need for adjustments of output document formats determined by national regulations.
Contact information	Guntars Reifelds, Board chairman, SIA "SELF Loģistika", e-mail: guntars.reinfelds@selflogistic.lv ; Normunds Krumins, Board Chairman, LLA, e-mail: n.krumins@gmail.com
Links to website/report/video (if applicable)	After registering user name and password will be provided, login to site http://graudvedis.selflogistic.lv
Pictures (if applicable)	

ITHub 1 - 8

Title of innovation	**New market for Silver fir products (LVL)**
ITHub	1
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	Silver fir
Operational Group (name)	Silver fir : Pre-study of innovation needs in the sawing of very large timber
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners, reasearchers, advisors, wood transformation companies
Link from OGs database	
Country, region, city	France, Auvergne - Rhône-Alpes
Type of innovation	Product
Keywords	Forestry, Supply chain, market and consumption, wood transformation, Silver fir, peeling, LVL products
Approach and main results (4000 characters max.)	Silver fir is a species for which it is important to find markets with added value. Numerous works carried out by the Auvergne inter-professional association (FIBOIS AURA) on this species have shown that there are potential outlets for peeling as well as for small sections; thus reducing the difficulties associated with drying. Birth of the project group. A first meeting was organized for the entire forest-timber sector to present the work previously carried out on the manufacture of plywood and LVL (Laminated Veneer Lumber) in order to encourage volunteers to go further on a common project. The objective being to continue work on the LVL in silver fir with the aim of validating the achievement of the expected quality and perhaps manufactured in Auvergne. This meeting allowed the partners to clearly express their fears and expectations regarding the project and to better define the contours of the action program. - Shared interest in a new product within our reach - Difficulty unwinding large and very large fir wood. - Need to scan the veneers in order to know the density and quality and carry out the sorting necessary for the manufacture of LVL - Need for a share of business self-financing - Role of the interprofession to collect, in complete confidentiality, comments, interests and wishes for each person to continue the study

	After numerous discussions, two companies in particular took on the project and were thus supported by the Auvergne Promobois inter-professional association (FIBOIS AURA) : Company C.B.D and Company Scierie Borie. Search for a new peeling company and partnership agreement For the project, it was necessary to find equipment capable of peeling very large fir wood with diameters of up to 1.20 meters. Only exotic wood peelers are able to meet this demand and there are few of them on French territory. Thus the TOUBOIS Company located in Chasseneuil sur Bonnieure (16260) was contacted and a partnership could be established. International market study An international market study was carried out on the basis of specifications and the search for service providers Choice and harvest of silver fir trees The specific needs for the wood to be harvested have been defined. Then cutting plots were visited and the wood marked with the sawmill technicians according to quality needs. Selection of silver fir logs, followed by peeling and veneer The fir logs are classified upon their arrival at the park in the sawmills. The identified and sorted logs are then transported to the peeling company TOUBOIS. Monitoring of veneers and LVL manufacturing 2000 veneers were selected and sent from the TOUBOIS company to the Raute company in Finland. Each stage of LVL manufacturing was followed and analyzed together with the heads of partner companies: - Veneer scans - Design of the “millefeuilles” making up the LVL panels - Gluing and manufacturing of LVL panels - Cutting samples for in situ tests and for the laboratory - Glue resistance tests at Raute company.
Lessons learned (1200 characters max.)	The first difficulty was finding companies willing to take on such a project. Given the ambitious objectives of creating an industrial LVL production unit, the commitment of entrepreneurs took place in a delicate context without a regional industry. Experimentation and testing of LVL product samples demonstrates here that Auvergne silver fir veneers are technically suitable for the manufacture of LVL panels. The production of LVL always requires careful planning of the constitution of the "millefeuille" of the panels with sheets of adequate density. The market study validated the export potential essential to this project. The project has been approved in full and has entered its industrial development phase belonging to the two partner companies.
Contact information	contact@fibois-aura.org a.laffont@fibois-aura.org
Links to website/report/video (if applicable)	www.fibois-aura.org
Pictures (if applicable)	

ITHub 1 - 9

Title of innovation	**Implementation of innovative forestry trials: improvement at lower cost**
ITHub	1
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	RAISON
Operational Group (name)	Network of adaptations of original forestry innovations in Normandy (RAISON)
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Advisors (National forestry property centre - CNPF) ; Managers and forest owners (Technical and forestry experimentation centre - CETEF of South Normandy)
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/raison-r%C3%A9seau-dadaptations-dinnovations-sylvicoles
Country, region, city	France, Normandy, Saint Etienne du Rouvray
Type of innovation	Process
Keywords	silviculture, experimentation, wood mobilization, costs, thinning systems
Approach and main results (4000 characters max.)	The stakes of a first thinning cut in a plantation are high. Thinning is necessary at around twenty years of age, in order to reduce the density in favour of future trees and thus encourage their growth in diameter. However, there are many delays in carrying out this first cut, with consequences for the quality of the stand (development of epicormics, stressed trees, etc.). The reasons given for this delay in thinning are the cost of the operation and the difficulty for owners to find skilled labour. Various alternative solutions could make it possible to carry out these thinning at lower cost. Qualification-dimensioning silviculture, in particular, aims to designate a limited number of future stems in order to limit the number of interventions in the plot. One of the aims of the RAISON project was to assess the economic and silvicultural benefits of managing a young deciduous stand using low-density designation and routing compared with conventional silviculture based on full thinning. A property located in the commune of Valdallière was selected by CETEF members to set up a system on a 1.31 hectare plot, with the main species being common beech (75%) planted in a mixture with chestnut (25%). The planting pattern alternates between rows of 2 m and 4 m, making it easier to clear and prune the trees. In 2016, the trees ranged from 8 to 15 cm in diameter and 7 to 9 m in height. The stand has been subject to two successive reserve markings, the first aimed at favouring beech trees and the second at favouring future stems. The plot was divided into 4 blocks of 0.3 ha, each allowing a different management method to be tested. Management method "a" was based on full thinning, "b" on low-

	density designation (QD silviculture) and clipping, "c" on low-density designation and ring-barking, and "d" was a control with no intervention. There were no replications of any of the methods. To avoid the edge effect, the two outermost lines of each plot were not measured. The plots were marked with stakes and the isolation strips were marked with a line 1.30 m apart on the outside trees closest to the measurement plot. Future trees were also specifically marked. The variables measured were circumference at 1.30 m, a rating of the epicormic trees, and a description of the social status of the objective trees. The total height, the height of the base of the leafy crown, and the average radius of the crown are noted on the 10 largest designated stems. The stand is also monitored, with estimates of density, basal area, and thinning. This estimate is made within a 10 meter radius of a designated tree near the centre of each plot. The data measured on the objective trees, the epicormic area, and the height of the 10 largest trees will be analysed to see whether the interventions maintain growth and whether the initial diameter is a true reflection of vigour, to see the impact of the interventions on the quality of the objective trees and to quantify the tree balance parameters. Finally, monitoring the time and cost of the interventions, as well as the revenue generated, will enable an economic comparison of the different methods.
Lessons learned (1200 characters max.)	35 to 40 "option" trees have been identified and marked out. They will be monitored individually until the final stand is harvested, ideally by taking measurements every three years at the beginning and then before each thinning. The first thinning of the "a" and "b" modalities and the girdling of the "c" modality was carried out in the 2nd half of 2022. Each sub-plot will be regularly maintained in accordance with the planned protocol. As tree growth is not linear over time, it is desirable for the monitoring of such an experiment to last until the stand is harvested. Of course, the experiment will produce results well before the harvest, but these results will only relate to the period measured and cannot be extrapolated over the entire life of the stand. Experimenting with different management methods is a long-term process for the forest and requires long-term sources of funding to enable the stands to be monitored.
Contact information	Mr Romain MANI - CNPF. Contact informations : romain.mani@cnpf.fr
Links to website/report/video (if applicable)	https://hautsdefrance-normandie.cnpf.fr/projet-raison

Pictures (if applicable)	 Title : Ringing of an aspen in favour of an oak. Copyright : Samuel Pont © CNPF.

ITHub 1 - 10

Title of innovation	**Innovative method for maintaining the quality of round and processed wood by controlling temperature and humidity**
ITHub	1
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	CoolWood (r)
Operational Group (name)	CoolWood (r) : Innovative method for maintaining the quality of round and processed wood by controlling temperature and humidity
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, Forest managers, advisors, Wood mobilisers, Primary wood processing, Forest/wood research laboratories
Link from OGs database	
Country, region, city	France, Bourgogne - Franche Comté
Type of innovation	Technological innovation
Keywords	Forestry, Supply chain, market and consumption, wood storage Quality of round and semi-processed woods Fungi, bacteria, insect larvae Storms, forest epidemics Alternative to spraying wood with water
Approach and main results (4000 characters max.)	The biological degradation of wood is a permanent risk for the entire industry. From the time the trees are felled in the forest to the time the timbers are dried, the quality of the wood stored is constantly called into question by attacks of biological origin (fungi, bacteria, etc.). As a result, wood products can lose some or all their market value, and this problem is exacerbated in emergency situations (storms, epidemics, etc.). Current wood protection techniques remain unsatisfactory. There are currently three main techniques for maintaining wood quality: + Wet protection (sprinkling, immersion), + Preservation by ensilage (under tarpaulin), + Chemical treatment. None of them is fully satisfactory (lack of technical efficiency, constraints, high economic and environmental cost, etc.).

	CoolWood®: an innovative storage process. The CoolWood® process is a new technology for maintaining wood quality. Logs are stored in an enclosure that is maintained at : + At a low temperature, to block the action of degrading biological agents, + At a high level of humidity, to slow down the drying of round wood and prevent deformation (splitting and cracking). CoolWood®: an industrial research programme. The development of the CoolWood® process was the subject of an industrial research programme from 2013 to 2017. The programme, funded by the French National Research Agency (ANR) and the Lorraine Region, involved eight partners: + Four public laboratories (Université de Lorraine, AgroParisTech / INRA, CNRS), + Four private companies (Biomasse Conseil, forestry cooperative F&BE, CDC Forestry Company, Inddigo). Results of our work. The process maintains a better quality of wood than other methods (water spraying in particular) and the energy requirements of the process are relatively modest: 25 to 40 kW of maximum power demand for 1,000 m3 of stored wood. Industrial applications of the process. Four industrial applications have been identified for the "CoolWood®" process, at different stages of the supply chain, from logging to drying: + Emergency storage, to manage emergencies caused by natural hazards, + Logistics platforms, to organise the mobilisation of timber and regulate commercial flows, + Logyards and industrial logyards, to maintain the quality of round timber, + Sawn timber yards, to maintain the quality of wood after processing. PEI-AGRI 2022 - 2024 project. The CoolWood® project is currently the subject of a EIP AGRI project with the following partners: + SARL Biomasse Conseil, owner of the process and the driving force behind its development, + The forestry cooperative F&BE (Forêts et Bois de l'Est), + Scierie Genet, which mainly processes beech, a species that is highly susceptible to degradation, + SAS Cebi 45, a consultancy specialising in energy and thermal engineering. At the current stage of the project (August 2023)… A sawmill has installed an industrial cold room for storing sawn timber. We can disseminate the process in industry by creating turnkey installations.

Lessons learned (1200 characters max.)	The added value of the entire timber industry is significantly reduced by attacks from biological agents that deteriorate freshly felled timber. After 5 to 6 months of summer storage, the depreciation of products sawn from these logs can represent up to 13% for oak and 30% for fir and spruce. In France and Europe, we are witnessing a massive deterioration in the health of trees, which will have to be harvested at a rate higher than that of industrial processing. It will therefore be necessary to store large volumes of wood, but the technique most used until now - continuous spraying of wood with water - is encountering increasing difficulties as water availability decreases. The advantages of the CoolWood® process over existing technologies (water spraying in particular): better quality of the wood stored, reduced raw material losses, simplified logistics, use of renewable energy sources, environmental protection, flexibility (variety of storage sites), adaptability to the volumes to be stored, self-sufficiency of the facilities (energy), possibility of visually assessing the wood.
Contact information	CoolWood® is a registered trademark Biomasse Conseil. Biomasse Conseil Luc EVRARD 4 rue Pierre Curie 88110 RAON-L'ETAPE Tel: 09 84 28 92 90 / 07 82 24 84 22 Web : www.biomasse-conseil.fr E-Mail: luc.evrard@biomasse-conseil.fr
Links to website/report/video (if applicable)	https://coolwood.fr/
Pictures (if applicable)	

ITHub 1 - 11

Title of innovation	**Adaptation and deployment of the "La Forêt Bouge" toolbox**
ITHub	1
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	Sylviconnect
Operational Group (name)	Sustainable, high-performance forestry for Brittany
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	advisors, businesses, public decision-makers
Link from OGs database	https://www.reseaurural.fr/centre-de-ressources/projets/sylviconnect-une-sylviculture-durable-et-performante-pour-la-bretagne
Country, region, city	France, Bretagne
Type of innovation	Social innovation
Keywords	services and reception, innovative tools, economy, cooperation, research and innovation
Approach and main results (4000 characters max.)	In the years leading up to the project, Brittany's forestry and wood industry was involved in the development of three main markets (construction, packaging and wood energy), as well as in wood processing using sawmills, and in ensuring the sustainability of timber resources through the Breizh Forêt Bois initiative. There is a need for structuring action, particularly in forestry and forestry work. This will require a better understanding of the sector's activities and needs, in order to facilitate contacts with the other links in the chain (owners and trainers) and to set up appropriate training and support for innovation. The aim of the project was to strengthen the position of forestry professionals in Brittany, with a view to optimising the supply chain. In particular, this work has involved adapting and deploying the "la forêt bouge" toolbox, with the aim of adapting it to the regional context of Brittany, as well as improving its functionality by adding new modules where necessary. The "La forêt bouge" service site targets forest owners and professionals in the forestry and wood industry. It aims to promote contact between the various stakeholders (private, economic or institutional) in the forestry sector. This tool enables them to facilitate procedures, forest management, and silvicultural operations by encouraging the grouping of management and/or land ownership. It aims to develop the mobilisation of wood in private forests through innovative services and access to news and popularisation documents. Stakeholders can create their own account and access tailored, individualised services more quickly. This project is a collaborative effort involving all the players in the forestry and wood

	industry. It is based on three strategies, firstly by defining a common foundation, then by testing the adaptation of the tool in four pilot regions and finally by implementing the tool in all the regions of France. The adaptation of the tool in the "Pays de la Loire" pilot region was carried out by the Sylviconnect operational group. The deployment of the "La Forêt bouge" tool was only able to be carried out imperfectly in the final year of the project, due to its dependency on national deployment and decisions. Nevertheless, all the editorial work and the creation of content, particularly on prices (for wood in forests and for forestry work) and good operating practices, have enabled significant progress to be made in the consultation of stakeholders in Brittany.
Lessons learned (1200 characters max.)	The development of the La Forêt bouge platform and, in particular, its regional office in Brittany, will ultimately provide a much better link between forest owners and forestry companies. Until now, forest owners simply didn't have access to the contact details of professionals depending on the type of work they needed. This tool, coupled with the database of professionals in the sector, will make it easier to put people in touch with each other and should help to improve the management or re-management of small forest plots. The platform also has a strong educational dimension, providing a wealth of information about the forest, forestry operations and the regulations that apply, as well as disseminating best practices. In a few years' time, this platform should be the key tool for forest owners and players in the industry. The process has been slow to get off the ground because of delays in development. Some of the functionalities developed at the regional level in Brittany are used as references at the national level. The meetings that have been held have also helped to build a collective driving force on the subject. However, all these actions need to be sustained over time if they are to have a real long-term impact on the forest.
Contact information	
Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 1 - 12

Title of innovation	**Technique for superficial heat treatment on wood product**
ITHub	1
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	Noir&Sens
Operational Group (name)	Noir&Sens Technique for superficial heat treatment on wood product
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, Forest managers, advisors, Primary wood processing, Architects
Link from OGs database	https://www.reseaurural.fr/centre-de-ressources/projets/noir-sens-valoriser-par-traitement-thermique-superficiel-les-bois
Country, region, city	France, Centre
Type of innovation	Technological innovation
Keywords	Forestry, Supply chain, market and consumption, wood product, heat treatment, design, architect
Approach and main results (4000 characters max.)	Today, to increase the lifespan of wood products outdoors, it is necessary to add chemicals that are often polluting and make recycling difficult. The use of surface-burned wood is very old, dating back to prehistoric times when our ancestors burned the tips of stakes to make them harder and make tools and weapons for hunting. This technique has also been used by farmers in many countries to make the tips of stakes, fences or vine stakes rot-proof. This technique was used all over the world and particularly in Japan, for the construction of houses, under the name Shou-sugi-ban or Yakisugi. Furthermore, in large markets such as construction, furniture, packaging and garden landscaping, regional woods have their strengths and limitations. Thus, secondary quality oaks, poplars but also other various species must find new outlets generating more added value for all stakeholders, producers and processors. The Noir&Sens project aims to : - develop an industrial tool for the surface heat treatment of wood that is efficient, reliable, flexible and with low energy consumption, - make it possible to disseminate this technique to wood processing companies, - identify the markets and products on which secondary quality surface-burned regional wood has sufficient added value to be competitive, - create and design new ranges of products thus valued.

	The results of the project are as follows: 1-Pre-study of areas of interest in surface heat-treated wood. 2-Study of potential markets and competitiveness of the process: - Exterior fittings and furniture, cladding, street furniture, vegetable gardens, composters, garden centers, pots, fences, benches, etc. - Interior fittings and furniture, decoration, design, interior architecture, kitchen, panels… 3-Tests and optimization of surface heat treatment techniques for soft wood parts for oak, poplar and pine wood. 4-Product qualification: not established for sustainability 5-Development of a flexible industrial tool for surface heat treatment of wood. 6-Creation of a prototype. 7-Estimation of the cost price of the treatment, of the added value brought to the products. 8-Design of one or more competitive product ranges meeting market expectations. Choice of outdoor use where burning provides real added value in terms of natural protection. 9-Diffusion of innovation during exhibitions, competitions, Paris Design Week, etc.
Lessons learned (1200 characters max.)	Noir & Sens has made it possible to develop an optimized industrial process for surface burning of wood, economical in cost and energy, making it possible to obtain a high-performance product in terms of durability, use and aesthetics for outdoor use. Additional durability is provided by the heat treatment of the wood under the thin carbonized layer. Surface carbonization provides an interesting aesthetic but is difficult to stabilize over time, particularly on south-facing facades for cladding. Requires treatment on 2 opposite sides to prevent curling and 6 sides for complete protection. The burning prototype is aimed at sawyers to promote less durable local wood and at secondary processing companies for finished products. Finished burnt wood products are aimed at architects, planners, landscapers, gardeners, communities and individuals for outdoor use, interior designers, decorators and individuals for interior products. It is now needed to find a machine tool manufacturing company to market the prototype.
Contact information	e.delarochere@fibois-cvl.fr
Links to website/report/video (if applicable)	https://www.fibois-cvl.fr/recherche-et-developpement/noir-sens/

Pictures (if applicable)	

ITHub 1 - 13

Title of innovation	**Sylv'éclair a decision support tool for thinning in pine plantation**
ITHub	1
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	SPNA
Operational Group (name)	SPNA : Precision silviculture in Nouvelle-Aquitaine
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/sylviculture-de-pr%C3%A9cision-en-nouvelle-aquitaine.html
Country, region, city	France, Nouvelle-Aquitaine
Type of innovation	Technological innovation
Keywords	Forestry, Decisional support system, Digital platform, Precision forestry
Approach and main results (4000 characters max.)	Design and development of an application to trigger thinnings in maritime pine stands and development of a database through "participative silviculture" via the same application. Thinnings help maintain the good growth of a forest stand, improve its quality and provide intermediate income. For the forest-timber sector, thinnings guarantee the qualities and quantities of wood that will be produced in the future. Finally, regular and well-performed thinnings, as well as careful planting and appropriate mechanical clearing, are the guarantee of good resistance of populations to climate change. The Landes de Gascogne massif is at a very special moment in its history. After two major storms, Martin in 1999 and Klaus in 2009, the last decades have mainly been devoted to cleaning and then rebuilding the stands. In certain properties, there was a delay in carrying out thinnings. At the same time, maritime pine prices encourage the mobilization of wood. This sometimes results in cuts made to the detriment of the future of the population : By triggering thinning too early or too late on certain plots, or too intense on others. In this context, each owner must be able to quickly diagnose each of their stands using simple tools to determine when and how to implement the next thinning. This decision support tool is based on the work of Jean-Paul Maugé carried out on the Maritime Pine in the 1980s. The limits defined by J.-P. Maugé correspond to a compromise between production maximum stand and individual growth of each tree. For a given circumference, these tables make it possible to determine a minimum density and a

	maximum density between which the population must be located. When the real density is greater than the maximum limit, it is necessary to clarify and bring this density to a value close to the minimum limit. These limits remain adapted to the maritime pine populations present today in the Landes de Gascogne Massif. The tool is suitable for all types of terrain. The only thing that changes is the age at which thinning occurs. Thus, the operation will be triggered later in plots installed on dry moors than for those located on more favorable moors. Current populations mostly benefit from genetic improvement and dynamic silviculture. They therefore arrive earlier at the thinning trigger circumferences. A mobile tool on smartphones will soon be available. It will be very easy to use by as many people as possible. In the event that thinning must be initiated, the diagnosis will indicate the dendrometric characteristics of the stand and the number of stems to be sampled. The tool will also remind you of the instructions concerning the organization of cutting and marketing. If thinning has to wait, the application will indicate the recommended intervention date.
Lessons learned (1200 characters max.)	SYLV'ÉCLAIR and its database developed as part of the SPNA project are designed to collect data from stands made up mainly of maritime pine and provide advice adapted to them. However, the tool is designed so that any other forest species (Douglas fir, laricio pine, Scots pine, etc.) managed in regular high stands can be integrated provided that it is equipped with forest standards and a growth model. Furthermore, if the first testing phases of this interface mainly take place in populations of the Massif des Landes de Gascogne, the tool is intended to be used throughout the national territory.
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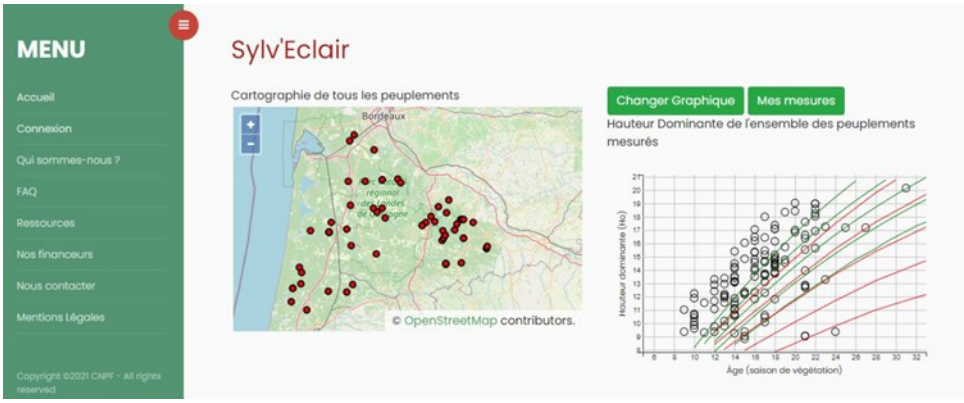
Links to website/report/video (if applicable)	https://nouvelle-aquitaine.cnpf.fr/sites/socle/files/cnpf-old/article_eclaircie_pm.pdf
Pictures (if applicable)	 Screenshot of the "Sylv'éclair" demonstration web interface - SPNA prototype site

ITHub 1 - 14

Title of innovation	**Mechanical structural classification for Pinus pinaster ssp atlantica in the northern Iberian Peninsula approved by the European Normailzation Committee.**
ITHub	1
FOREST4EU partner (short name)	Cesefor
Operational Group (short name)	OG SIGCA
Operational Group (name)	SiGCa: Forest management systems in quality timber producing forests
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest Owners
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/sigca-sistemas-de-gesti%C3%B3n-forestal-en-bosques.html
Country, region, city	Basque Country, Cantabria, Asturias, Galicia and Castilla León
Type of innovation	Process
Keywords	Forest industries; wood mobilization
Approach and main results (4000 characters max.)	For the first time for maritime pine wood of Spanish origin, mechanical structural grading tools have been developed, which will allow maritime pine wood to be classified into C24 and C18 classes. Mechanical grading is based on the use of equipment for measuring physical and/or mechanical parameters in the wood, which allows different strength and stiffness values to be assigned directly, without the need to destroy or alter the wood or to carry out a detailed visual classification of the piece. These machines are widely developed throughout Europe, as they optimise the mechanical properties to be declared, as they have excellent prediction levels, and greatly improve classification times. Despite this, they are practically non-existent in Spain.
Lessons learned (1200 characters max.)	During the process, it was found that the maritime pine wood obtained resistance classes: C30, C27, C24, C18 and C16, which allow the industry's resource to be optimised to the maximum. It was also found that mechanical grading with respect to structural visual grading improves yields. Specifically, with respect to the visual classification stipulated in the Spanish standard UNE 56546, the mechanical classification improves performance by 30% with respect to the visual classification. It was also found that although the UNE-EN 56544 standard only allows classification for

	maritime pine C-27 and C-18, with the mechanical classification it has been possible to classify up to C30, which also means an improvement in mechanical properties.
Contact information	joseluis.villanueva@cesefor.com
Links to website/report/video (if applicable)	https://www.sigcamaderadecalidad.info/
Pictures (if applicable)	

ITHub 1 - 15

Title of innovation	**LVL (Laminated Veneer Lumber) of fagus silvatica**
ITHub	1
FOREST4EU partner (short name)	Cesefor
Operational Group (short name)	OG FAGUS
Operational Group (name)	Operative Group FAGUS: Adding value to beech trees through innovation and improving the competitiveness of their forest industry value chain.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest Owners
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/grupo-operativo-fagus-puesta-en-valor-del-haya.html
Country, region, city	Navarre, Basque Country, Castile and Leon, La Rioja.
Type of innovation	Product
Keywords	Forest industries; wood mobilization
Approach and main results (4000 characters max.)	A new LVL product has been developed and tested using beech veneer from Spain. This product did not exist before and it is hoped that with its development, the beech wood value chain can be revalued. LVL is a product that consists of the successive stacking of thin layers of wood, veneers, obtained by unrolling. Obtaining the material in this way has the following implications: - Beech veneers used for the manufacture of LVL The raw material for the manufacture of this product is high quality logs. Large diameters, straight, with little taper and knots in order to obtain an adequate yield, volume and quality during unrolling. For this reason, it is to be expected that the manufacture of structural products with peeled veneer will offer superior properties to sawn timber of the same species. - Bending tests have been carried out on small dimension and structural size specimens, as well as tensile tests perpendicular to the fiber. The results of the tests are satisfactory and encouraging, achieving good mechanical properties that indicate that the raw material is suitable for the production of this product. Comparing the properties of LVL tested in bending with those of sawn timber from the same source, the results have been improved in both bending strength and stiffness.

Lessons learned (1200 characters max.)	It has been observed that the bending strength of LVL is higher than that of the tested sawn timber sample. This is consistent with the fact that engineered wood products such as LVL improve the properties of sawn timber due to the better use of the material and the reduction of singularities in the structural elements. If we now analyse the results of the bending tests performed on small specimens, we can see, as expected, that these samples are stronger and stiffer than those of structural size. In particular, the ratio between strengths is 1.67, and in the overall modulus of elasticity 1.43. This can be explained by the lower amount of singularities that small-sized wood has compared to structural-sized wood. On the other hand, the pressing process with the hot plate press, used to produce the panels from which the small dimension specimens were obtained, has a higher degree of control than that carried out with the large press used to produce the structural size beams. The latter may also influence the better results obtained with the small specimens. Finally, with regard to the results of the tensile tests perpendicular to the fibre, it can be commented that the characteristic strength value obtained of 0.94 MPa is higher than that indicated for all hardwood D strength classes in the EN338 standard, which corresponds to 0.6 MPa.
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Links to website/report/video (if applicable)	https://gofagus.es/
Pictures (if applicable)	

ITHub 1 - 16

Title of innovation	**Visual structural grading tool and a mechanical structural grading tool**
ITHub	1
FOREST4EU partner (short name)	Cesefor
Operational Group (short name)	GO FAGUS
Operational Group (name)	Operative Group FAGUS: Adding value to beech trees through innovation and improving the competitiveness of their forest industry value chain.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest Owners
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/grupo-operativo-fagus-puesta-en-valor-del-haya.html
Country, region, city	Navarre, Basque Country, Castile and Leon, La Rioja.
Type of innovation	Technological innovation
Keywords	Forest industries; wood mobilization
Approach and main results (4000 characters max.)	For the first time, structural grading tools have been developed for beech wood of Spanish origin. This will allow beech timber to be used for structural products: beams, pillars, glued laminated timber, etc. Specifically, a structural visual grading and a mechanical grading have been developed. The structural visual grading consists of a wood industry operator who, on the basis of visual observation criteria of each piece of wood, can declare a resistance class. On the other hand, mechanical grading consists of the determination of a strength class with the use of a grading machine, which, based on the density of the wood and the natural vibration frequency of the piece, is able to determine the strength class. Finally, the results obtained in the reports will be submitted to the European committee for approval so that it can be used by the industry.
Lessons learned (1200 characters max.)	During the process, it has been found that beech wood obtains better resistance classes than the Spanish conifers approved for use in structures within the UNE 56544 Standard. Specifically, resistance classes ranging from D45 to D24 were obtained. It was also found that the structural visual classification according to the Spanish standard

	UNE 56546 obtained 75% of wood suitable for use in structures, which allows to expand the customer market. In the process, a modification of the UNE 56546 standard has also been proposed, for the improvement of yields, with this modification, higher graded wood yields are obtained (84% of MEF wood corresponding to a CR D35). On the other hand, modification 2 establishes a high percentage of high structural quality wood (44% of MEF A class), with an added value corresponding to CR D45, to which we must add 40% of CR D35 and 16% of rejected wood.
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Links to website/report/video (if applicable)	https://gofagus.es/
Pictures (if applicable)	

ITHub 1 - 17

Title of innovation	**Wood potentially available for harvesting activities**
ITHub	1
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	Shared PRIvate FORest MANagement in Eastern Alps
Operational Group (name)	PRI.FOR.MAN
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest companies, advisors, research institutions
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/gestione-condivisa-delle-proprieta-forestali
Country, region, city	Italy, Friuli Venezia Giulia
Type of innovation	Technological innovation
Keywords	Forestry, Remote Sensing data, digital platform,Decisional Support System, wood mobilization, new value chain, Sustainible Forest Managment
Approach and main results (4000 characters max.)	Understanding the volume that can truly be harvested using mechanical means is of paramount importance in assessing the real value of forest utilization. In this context, it is necessary to develop methodologies that enable companies to identify areas of higher value. In Italy, several methodologies for assessing accessible areas have been developed in the research field, but none have been applied at a regional scale. In this context, the GO-PRI.FOR.MAN has applied a methodology for calculating the volume that can actually be harvested, using slope data derived from the digital terrain model and a regional map of wood volume derived from the integration of LiDAR remote sensing data and national forest inventory data as input. Additionally, operational limits of the extraction systems commonly used by companies (cable cranes and tractors) were considered, along with topographic limits (slope change). For example, it's not possible for a cable crane to cross a ridge or work simultaneously up and down a slope. Indeed, in this context, the project aimed to provide a comprehensive assessment of the actual harvesting potential of forested areas, taking into account both natural terrain characteristics and the capabilities of the machinery used in logging operations. This approach helps companies identify areas with the highest potential for profitable utilization. For the first time in the wall Region of Friuli-Venezia Giulia Region it is possible to have access to this information.

	Quantifying the amount of potential wood harvesting compared to the available supply is an important factor in calculating the amount of wood that can be extracted from a specific forest area.
Lessons learned (1200 characters max.)	To quantify the volume that can actually be harvested, a series of regional-scale geographic layers are required. These layers, thanks to new methodologies, including the integrated use of ground-based and remote sensing data, allow for the application of research-developed methodologies in operational contexts, such as in the Friuli Venezia Giulia region. The integration of various geographic layers, including terrain data, wood volume data derived from remote sensing, and ground-based data, enables a more accurate and comprehensive assessment of the actual harvestable volume in a region. These advancements in data collection and analysis methods have made it possible to apply research findings and techniques to practical forestry operations, allowing for a more informed and efficient approach to forest resource management in the Friuli Venezia Giulia region.
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Links to website/report/video (if applicable)	https://www.legnoservizi.it/pri-for-man-dss-un-sistema-di-supporto-delle-decisioni-forestali-a-scala-locale/
Pictures (if applicable)	

ITHub 1 - 18

Title of innovation	**MOTI**
ITHub	1
FOREST4EU partner (short name)	GIS
Operational Group (short name)	DIGIGOZD
Operational Group (name)	Digitalization of agricultural holdings for forest management planing
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	farmers, forest owners, researchers, advisors, businesses, environmental groups
Link from OGs database	-
Country, region, city	Slovenia
Type of innovation	Service
Keywords	Calculations, costs, web-tool, optimization, model, wood mobilization
Approach and main results (4000 characters max.)	MOTI is a mobile application that can be used to measure standing stock, tree height, tree composition, number of trees per hectare and timber stock. MOTI calculates the timber stock based on the standing stock, calculated with the Bitterlich angle counting method, and the measured standing height and shape of the trunk. The application has a built-in automatic correction of the calculation due to the slope of the terrain. The measurements of the logbook with the MOTI application are not significantly faster than manual measurements, but we save a lot of time when calculating the wood stock and transferring and processing the data, since MOTI allows immediate calculation of the wood stock in the field.
Lessons learned (1200 characters max.)	Compared to classical methods of measurement, the application has many advantages. Smart devices offer ever-improving optics, contrast screens with the ability to enlarge the image, which is especially important for measurements of the existing baseline, when by enlarging the image, you can quickly we find out whether a certain tree still exceeds the selected viewing angle or not. Enlarging the image is very useful even in conditions of poor visibility, when by zooming in on the image on the phone or tablet, we can quickly check what is several tens of meters away from us and whether another tree might be hiding behind the tree.
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Links to website/report/video (if applicable)	http://digigozd.si/aplikacija-moti/
Pictures (if applicable)	

ITHub 1 - 19

Title of innovation	**SiWaWa**
ITHub	1
FOREST4EU partner (short name)	GIS
Operational Group (short name)	DIGIGOZD
Operational Group (name)	Digitalization of agricultural holdings for forest management planing
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	farmers, forest owners, researchers, advisors, businesses, environmental groups
Link from OGs database	
Country, region, city	Slovenia
Type of innovation	Service
Keywords	Calculations, costs, web-tool, optimization, model, wood mobilization
Approach and main results (4000 characters max.)	As part of the MOTI mobile application, a SiWaWa simulator has been created, which shows us the development of forests in the next 30 years. SiWaWa is intended for the simulation of development in one-dimensional and pure stands, where the parameters are like average stands. With the help of the SiWaWa application, we determine the type, amount, and time of implementation of silvicultural measures for a certain stand. We can decide based on the set wood production goals, which measure makes the most sense and what we will achieve with it.
Lessons learned (1200 characters max.)	For the owner, data such as wood production goals or measures are important when planning the yield of the forest. The newer version of the SiWaWa growth simulator is available as a stand-alone mobile application, allowing the owner to obtain simulation results while in the field, directly after recording a stand with the MOTI application.
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Links to website/report/video (if applicable)	DIGIGOZD – Projektna stran EIP projekta PRP DIGIGOZD
Pictures (if applicable)	

ITHub 1 - 20

Title of innovation	**Online tool for quality classification of round-wood**
ITHub	1
FOREST4EU partner (short name)	GIS
Operational Group (short name)	eGOZD
Operational Group (name)	Electronic management of agricultural holdings with emphasis on forestry activity
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/elektronsko-poslovanje-kmetijskih-gospodarstev-z.html
Country, region, city	Slovenia
Type of innovation	Service
Keywords	Forestry, Supply chain, market and consumption, wood product conservation
Approach and main results (4000 characters max.)	The online tool for quality classification of roundwood is intended for all users who want to conveniently determine the quality of roundwood and simultaneously gain knowledge about the evaluation of roundwood assortments. The information may be helpful for forest owners who aim to increase the utilisation of wood from their forests by using the quality criteria for the roundwood assortments. Slovenia's geographical region in the moderate climate zone enables the cultivation and production of timber products of high quality. Due to its natural resources, it is not sensible to strive for mass production of wood but rather for directed cultivation and production of assortments of higher quality, which are consequently classified in a higher price range. Poor knowledge or round wood classification according to quality classes can ultimately devalue the quality of timber and work achieved through tending in the long-term process of silviculture. The project has developed guidelines for forest owners to collect information for the correct measurement of dimensions and the rules for calculating the volume of round wood. Typical values of the bark thickness are given for each tree species, which is not considered when calculating the diameter. Furthermore, roundwood quality classes for Slovenia's most common soft- and hard-woods are presented. In the case of soft- and hard-wood species, we emphasise the quality measures for spruce, fir and beech. The guidelines for measuring dimensions, the rules for calculating the volume and the quality

	classification of logs are based on the standards and rules that apply to the broader European area. Thus, European standards (SIST EN 1309) and "Rules of Good Practice" as given by the German Forestry and Wood Processing Industry Council were used as the primary literature. Both standards define four quality classes of logs (A, B, C, D). In the past, the Slovenian standards of classifying roundwood defined assortments according to the purpose of use. In our case, however, the standards define only the quality from the best (A) to the low-quality logs (D) without a specific purpose. It is then left to the wood users to choose the most suitable class according to their needs. Traditional Slovenian classification rules also define dimensional requirements for an individual quality class, while dimension classes are entirely separate in the case of European or German quality grading. We also included indicative dimensional requirements for each quality class in the article, so we still needed to completely break the link between the Slovenian traditional classification and European rules. Using the online tool for quality classification of roundwood the forest owners get know-how on wood defects. Quality is usually determined by stating the maximum number and size of permissible defects that an assortment may still have in order to achieve a certain quality class. Wood defects spoil some of its properties and thus reduce its usefulness. Wood defects have different origins. They are formed due to the unfavourable influence of the natural site on the development of the tree or due to mechanical damage during the process of wood production. In the case of wood defects, we must know how to properly identify and define them. To determine its size, knowing the agreed method of measuring the defect is necessary. Last but not least, it is also necessary to determine the degree of defect influence for each defect, which consequently affects the classification of the assortment into a certain quality class. Wood defects that affect the quality of wood are the most important when defining assortments. When bucking, we estimate those defects of the wood that are noticeable on the circumferential surface and the cross-section of the trunk. Based on these, we also conclude on the wood quality of the trunk.
Lessons learned (1200 characters max.)	Knowing wood defects is important in direct trunk bucking. Knowledge of how to eliminate the defect, how to reduce the impact of the defect, where to make demarcations between assortments of different quality and where to cut is a key element of bucking. In this way, we influence the quality and value of an individual assortment.
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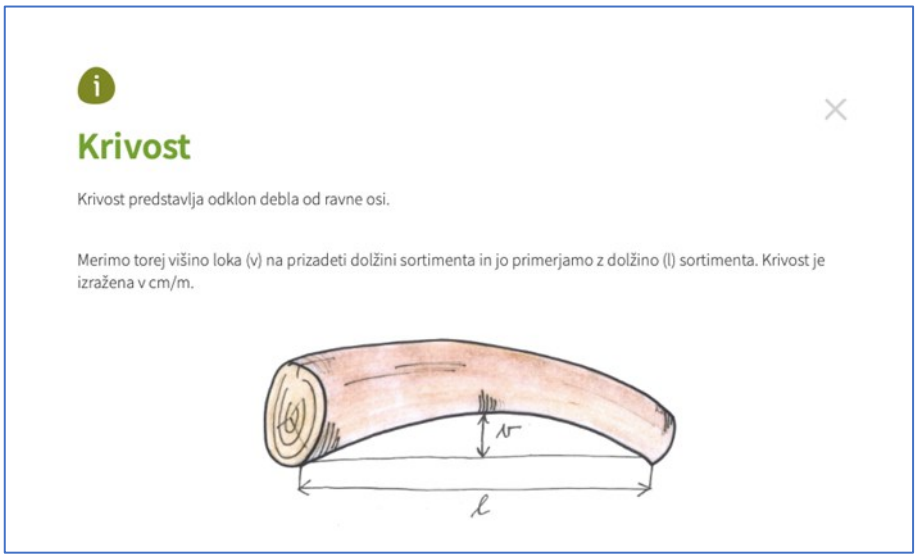
Links to website/report/video (if applicable)	www.mojgozdar.si

Pictures (if applicable)	 

ITHub 1 - 21

Title of innovation	**Web-based due diligence and traceability system for forest timber assortments**
ITHub	1
FOREST4EU partner (short name)	GIS
Operational Group (short name)	eGOZD
Operational Group (name)	Electronic management of agricultural holdings with emphasis on forestry activity
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/elektronsko-poslovanje-kmetijskih-gospodarstev-z.html
Country, region, city	Slovenia
Type of innovation	Service
Keywords	forestry, supply chain, maket and consumption; biomass, digital platform, sustainable forest management, wood mobilization
Approach and main results (4000 characters max.)	The international community has developed policy measures to promote sustainable forest management and combat illegal logging and related trade to protect the world's forest resources, mitigate climate change, and safeguard biodiversity. Illegal logging causes damage to forests, affecting climate, biodiversity and the economy. One cause is international trade, driven by the demand of consumer countries. In 2003, the EU adopted the Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan, which is considered the central document and provides various measures to prevent the import of illegal timber. These include the implementation of the European Timber Regulation (EUTR, 2010) and the implementation of the Voluntary Partnership Agreements (VPAs). Since 2013, the EUTR (2010) prohibits placing timber and timber products from illegal sources on the European market. Illegal timber is defined as timber obtained contravening the legislation in force in the country of origin. The EUTR (2010) requires legal entities and private persons, when placing timber or timber products on the European market for the first time, to act with due diligence and related traceability of timber and timber products. According to the Regulation, information must be provided for the last five years on: - the type of product, - the species of tree and the quantity of wood,

	- the felling permit (e.g. decision of the Slovenian Forest Service authorising the felling of the selected trees or other document that is the basis for legal felling), - the name and address of the consignee or trader (personal name and address of the natural person or company and the registered office of the legal entity) to whom the forest timber was supplied or sold, and any other permits, if the logging took place in areas protected under other legislation. The essence of a 'due diligence system' is that economic operators implement risk management measures to minimise the risk of placing illegally harvested timber or timber products containing illegally harvested wood on the market. For example, in the EUTR (2010), a due diligence system has three essential elements: information gathering, risk assessment and risk mitigation. Risk mitigation measures should also be specified if the risk is not negligible. By establishing a due diligence system, manufacturers and traders demonstrate that the products they trade are sourced by the applicable legislation in the country of origin. Traders throughout the supply chain must ensure the traceability of timber and derived products by identifying the operators or traders who have supplied them with wood and derived products and, where applicable, the traders to whom they have provided timber and derived products. They shall keep this information for at least five years and make it available to the competent authorities on request.
Lessons learned (1200 characters max.)	The basis for ensuring a due diligence and traceability system with forest timber products is the possession of a felling licence and a contract with a forestry service provider. At the same time, all other necessary documents can be arranged through the online system. To manage digital records, users must register and log in to the system free of charge. After that, the system guides users through a series of questions which provide needed documents (e.g., a record sheet, an accounting document or a transport declaration). To make it easier to organise digital records, a video guide has also been produced and is available at the following link: https://www.youtube.com/watch?v=lNbgJ2kjr7I.
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Links to website/report/video (if applicable)	https://www.mojgozdar.si/digitalne-evidence/seznam/

Pictures (if applicable)	

ITHub 1 - 22

Title of innovation	**New methodology for Douglas-fir timber qualification**
ITHub	1
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	Do.Na.To
Operational Group (name)	Douglasiete Naturali Toscana
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, researchers, territorial and public institutions, editorial company, formation company, moral company
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/douglasiete-naturali-toscane
Country, region, city	Italy, Tuscany
Type of innovation	Technological innovation
Keywords	Sustainible Forest Management, wood trasformation, new value chain
Approach and main results (4000 characters max.)	Douglas fir has a medium texture with pronounced heartwood and a yellowish/red colour. Its physico-mechanical properties can vary considerably depending on origin, altitude, silviculture treatments, stand age and growth rate, and the wood characteristics can also be influenced by the different Douglas-fir varieties used in plantations. The aim of the work was to fit into the forest wood supply chain by creating conditions for more profitable use of Douglas fir wood. This can be achieved, for example, by increasing the value of production through more careful wood qualification and diversification of possible uses. The National Research Council's Institute of Bio-Economics based in Florence (Italy) has identified alternative and profitable uses for Douglas fir wood, such as in construction, by defining its technological characteristics and grading methods best suited for its economic and commercial valorisation. The Do.Na.To project tested a rapid method for analysing Douglas fir roundwood in order to classify its timber for structural uses and define the necessary technological characteristics and grading methods. For the study, 158 logs from trees felled in the Vallombrosa forest complex were marked. The characterization was nondestructive and carried out with the Hitman HM200 instrument from the company Fibre-gen. This instrument, designed for qualitative assessment of roundwood, measures the speed of a mechanical wave generated by percussion, which propagates longitudinally; higher speeds correspond to higher physical-mechanical quality. During on-site measurements, moisture was also measured with an electric wood hygrometer, as it correlated with speed. Based on

	the speed values, it was possible to separate better quality logs intended for structural sawing from lower quality logs. The better quality logs were then divided into assortments of various sizes (beams, squares, boards and planks) and then characterized with ViSCAN, a non-destructive tool used for grading timber for structural uses. Since the parameters thus obtained on logs and sawn timber correlated well, the qualification of the roundwood was predictive of the quality of the sawn timber obtained. Finally, to assess the structural quality of the sawn timber, a ViSCAN-portable simulation was performed to grade the strength of each element. Timber qualification from roundwood to sawn timber permits to find the more profitable use for each Douglas-fir log, while the properties of the Douglas fir timber make it suitable for various uses. It can be used for the production of plywood panels, of beams (worked in fours wires, Uso Fiume or Uso Trieste), while sawn timber of lesser thickness is used in carpentry (fixtures, furnishings, beads), for packaging production, and also for the production of glued structural products, such as laminated beams and board panels (CLT - Cross Laminated Timber). Innovation activities consisted of transferring experience gained in instrumental applications aimed at assessing the quality of Douglas-fir roundwood and sawn timber produced from it.
Lessons learned (1200 characters max.)	The aim of the work was to unite the forest-wood chain and create the conditions for a more profitable use of Douglas fir, as had been learned from exchanges with other European countries. This could be achieved by increasing the value of production through more careful qualification of the wood and diversification of possible destinations. The cost of the equipment is high and therefore only accessible to industries with a high turnover, but the qualification of the wood, from roundwood to sawn timber, can allow a more efficient and therefore more profitable use. In addition to the critical points, the Tuscan wood supply chain also has some strengths that must be exploited in order to succeed in creating a local Douglas fir supply chain that enhances the different assortments. Firstly, the availability of the local wood resource and the territorial "vocation"; secondly, the changing scenarios of the global wood market and the attention given to the issues of carbon footprint reduction in all economic sectors, which have led to a significant upward variation in the prices of roundwood and semi-finished products, making local products economically competitive; then, the research/innovation/transfer experience carried out in the region; and finally, the very active local industrial sectors that have focused on Douglas fir to characterise their production and diversify their products.
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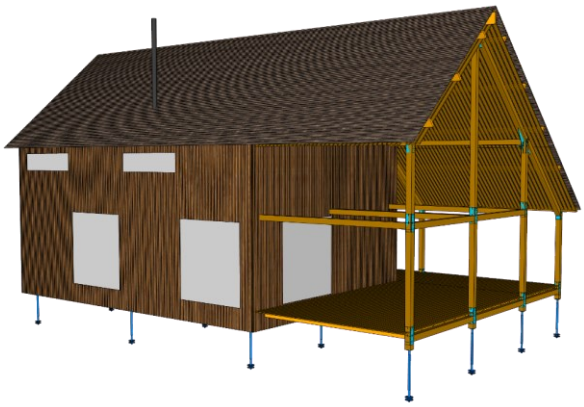
Links to website/report/video (if applicable)	https://www.progettodonato.it/

Pictures (if applicable)	 *Figura 1 – Misurazioni strumentali su toppo in piazzale*

ITHub 1 - 23

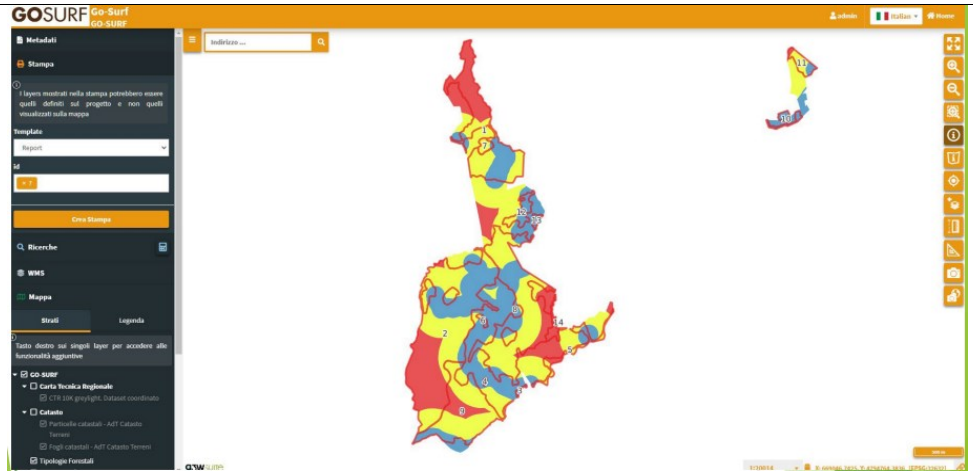
Title of innovation	**Prefabricated modular construction system made from Normandy hardwoods**
ITHub	1
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	BBN
Operational Group (name)	Normandy wood building
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	businesses
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/batiment-bois-normandie.html
Country, region, city	France, Normandie
Type of innovation	Product
Keywords	Construction, Downstream sector, Wood processing
Approach and main results (4000 characters max.)	The Normandy region is renowned for its oak and beech forests, which produce high-quality wood. The hardwood market is therefore large, and companies in the region are involved in the production and processing of this resource. It is used for a wide variety of purposes, including construction, joinery and cabinet-making, cooperage, veneer and panel production, and wood energy. The technical issues are diverse and evolve according to the species and destination selected. For structural timber, oak can be supplied by fresh sawn timber, or air-dried or re-dried. Each of these methods of supply brings with it its own set of constraints (mould and deformation in the case of fresh sawn timber, and a complex supply cycle in the case of re-dried timber). Beech can be used in the form of glued laminated timber, which provides mechanical strength, a standardised appearance and the use of lower quality raw timber. However, beech does not tolerate humidity. Regarding wood used for siding, chestnut has many advantages, but the available volumes are very low and it shows tannin stains. Douglas fir, on the other hand, can be used in larger volumes, but the market is very tight and it is less resistant to punching. Constraints linked to the construction system can also be highlighted. The timber post-and-beam system requires on-site installation, making it tricky to incorporate prefabricated floors, it takes longer to install than timber-framed studs, and it is more complex to install networks. The timber-framed façade system requires fixing systems that

	ensure perfect watertightness while allowing for expansion gaps with the load-bearing part. Bâtiment Bois de Normandie wants to develop a prefabricated modular construction system based on hardwood from Normandy, enabling the construction of houses, collective housing and public buildings. The target groups for this innovation are social landlords, local authorities and private clients. The main environmental benefit of the project is to be able to supply buildings whose life cycle analysis is better than or equal to current timber-frame construction standards. In particular, this means that the structure can be easily converted, deconstructed and/or reused. From an economic point of view, the design must be able to minimise costs, and its viability depends in particular on economies of scale. Modular design must therefore be standardised and simplified, via a controlled industrial process in agreement with reliable partners and committed to framework agreements. From a social point of view, the design of the uses, the manufacturing techniques and the destination of the buildings are intended to be as inclusive as possible, in particular through the use of common spaces, the comfort of use of the buildings, the use of local staff for its manufacture as well as a training component and an increase in the skills of the staff during installation and maintenance. A number of private partners have already committed to the project: Bellême Bois (timber supply and sawing), RBD (machining), Artémis (engineering office), Technopieux Normandie (foundations), Leduc Bâtisseur (frame assembly), Manubois (structural timber supply). Institutional partners are also supporting the creation of the prototype. The provision of a location as well as administrative, financial and technical support ensure the success of the project. Discussions with these partners have led to the emergence of a number of solutions and ideas. The choice of wood species and cross-sections was determined. A selection was also made for the thermal envelope system, which is currently being developed.
Lessons learned (1200 characters max.)	The entire primary structure will be produced by the end of the year 2023, for assembly in the 1st quarter of 2024. Work is scheduled for completion in March 2024. Ultimately, the building will be used as a demonstrator and will be open to a wide range of visitors, from professionals in the timber industry to social landlords, elected representatives and architects. Once the prototypes have been tested and marketed, this project will make it possible to add value to local wood that is currently poorly exploited and/or exported. We will therefore avoid importing softwood and exporting unprocessed French wood. The volumes produced will make it possible to develop the local industry through to secondary processing and thus create long-term jobs in the sector, as this is a long-term project. Skills upgrading should accompany this recruitment drive. The estimated economic impact on the oak market is €2.5 million, on the beech market €1.2 million and on the chestnut market €1.8 million, excluding tax, for the Normandy region. It could lead to the creation of 20 to 25 direct jobs and 10 to 15 indirect jobs (transport, maintenance, administration, etc.).
Contact information	M. Pierre GAUTIER (contact@batimentboisdenormandie.fr)

Links to website/report/video (if applicable)	https://www.batimentboisdenormandie.fr/
Pictures (if applicable)	 copyright : batimentboisdenormandie

ITHub 1 - 24

Title of innovation	**Map accessibility of forest parcel to support wood mobilization**
ITHub	1
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-SURF
Operational Group (name)	DECISION SUPPORT TO SUSTAINABLE FOREST PLANNING
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company,
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/supporto-decisionale-alla-pianificazione-forestale
Country, region, city	Italy
Type of innovation	Technological innovation
Keywords	Forestry, Remote Sensing data, digital platform, Decisional Support System, wood mobilization
Approach and main results (4000 characters max.)	Forest roads and associated structures are essential for various forestry activities, including harvesting, and have a broader role in supporting agro-silvopastoral operations. Specifically, planning, construction, adaptation, and maintenance of these infrastructures are integral to forest management activities. Forest roads, which encompass both roads and tracks, play a crucial role in facilitating activities aimed at preserving, managing, and enhancing forests and the environment as a whole. Their primary functions include: -Facilitating surveillance and monitoring activities. -Ensuring safe forest management practices. -Supporting the construction and maintenance of hydraulic-forestry and hydrogeological defense structures. -Enhancing the enjoyment of ecosystem services associated with recreational and tourism activities in forested areas. -Aiding in wildfire prevention and suppression efforts. -Contributing to civil protection initiatives.

	-Enabling rescue operations and emergency medical responses in forested regions. -Additionally, they serve as vital connectors to the management of agricultural and pastoral production units situated within or adjacent to forested areas. From a productivity perspective related to timber harvesting, careful forest road planning is crucial for reducing the overall cost of forest operations. Therefore, it is important to evaluate the condition of forest roads and calculate the accessibility of each forest parcel. In the context of the GO-SURF project, an algorithm has been developed to link the forest road network, slope data, and distance from the roads to create maps assessing the accessibility of each forest parcel. These maps were produced for the forest of companies that are involved in the OG and they are invaluable for understanding and planning future forest road features and evaluating the potential wood resources available for harvesting.
Lessons learned (1200 characters max.)	Mapping accessibility with the algorithm developed within the project is not a complex task. However, very often, the roads identified in the initial cartographic survey of the properties were not actually well-maintained. Therefore, before they can be used for accessibility mapping, it is necessary to undertake maintenance on these roads. So we suggest that before mapping accessibility using road maps, a field survey should be conducted to assess their maintenance status.
Contact information	Francesca Giannetti (francesca.giannetti@unifi.it)
Links to website/report/video (if applicable)	Video: https://youtu.be/tIyNjOTKPXY Website: https://www.go-surf.it/
Pictures (if applicable)	

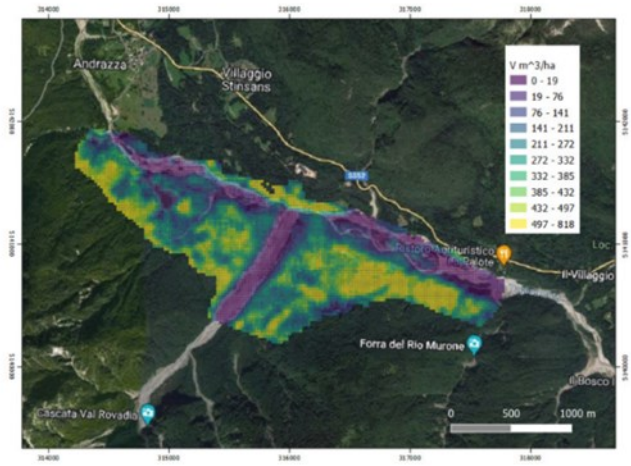
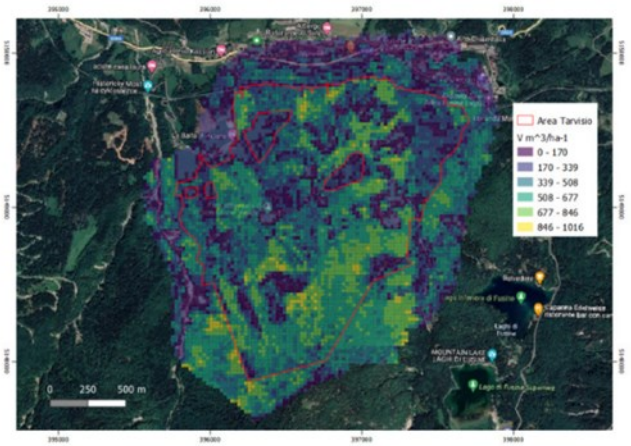
ITHub 1 - 25

Title of innovation	**Growing Stock Volume mapping using Remote Sensing Data**
ITHub	1
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO FORTRACK
Operational Group (name)	DECISIONAL SUPPORT SYSTEM TO MAP FOREST RESOURCES
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company, NGOs, research institutions, advisor
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/sviluppo-di-un-sistema-di-supporto-decisionale-la
Country, region, city	Italy
Type of innovation	Process
Keywords	Forestry, Remote Sensing data, digital platform,Decisional Support System, wood mobilization
Approach and main results (4000 characters max.)	The objective of the GO-FORTRACK project is to develop and test a structured modular decision support system that simplifies the implementation of Precision Forestry practices. This system will enable the transfer of research-based procedures to companies in the forestry sector, including technologies like Geographic Information Systems (GIS) and multi-scale remote sensing, forest spatial modeling, and computer algorithms integrated into decision support systems. Within this context, partner companies of the project have emphasized the need to map the volume of growing stock present in the forests throughout their entire company area, which amounts to approximately 1000 hectares per company. This mapping is essential to identify the variability within each individual forest parcel. To accomplish this, an area-based approach was employed, linking field plot data acquired in the context of forest management plans with freely available remote sensing data, such as Sentinel-2 multi-temporal products and GEDI Lidar (Global Ecosystem Dynamics Investigation LiDAR). As a result, a map of growing stock volume within the area of interest was generated and integrated into the GIS (GeoInformationSystem) Decision Support System. This map can be utilized for future forest management planning activities.

Lessons learned (1200 characters max.)	The data used to map the growing stock volume were already pre-existing within the companies, as they were acquired for forest management plans as required by the regional law of Calabria. However, it would have been preferable to use a sampling plan that also considered the variability of remotely sensed variables to achieve more accurate maps. Nevertheless, the system that exclusively relies on freely available data enables the mapping of woody volume and the analysis of variability within a forest parcel.
Contact information	Francesca Giannetti francesca.giannetti@unifi.it
Links to website/report/video (if applicable)	
Pictures (if applicable)	

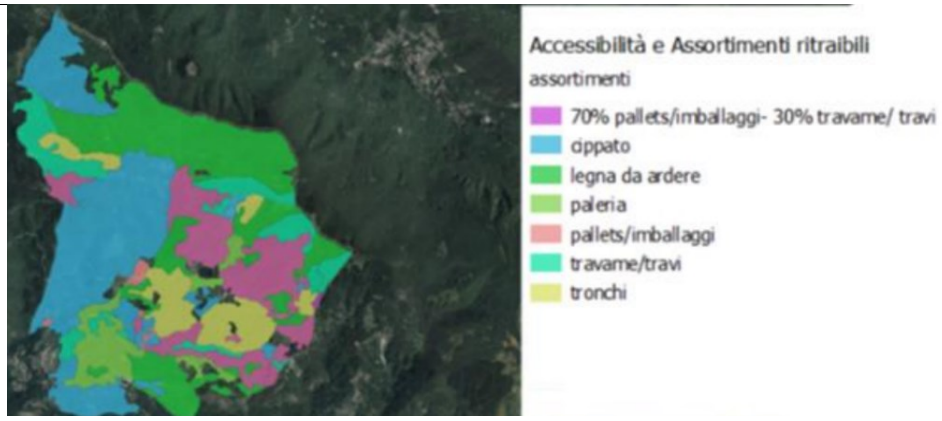
ITHub 1 - 26

Title of innovation	**UAV to map growing stock volume for sharing forest management plan**
ITHub	1
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	PRI.FOR.MAN
Operational Group (name)	Shared PRIvate FORest MANagement in Eastern Alps
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest companies, advisors, research institutions
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/gestione-condivisa-delle-proprieta-forestali
Country, region, city	Italy, Friuli Venezia Giulia
Type of innovation	Technological innovation
Keywords	Forestry, Remote Sensing data, digital platform,Decisional Support System, wood mobilization, new value chain, Sustainible Forest Managment
Approach and main results (4000 characters max.)	The PRI.FOR.MAN project aimed to develop a decision support system that also promoted shared management approaches among multiple landowners. To achieve this, the project initially mapped forest resources across the entire region using data from the national forest inventory and LiDAR data to identify the most promising areas. Once these areas were identified, the project simulated the development of shared forest management plans to demonstrate their feasibility. To accomplish this, four test areas were selected, each involving different landowners. In these areas, 15 ground plots were measured through field sampling, and the area was surveyed using a fixed-wing photogrammetric drone to create a hybrid canopy digital model (photogrammetric DSM - LiDAR DTM). These data were then used to map woody volume, basal area, and dominant height in the area with greater accuracy. The growing stock volume map were subsequently utilized to calculate the value of each landowner's forests within each forest parcel in a shared forest management plan. Under a technical point of view the drone allow to collect very high spatial resolution data within a very short time (approximatelly 250 ha in 1h30minutes).

Lessons learned (1200 characters max.)	The fixed-wing drone data with vertical take-off used in the project enabled the collection of information over vast areas in a very short time. However, the cost of the drone is quite high and can only be feasible for purchase in the Friulian context where it was tested if multiple organizations and technicians come together to share the costs. The flight itself is straightforward because it's entirely automated. Fieldwork for collecting data on at least sample areas is always necessary and remains somewhat costly. However, when compared to forest management plans developed using traditional methods, the number of sample areas required is significantly reduced. Nonetheless, costs can be reduced when multiple landowners decide to pool resources compared to conducting surveys independently.
Contact information	Francesca Giannetti (francesca.giannetti@unifi.it)
Links to website/report/video (if applicable)	
Pictures (if applicable)	 

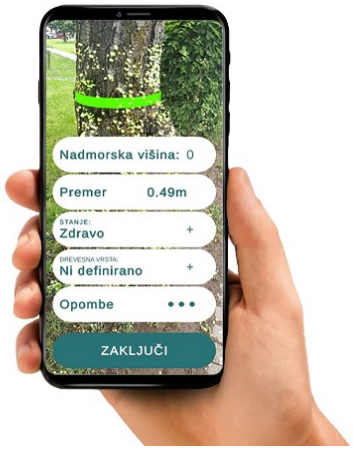
ITHub 1 - 27

Title of innovation	**Mapping forest assortment at parcel level to support wood mobilization**
ITHub	1
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-SURF
Operational Group (name)	DECISION SUPPORT TO SUSTAINABLE FOREST PLANNING
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company, NGOs, research institutions, advisor
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/supporto-decisionale-alla-pianificazione-forestale
Country, region, city	Italy, Tuscany
Type of innovation	Technological innovation
Keywords	Forestry, Remote Sensing data, digital platform, Decisional Support System, wood mobilization
Approach and main results (4000 characters max.)	Efficiently categorizing wood assortments is a critical task for gaining a more precise understanding of the genuine value of wood, whether it's within a forest or stored in a yard. Additionally, it's essential to measure and classify wood assortments at the parcel level before harvesting to obtain accurate insights into the forest's overall value. Within the GO-SURF system, various maps, such as the Growing Stock Volume Map and Forest Types Map developed using decision trees, enable the creation of a map that identifies potential wood assortments. This map employs the regional mean value to extract this valuable information. At the forest parcel level, the map provides the percentage of growing stock volume for each potential wood assortment, such as pellets, wood chips, firewood, poles, and beams. This map is a valuable tool for forest managers in assessing the economic value of the forest prior to its sale. Furthermore, it is integrated into the Decision Support System within the GO-SURF framework, making it accessible through a simple polygon design in the user interface.
Lessons learned (1200 characters max.)	The map of wood assortments provides information of wood assortments at parcel level and from the poin of view of forest managers working within the project appers to be a support instrument to quantify the possible velue of the forest. However, in our study area

	there are many forest managed as coppices so the main forest assortments that were observed in our map were mainly firwood and chips.
Contact information	francesca giannetti francesca.giannetti@unifi.it
Links to website/report/video (if applicable)	
Pictures (if applicable)	

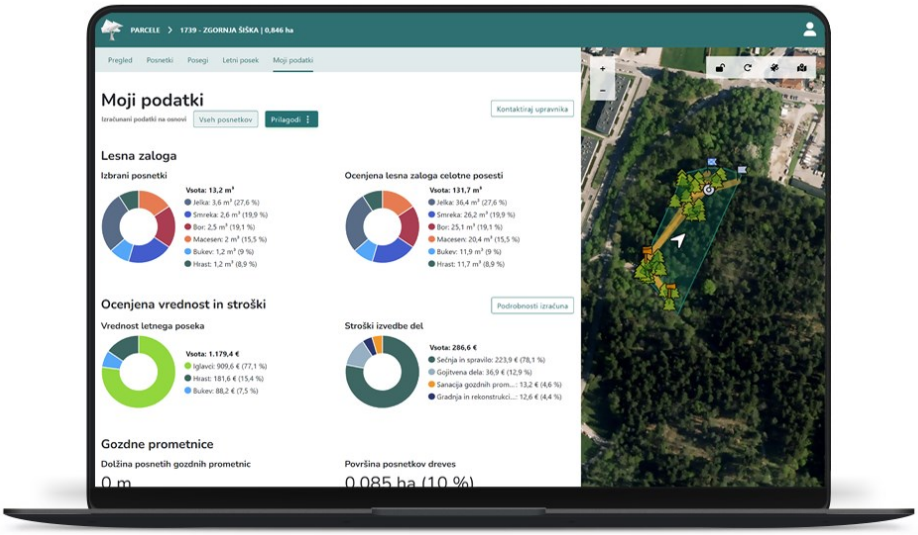
ITHub 1 - 28

Title of innovation	**Di-Gozd Digital Forest Inventory - Mobile app**
ITHub	1
FOREST4EU partner (short name)	GIS
Operational Group (short name)	Di-Gozd
Operational Group (name)	Digital Forest Inventory - Mobile app
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/di-gozd-digitalna-inventarizacija-gozda.html
Country, region, city	Slovenia
Type of innovation	Service
Keywords	Biodiversity and nature managment, supply chain, marketing and consumption, farming
Approach and main results (4000 characters max.)	The mobile application complements the web application. After registering the plot in the online application, you can make five different records. Tree count recording can be done in two ways, automatically or manually, using augmented reality technology. It is used to estimate the wood supply or to determine the amount and value of the wood mass. A recording of the felling path can be used to search for felled trees later or to control the felling.
Lessons learned (1200 characters max.)	The mobile application complements the web application. After registering the plot in the online application, five different surveys can be taken. Tree counting can be done in two ways, automatically or manually, using augmented reality technology. It is used to estimate the wood supply or to determine the amount and value of the wood mass. A recording of the felling path can be used to later search for felled trees or to control felling. Mobile applications, classified as augmenting artificial intelligence system, are also contributing to digitalization and have been developed for forestry or related sectors.
Contact information	info@kocevski-les.si
Links to website/report/video (if applicable)	Di-gozd

Pictures (if applicable)	

ITHub 1 - 29

Title of innovation	**Di-Gozd Digital Forest Inventory - Internet app**
ITHub	1
FOREST4EU partner (short name)	GIS
Operational Group (short name)	Di-Gozd
Operational Group (name)	Digital Forest Inventory - Mobile app
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/di-gozd-digitalna-inventarizacija-gozda.html
Country, region, city	Slovenia
Type of innovation	Service
Keywords	Biodiversity and nature management, supply chain, marketing and consumption, farming
Approach and main results (4000 characters max.)	The online application allows users to review their own forest land based on existing public data and estimate the value of their own forest's annual yield. Users can also assess the condition, value, and control measures of the forest based on their own images created with the mobile application. The application provides users with analysis tools for reviewing the images created, a method for calculating the value of trees, and a system for monitoring events on the forest plot
Lessons learned (1200 characters max.)	From the online application, we can get an overview of our own plots using publicly available data. It provides us with control over the interventions carried out and an overview of the records created. It allows us to make a more accurate assessment of the condition of the forest plot. It gives us information about our planned harvest and value.
Contact information	info@kocevski-les.si
Links to website/report/video (if applicable)	Di-gozd

Pictures (if applicable)	

ITHub 1 - 30

Title of innovation	**Social network of sustainable forest use for the production of biomass for thermal purposes**
ITHub	1
FOREST4EU partner (short name)	BOSCAT
Operational Group (short name)	Calor Rural
Operational Group (name)	Social network of sustainable forest use for the production of biomass for thermal purposes
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest Owners, Advisors, consumer interests groups, NGOs,
Link from OGs database	
Country, region, city	Spain; Aragon, Navarra, Catalunya
Type of innovation	Social innovation
Keywords	biomass, cicrular bioeconomy, Cooperation, Innovation social systems, organisational innovation, Sustainible Forest Management, wood mobilization and transformation
Approach and main results (4000 characters max.)	The lack of demand in the rural area of forest biomass for thermal purposes is a brake on the implementation of viable models of collective management of this resource. On the other hand, there are masses of trees with little commercial interest, currently unused, which increase the risk of fires and forest pests. It is necessary, therefore, to plan a collective management of forest masses and endogenous use of the resource that contributes to the circular economy that the rural environment requires, contributes to the creation of employment and resources, reduces GHG emissions to the atmosphere and minimizes Fire risks and forest pests. It is essential that both administrations and the general public perceive the economic, social and environmental benefits of sustainable collective management of forest biomass. Creation of a social network for the use of forest biomass for thermal purposes, generating employment and resources, improving its management, contributing to the energy transition and reducing GHG emissions. Implement biomass exploitation networks based on the ownership of the masses, their management, optimizing collective production processes, and setting the business model. Design and implement the model of intervention in masses and forest remains of low commercial interest that minimize the risk of fires and proliferation of forest pests. Promote the use of biomass, in public

	buildings and local populations, and disseminate the resource as a source of renewable energy, reinforcing the role of the rural environment in the energy transition.
Lessons learned (1200 characters max.)	**The sustainable and viable use of forest biomass presents environmental, economic and social advantages in the territories. Environmental** - Contribution to the 5C focal area and objectives 1 and 3 of EPI-AGRI: - Reduces the risk of forest fires due to the management of trees, eliminating excess fuel in the forest; - Reduce the emission of CO2 into the atmosphere by replacing fossil fuel emissions; - It improves the stability of the forest masses through the application of viable intermediate silvicultural treatments; - 100% renewable energy. **Economic** - Contribution to the 5C focal area and objectives 1 and 3 of EPI AGRI: - Competitive discounts compared to other sources of energy (diesel, natural gas, etc.); - Encourages local economic activity; - Decreased external energy dependence, which favors the trade balance. **Social** - Contribution to the 5C focal area and to EPI AGRI objective 3: - New jobs for the creation of jobs in the rural environment (In the mountains with the creation of forestry teams, equipment, transport, logistics and distribution and in points of consumption (machinery, installations, maintenance, boiler changes). **Contribution to the circular economy** - On the other hand, the proposed use, based on collective and grouped interests, as well as the use of the resource, fundamentally endogenous, enhances the circular economy by using this resource, closing the cycle of its life cycle. The creation of jobs in the rural area also contributes to generate economy in the territory where the resource is located. **Young people and women -** The depopulation of rural areas is taking place, fundamentally, due to the lack of job opportunities for young people and women of the territory. The creation of new employment opportunities and new opportunities for entrepreneurship generated by theproject will provide a better viability to the whole of the territories.
Contact information	joachim@boscat.cat
Links to website/report/video (if applicable)	https://teder.org/proyectos-finalizados/grupo-operativo-calor-rural/, https://www.youtube.com/watch?v=Ohi5nZyFW6o&t=13s
Pictures (if applicable)	

ITHub 1 - 31

Title of innovation	**Innovation in products, processes and marketing to introduce local woods with special, greater value-added characteristics to the Catalan market**
ITHub	1
FOREST4EU partner (short name)	BOSCAT
Operational Group (short name)	SINGULARWOOD
Operational Group (name)	Innovation in products, processes and marketing to introduce local woods with special, greater value-added characteristics to the Catalan market
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest and wood businesses, researcher centers, advisors, forest owner association
Link from OGs database	
Country, region, city	Spain, Catalunya
Type of innovation	Product
Keywords	Sustainable forest management, circular bioeconomy, carbon stock, virtual platform, wood mobilisation, forest industry, new products,
Approach and main results (4000 characters max.)	The aim of the project is to valorise wood with special dimensions and characteristics in the forests of Catalonia, and in particular, wood produced by the members of the cooperative Forestal de Catalunya, SCCL (Serveis Forestals, SF) and the company Agrupació Forestal del Montnegre i el Corredor SL (AFMC) through innovation in products, the transformation process and the methods/techniques for marketing these types of wood, presenting them to the market in a format that is different from the usual format in Catalonia. The project aims to introduce a new product "as a different concept to the formats of planks in standard dimensions available in large retail outlets," and to offer a product that has been preprocessed as little as possible and dried under ideal conditions to ensure an optimal technological quality and in "boules", using the French model. The idea is to introduce this product to the retail market (wood craftsmen, cabinetmakers, carpenters, decorators, architects, surveyors, etc.), which has been identified as a "market niche". The aim is to improve the economic results of forestry operations and provide the opportunity for forest owners to have a wider range with greater added value when selling their wood, in a market different from the one for which this wood was initially intended, which was packaging and/or bioenergy. Another objective of the project is to improve the competitiveness of the two groups of forest producers (Forestal de Catalunya, SCCL and Agrupació Forestal del Montnegre Corredor), which include forestry producers and groups

	of forest owners. By applying new processes, they can add value to their products, and focus them on new local markets, with short distribution circuits.
Lessons learned (1200 characters max.)	The end result is the "SingularWood" business initiative, which aims to facilitate marketing and add value to the woods from Catalonia's forests with special and unique features. Each and every one of our products is unique. The virtual platform (www.singularwood.cat) has been created to offer all the "boules" to the end customers: cabinetmakers, carpenters, designers, etc. The same platform contains a description of each product, which includes all the necessary information and which asks the craftsman who will use the "boules" to determine the suitability of each product for the creation of the unique pieces that they have conceived and designed. The execution of this OG led to the launch of an initiative that gives added value to trunks with unique features, and which after going through a minimal pre-treatment process and with a guarantee of traceability, can be made available to craftsmen (cabinetmakers, carpenters, designers, architects, etc.) for use in their unique creations
Contact information	cooperativa@forestal.cat
Links to website/report/video (if applicable)	FUSTES LOCALS - Posem en valor fusta de característiques especials i seva singulars (singularwood.cat)
Pictures (if applicable)	  

ITHub 1 -32

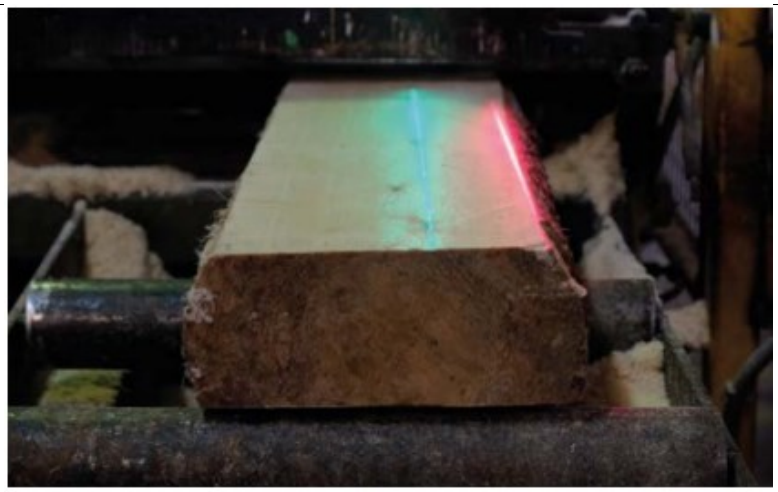
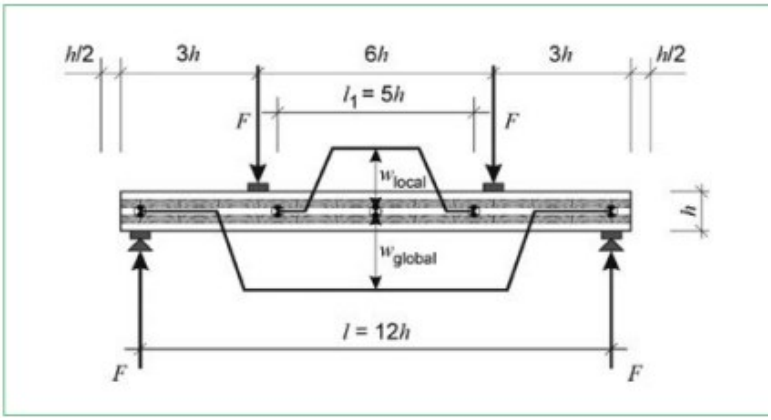
Title of innovation	**Development of an efficient logging system using the LOGGFORCAT boom harveste**
ITHub	1
FOREST4EU partner (short name)	BOSCAT
Operational Group (short name)	LOGGFORCAT
Operational Group (name)	LOGGFORCAT – Development of an efficient logging system using the LOGGFORCAT boom harvesteR
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest businesses, research center
Link from OGs database	
Country, region, city	Spain, Catalunya
Type of innovation	Technological innovation
Keywords	Wood mobilization, new value chain, forest industry, circular bioeconomy, biomass, tecnical innovation, Landscape / Territorial management, Supply chain, marketing and consumption
Approach and main results (4000 characters max.)	LOGGFORCAT is an operational project that has created an innovative wood clearing system based on the construction of a prototype 15-meter telescopic arm with a fastener that allows easier track-side clearance of felled trees, stacking them to match forest truck loading requirements, improving yields, reducing environmental impact and improving safety in forestry work. Description of the actions carried out in the project: - Design and construction of the LOGGFORCAT RS prototype. - Design and validation of clearing system with the LGGFORCAT RS prototype. - Pilot tests for the validation of the LOGGFORCAT RS prototype and LOGGFORCAT clearing system. - Transfer of results
Lessons learned (1200 characters max.)	Description of the actions carried out in the project. Design and construction of the LOGGFORCAT RS prototype. Design and validation of clearing system with the LGGFORCAT RS prototype. Pilot tests for the validation of the LOGGFORCAT RS prototype and LOGGFORCAT clearing system.

	Transfer of results The prototype, LOGGFORCAT RS, has been created, involving a collection arm with clamp, which is approved and bears the CE mark. The prototype allows clearing with a new, more financially and environmentally efficient system
Contact information	estratsdebosc@gmail.com
Links to website/report/video (if applicable)	Twitter account @loggfor
Pictures (if applicable)	

ITHub 1 - 33

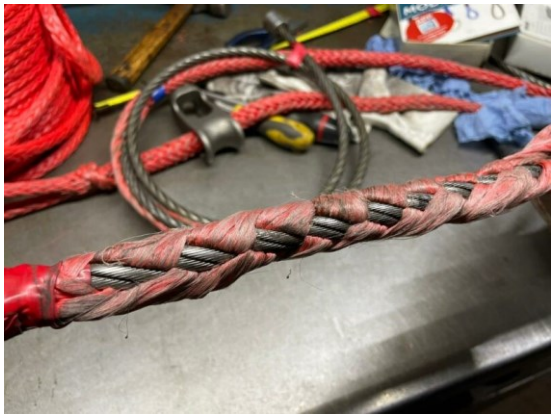
Title of innovation	**Development of a prototype crosslaminated timber panel made from local timber to improve the construction of buildings in terms of sustainability**
ITHub	1
FOREST4EU partner (short name)	BOSCAT
Operational Group (short name)	not found
Operational Group (name)	Development of a prototype crosslaminated timber panel made from local timber to improve the construction of buildings in terms of sustainability
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest industry, research center, association of timber dealers and sawyers of Catalonia
Link from OGs database	
Country, region, city	Spain, Catalunya
Type of innovation	Technological innovation
Keywords	Wood mobilisation, forestry, new product, circular bioeconomy, tecnical innovation, supply chain
Approach and main results (4000 characters max.)	The project was designed to obtain the information needed to assess whether the manufacture of cross-laminated timber panels (CLT) in Catalonia using local timber is technically and economically feasible. To this end, a prototype panel was manufactured under real industrial production conditions. This allowed us to measure the performance of the processing and preparation of the wood (sanitisation, planing, drying), the quality of the manufactured product and its strength. Based on the technical results together with the economic and market information that has also been obtained, the evidence for and against manufacturing CLT in Catalonia with Catalan wood has been identified. The project analysed CLT manufacturing technologies, design procedures and building construction. Visits were paid to factories, CLT machining centres, adhesive producers and specialised industrial machinery manufacturers in Europe. The objectives addressed in the framework of this project were: 1. Determine the physical and mechanical properties of the country's wood in order to determine the potential quality of the CLT that can be obtained.

	2. Ascertain the wood processing yields for CLT production: drying, sawing, planing, optimisation and gluing. 3. Manufacture prototype panels with local wood and analyse their properties according to current European standards. 4. Analyse the potential market and the feasibility of implementing CLT manufacturing technologies in Catalonia.
Lessons learned (1200 characters max.)	The results obtained show that the weaknesses are the cost of raw material, the availability of material and the relatively low yield of local wood. The strengths are the high strength of the material and the increase in demand, which is already apparent and is expected to increase even more in the near future. Therefore, further research is recommended to improve the weaknesses identified, for example through the use of automatic grading systems that identify the best structural timber for each project, or the improvement of the drying processes. From a qualitative point of view, the industrial manufacture of CLT panels in Catalonia is technologically feasible. In terms of the strength characteristics of the material and the gluing processes, there is no reason to rule out the possibility of manufacturing this material with local wood. However, it must be borne in mind that it is necessary to achieve a processing yield comparable to that of other European factories in order to produce competitively priced panels. To achieve this, it is necessary to have enough affordable timber with a reduced amount of singularities that comes from forests managed to obtain quality wood.
Contact information	grupboix@grupboix.com
Links to website/report/video (if applicable)	https://www.arescat.cat/es/2018/11/23/arescat-participa-en-lo-proyecto-desarrollo-de-un-panel-prototipo-de-madera-laminada-cruzada-con-madera-local-para-mejorar-la-construccion-de-edificios-en-temas-de-sostenibilidad/

Pictures (if applicable)	 *Wood being sawed. Photo: Operational Group* 

ITHub 1 - 34

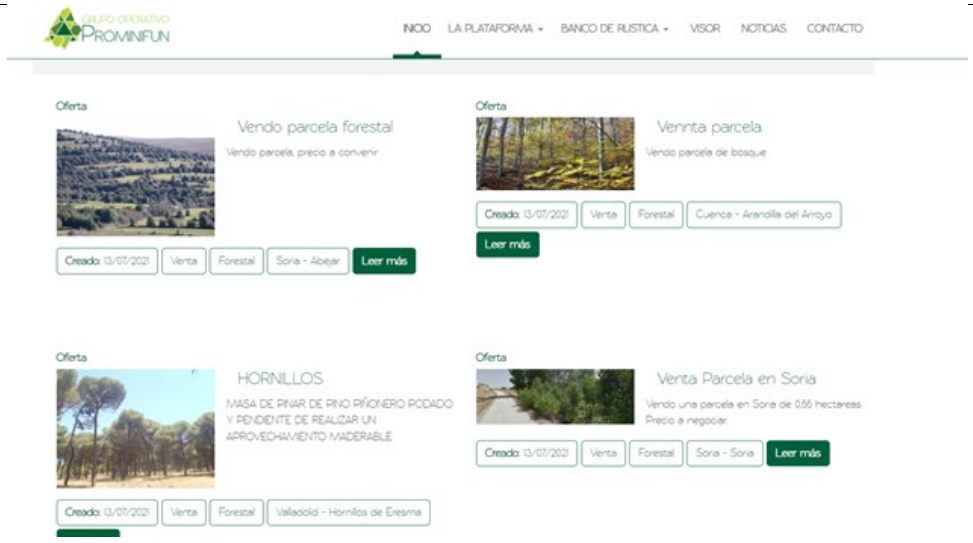
Title of innovation	**Improving the bond between steel and synthetic cable (MUCAS)**
ITHub	1
FOREST4EU partner (short name)	BOSCAT
Operational Group (short name)	MUCAS
Operational Group (name)	Improving the bond between steel and synthetic cable (MUCAS)
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	research center, forest business
Link from OGs database	
Country, region, city	Spain, Catalunya
Type of innovation	Technological innovation
Keywords	Wood mobilisation, forestry, tecnical innovation, forest machinery and tools, labor security, sustainable forest management
Approach and main results (4000 characters max.)	The use of synthetic cable among companies involved in timber harvesting and associated services is very low in Catalonia, as a result of the high abrasion suffered by the cable, which reduces its useful life and its high acquisition cost, up to 2 or 3 times higher than steel. The feedback we have from the sector is that this abrasion and subsequent breakage occurs mainly in the last few metres of the synthetic cable, so the hypothesis put forward is that if wear can be reduced only in these last few metres, this would increase its useful life. To make this possible, a synthetic-steel bond is proposed, with the steel located in the last few metres of the cable. In this way the abrasion would be concentrated to a large extent on the steel and not on the synthetic part. The difficulty lies in creating a bond that is effective during timber harvesting work. It must be able to withstand the stresses applied, be adaptable to the machinery used, and be relatively easy to implement. The aim is to enhance synthetic cable by implementing new tools and techniques to improve its use.
Lessons learned (1200 characters max.)	The aim is to promote synthetic cable and its advantages that go beyond both its technical and economic limitations and to obtain positive results that ensure the synthetic-steel connection increases the service life of synthetic cable, further reducing the aforementioned limitations.

Contact information	grupboix@grupboix.com
Links to website/report/video (if applicable)	https://www.grupboix.com/en/cooperation-for-innovation-improving-the-union-between-steel-wire-rope-and-synthetic-wire-rope-mucas/
Pictures (if applicable)	 

ITHub 1 - 35

Title of innovation	**Rural property management platform**
ITHub	2
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO PROMINIFUND
Operational Group (name)	Innovative management models to improve productivity in smallholder areas
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, reseachers, tecnological centers,
Link from OGs database	Grupo Operativo GO PROMINIFUN: 'Modelos de gestión innovadores para la mejora de la productividad en áreas de minifundio' | EIP-AGRI (europa.eu)
Country, region, city	Spain, Soria, Zamora y Pontevedra
Type of innovation	Technological innovation
Keywords	forestry, business model, Decisional Support System, Multifunctional forest management, digital platform
Approach and main results (4000 characters max.)	The change in population and land use in the Spanish rural forest environment in recent decades has led to the abandonment of large areas with the potential to be put to good use, which requires the design of new management models and proposals for solutions to facilitate access to their productive revaluation. Those areas whose management is limited due to their size and/or the difficulty of knowing their ownership constitute a large number of hectares that can add value to rural areas, for which administrations, owners and other agents involved must work together in the innovative implementation of solutions. The **Rustic Property Management Platform is a web tool designed to facilitate the management of rustic plot**s, both agricultural and forestry, and help their owners to manage their plots, as well as to contact other owners with whom they want to interact either by associating or through the purchase, sale, exchange or lease of plots. Through this platform you will be able to administer the management of your rustic plots, both agricultural and forestry, as well as to get in touch with other owners with whom you want to interact either by joining or by buying, selling, exchanging or leasing plots. The tool allows: (1) Carry out an inventory, stock and profitability analysis of an owner's rustic holdings through tabular and geographical consultation tools in a map viewer. (2) Promote the exchange or swapping of properties that favors their grouped management. Register plots of land in a rural holdings registration service. (3) Access a service for the

	generation of agreements for the transfer, custody, rental or lease of rural real estate between owners or managers. (4) Access information on fire risk and territorial zoning (regional, municipal or other) that may affect forestry treatments, exploitation and/or post-fire restoration, as well as funding through subsidies or aid in relation to this zoning. (5) Obtain information about forest fire damage coverage. (6) Obtain information on the times of danger with a view to regulating uses and requesting permits. Specifically, the user would be able to: (1)- Access cadastral rustic plots of land throughout Spain to: o Register the plots of your property. o Create holdings by grouping your plots to manage them more easily. o Create groupings of owners to manage your plots together. (2)- Access the Plot Announcement Service: o Where you can create advertisements to buy, sell, lease or exchange plots of land. o You can also create announcements to form groups of owners. o Access the ads of other registered owners and get in touch with them to make transactions. (3)- Access the geographic viewer with information about your plot: o Current vegetation. o Suitability of your plot for other vegetation o Potential assessment of the profitability of your plot o Fire risk o Regulations o Protected areas
Lessons learned (1200 characters max.)	The atomisation of land ownership and the need for a tool to facilitate the management of these plots makes it necessary to develop a digital tool to help facilitate this management. The smallholding management platform proposes a range of innovative solutions, such as having prior information on the characteristics of the plots in terms of their dendrometric possibilities and productive potential. The platform incorporates the possibility of grouping plots from different owners and being able to be managed as a group of producers or owners. However, in order to be used, it is necessary to add forestry references and to be able to document forestry operations under forest planning instruments. Therefore, there is a need to develop the appropriate software for the tool, enabling the management of these plots according to the technical management plans or associated forestry references. It is also necessary to extend the tool, making it possible to have all the spatial information of the management plans available. In the agricultural field, the tool needs to develop a digital version of the field notebook as an additional utility. Finally, a mobile application with offline functionality is necessary to complete its implementation.
Contact information	roberto.rubio@cesefor.com
Links to website/report/video (if applicable)	https://gestion.minifundio.es/

Pictures (if applicable)	

ITHub 1 - 36

Title of innovation	**Methodology for assessing the economic-financial sustainability of forest holdings**
ITHub	1
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO PROMINIFUND
Operational Group (name)	Innovative management models to improve productivity in smallholder areas
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, reseachers, tecnological centers,
Link from OGs database	Grupo Operativo GO PROMINIFUN: 'Modelos de gestión innovadores para la mejora de la productividad en áreas de minifundio' | EIP-AGRI (europa.eu)
Country, region, city	Spain, Soria, Zamora y Pontevedra
Type of innovation	Service
Keywords	forestry, business model, Decisional Support System, Multifunctional forest management
Approach and main results (4000 characters max.)	Historically, the Spanish forestry sector presents a deficit in the economic study of forestry operations in terms of the analysis of either the capitalization of the income obtained by the forest owner or the income derived from the extraction of the different types of products in the different types of forestry operations. A calculation methodology is proposed to evaluate the economic-financial sustainability of the most relevant forestry exploitations in Spain, incorporating the analysis from the perspective of the forester-producer and/or the investor, by calculating the profitability, the Internal Rate of Return (IRR) and the Net Present Value (NPV). The profitability analysis is based on the annual income per reference Agricultural Work Unit in the Spanish agricultural sector, established at 30,622.23 for 2021. The analysis from this new perspective makes it possible to evaluate the profitability of the forest, compare it with those of other forestry systems that could occupy the same areas and establish a minimum area for each forest with which to obtain a "forestry" income equivalent to the agricultural income. The assessment of the economic-financial sustainability of forest holdings has usually been analysed from the point of view of the investor, so that the periodic forest income obtained, which could share many aspects and be assimilated to a certain extent to agricultural income, has generally not been taken into account. The purpose of this methodology is to evaluate the economic and financial sustainability of the most relevant forestry operations in Spain, both from a business perspective -with a broader approach from the point of view of a private investor- and for the owner/forester. The methodology proposed in this work

	incorporates the perspective of the annual income for the owner/forester into the more usual analysis of profitability, by calculating the IRR and NPV. The **key aspects** for the evaluation of the economic-financial sustainability of the forest holdings analyzed were: Market situation, Variability of timber prices and rotation cycle optimisation. control of expenditure, forest activity diversification, determination of IRR and NPV and economic evaluation comparable to agricultural crops. The **forestry systems analyzed** where: 5 *Pinus sp*. systems (for wood, pine cones and resin production), 5 *Quercus sp* systems (for wood, cork and dehesa systems), chestnut (for wood and fruit), poplar, eucalyptus and beech for wood use and finally, scrub and grassland. Regarding the choice of **silvicultural models**, the most representative models existing in Spain have been identified, trying to establish for each of them a standard model that encompasses all possible scenarios and that can at least be applied in the greatest number of possible situations. For the calculation of the **annual costs** of each silvicultural treatment, many variables where taken into account: whether or not the land can be mechanized, whether or not it is steep or stony, the average productivity according to the quality of the season, etc. Average operating costs and acceptable quality and health status have been taken into account. For the **calculation of income**, three season qualities are established: OPTIMAL, ADEQUATE and MARGINAL, based on three productions (high, medium or low). The **prices** are constant for all models and have been set with different references such as (1) prices from the study on the profitability of different Spanish forest species carried out by the Polytechnic University of Madrid for the Ministry of Ecological Transition and Demographic Challenge (Ortuño, 2018). Data from the Observatorio de Precios de la Madera de la Confederación de Organizaciones de Selvicultores de España (COSE, 2015). The prices used by the technicians of the Forestry Associations of Castilla y León. For the standardization of methodology and results the application of the designed methodology has been standardized by creating an Excel file per silvicultural model with a standardized structure distributed in five tabs: **starting assumptions, expected income, expected costs, analysis tables and results.** In this file, starting conditions must be established and a list of costs and revenues that will occur in the different years of the production cycle must be entered. All the information is used in the analysis tab to establish the corresponding silvicultural itinerary in which both, the costs to be assumed and the income to be obtained, are detailed, specifying the year in which each of them occurs. From this itinerary and automatically, the corresponding analysis table is fed, used to generate all the calculations presented in the results tab.The final results generated are grouped under four headings: (a) NPV and IRR of the logging operation for the discount rate set in the baseline assumptions (also for 4, 6 and 8 %). (b) Determination of the annual equivalent income and minimum harvest size. (c) Valuation of the profitability of the logging operation without considering financing: costs, income and final balance, referred to in €/ha and €/(ha/year), referred to € year 0, € end-of-shift and € end-of-shift applying the CPI. (d) Same values as in the previous section, but considering financing.
Lessons learned (1200 characters max.)	With the data from the analysis in the current economic framework, it can be concluded, for economic calculation purposes, the similarity of forestry and agricultural holdings, as well as the need to use profitability calculation systems already identified in the agricultural activity. Of particular importance is the exhaustive control of costs, which is considered an essential issue for the viability of the forest exploitation. It is recommended to continue developing the methodology with analyses based on different silvicultural

	models and to incorporate environmental benefits not contemplated in this study, such as income from carbon sequestration, which could make plantations profitable that apparently are not. A future development of the market for greenhouse gas emission allowances, in which direct compensation to landowners for carbon sequestration is established, may generate new economic benefits from net carbon sequestration in forest biomass and wood products. Internalizing carbon or other ecosystem benefits in land-use change decisions can clearly favour the expansion of some species in areas where valuing the net benefits of the commercial goods and services associated with their exploitation alone does not favour this investment.
Contact information	roberto.rubio@cesefor.com
Links to website/report/video (if applicable)	https://www.minifundio.es/sites/default/files/editor/2_rentabilidad_ok.pdf
Pictures (if applicable)	

ITHub 1 - 37

Title of innovation	**Logging trailer - solution for efficient use of transportation resources of farmers out of agricultural season**
ITHub	1
FOREST4EU partner (short name)	LLA
Operational Group (short name)	IR_MP3
Operational Group (name)	Innovative solutions in efficient use of agricultural resources in transportation of logs outside agricultural season.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Seven (7) private agricultural, forestry and transport companies agricultural and forestry sector, one researcher (Riga Technical university), two NGOs (Latvian Logistics association and Latvian Association of Agricultural Cooperatives)
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/inovat%C4%ABvi-risin%C4%81jumi-lauksaimniec%C4%ABbas-un.html
Country, region, city	Latvia
Type of innovation	Technological innovation
Keywords	Wood mobilization, Cooperation, Agricultural production system, Farming equipment and machinery, Smart-application, Adaptation to climate change
Approach and main results (4000 characters max.)	OG has developed a version of a long logging trailer that is convenient in use also for transportation of short logs thanks to specific construction of bunks that can be moved closer to lifting crane and away from that when cradles are filled. Another aspect of this innovation is utilising idle truck resources of agriculture businesses during their off-season and engaging in transportation of logs where in winter period there is shortage of transportation capacity. Transportation of timber from forest to production has large seasonal fluctuations. In Latvia logistics experience about 50% of transportation capacity shortage in winter while there is close to 50% surplus of transport in summer. This technical innovation provides opportunity to involve idle cargo trucks from agriculture sector where there are lots of trucks that are equipped with dump trailers and dedicated for transporting grain in autumn. Rest of the season they are partly idle, partly used for transportation of mineral materials for road construction in summer if there is any construction in the neighbourhood. Logging trailer can be attached to same truck instead of dump trailer and thus truck can be efficiently used also in winter. Business models could be various. One option is that forestry company owns the logging trailer and rents it out when there is shortage of transportation means.

Lessons learned (1200 characters max.)	Question that may arise: why has above described innovation not spread and popular widely already now? This mostly is due to shortage of money. Farmers cannot afford to invest in another asset that will be used 1/2 of the year only. Options of owning them by forestry businesses or renting businesses seems to be alternatives.
Contact information	Guntars Reifelds, Board chairman, SIA "SELF Loģistika", e-mail: guntars.reinfelds@selflogistic.lv ; Normunds Krumins, Board Chairman , LLA, e-mail: n.krumins@gmail.com
Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 2 – Adaptation to climate change (33 extended summaries)

Table 9. Overview of the extended summaries of ITHub 2

	Title of innovation	Operational Groups (short name)	Type of innovation	Country
1	Bioclimsol : a decision support system integrating future climate and ground conditions	OG SPNA	Technological	France
2	Survey of atypical tree species in Normandy thought to be resistant to climate change (under revision of the coordinator)	OG RAISON	Product	France
3	Setting up innovative silviculture trials: planting on waterlogged soil (under revision by the coordinator)	OG RAISON	Process	France
4	Specialised logging trailer - solution for efficient use of transportation resources	OG IR_MP3	Technological	Latvia
5	Douglas-fir silvicoltural management with strips cuttings to enhance natural forest regeneration	Do.Na.To	Process	Italy
6	Valorisation and energy use of precommercial thinning products in forest stands of Aleppo pine (Pinus halepensis) regenerated after forest fires	OG Aleppo Pine	Product	Spain
7	Chestnut forests management for quality products and promote C sequestration	CASTANI-CO	Process	Italy
8	Evaluation of the soil response of different types of pruning of chestnut tree	Castagni Parlanti	Process	Italy
9	Participative simulation game "Foster Forest"	EUROFORNORM	Service	France
10	Theatrical forest excursions	EUROFORNORM	Social	France
11	UAV and multispectral camera to map stressed forest area	GO-SURF	Technological	Italy
12	Educational module 'foresters, it's your turn to play"	EUROFORNORM	Social	France

13	Douglas fir in the face of climate change in Burgundy region	OG Douglas	Process	France
14	Assisted tree migration : 70 islands of trees of the future	OG Futur Forest	Process	France
15	Course on GIS and Remote Sensing Data to monitor forest ecosystem	GO-SURF	Service	Italy
16	Evaluation of different microclimatic conditions in a linear planting with rows of hybrid biomass poplars combined with maize	NEWTON	Process	Italy
17	Application of SlideforMap for the hydrological risk assessment in sustainable managed forests	BIOSEIFORTE	Technological	Italy
18	Management manual for stone pine	GO PINEA	Service	Spain
19	Reducing Input in Forest Operations: A Valuable Opportunity for Carbon Credit Generation	CO2MARCHE	Process	Italy
20	Cause of the decline of cork oak forests and management strategies	GO GEOSUBER	Process	Portugal
21	Geosuber Tool - Monitorization of the vitality of cork oak stands	GO GEOSUBER	Technological	Portugal
22	Precision fertigation of Cork Oak (*Quercus suber* L.) in intensive cork production stands.	GO REGACORK	Process	Portugal
23	"New" pruning method for fertigated Cork Oak (*Quercus suber* L.)	GO REGACORK	Process	Portugal
24	Increase and transfer knowledge to producers about precision fertigation of Cork Oak (*Quercus suber* L.) in intensive cork production stands.	GO REGACORK	Social	Portugal
25	Good practices for the management of pests in Stone Pine (*Pinus pinea* L.)	GO +PINHÃO	Technological	Portugal
26	Good practices for the management of diseases in Stone Pine (*Pinus pinea* L.)	GO +PINHÃO	Technological	Portugal

27	Increase and transfer knowledge to producers about good practices for the management of pests and diseases in Stone Pine (*Pinus pinea* L.)	GO +PINHÃO	Service	Portugal
28	Identifying the presence of Flathead Oak Borer (*Coroebus undatus* F.) in Cork Oak (*Quercus suber* L.)	GO UNDERCORK	Technological	Portugal
29	Monitoring the population of Flathead Oak Borer (*Coroebus undatus* F.) in Cork Oak (*Quercus suber* L.)	GO UNDERCORK	Technological	Portugal
30	Innovative Silo for the Supply of Wood Chip (SISE)	GO SISE	Technological	Spain
31	An experimental laboratory in forestry on the classified site of Mont Beuvray	GO Mont Beuvray	Organisational	France
32	Pilot silo with an automated biomass (forest biomass) supply system	GO SPASB	Technological	Spain
33	The "sustainable bee forest" concept and implementation	Bienenwald (bee forest)	Process	Germany

ITHub 2 - 1

Title of innovation	**Bioclimsol : a decision support system integrating future climate and ground conditions**
ITHub	2
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	SPNA
Operational Group (name)	Precision sylviculture in Nouvelle-Aquitaine
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, researchers, advisors, local communities
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/sylviculture-de-pr%C3%A9cision-en-nouvelle-aquitaine.html
Country, region, city	France, Nouvelle Aquitaine
Type of innovation	Technological innovation

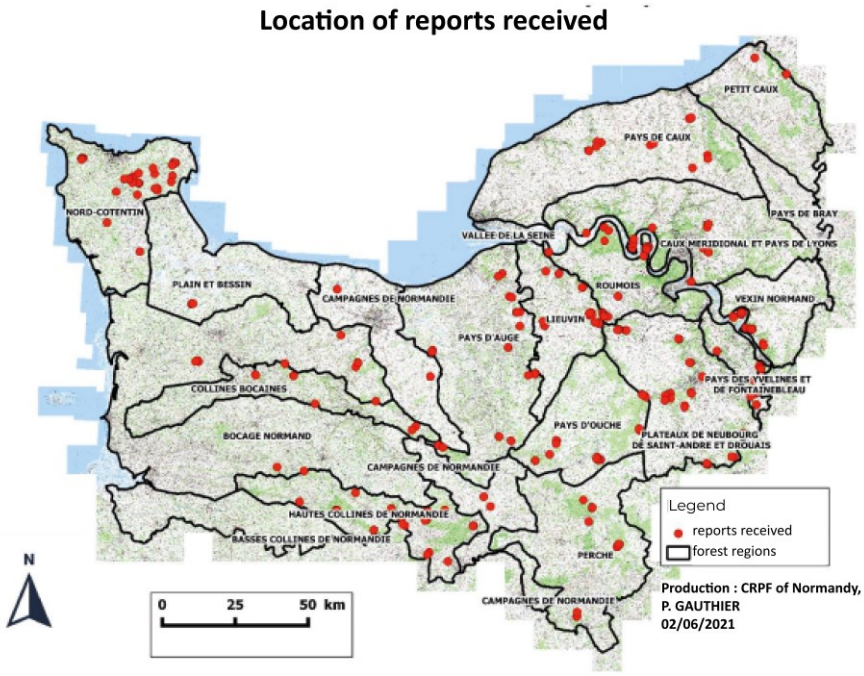
Keywords	Forestry / Adaptation to climate change / Decision Support System / Digital tools / Precision forestry
Approach and main results (4000 characters max.)	This tool, called "Forrecast by BioClimSol", is a digital application available online. It has been disseminated in the Nouvelle-Aquitaine region through a training session for forest managers as part of the SPNA operational group. The aim of BioClimSol is to help forest owners and managers to take account of stand dieback risk in forest management and in the choice of tree species in the context of climate change, by means of two complementary approaches: 1) by assessing the zones of vigilance or risk of dieback in existing stands, and 2) by using its nest models to assess the climatic, pedological and topographical compatibility of a number of reforestation species. BioClimSol takes into account : - The biotic conditions of the stand (Bio) - Current and future climatic conditions, with the integration of different models (Clim) - Soil conditions (Soil), which can have a positive or negative impact on tree vitality. This application is made up of modules for entering data on the stand, soil, topography, biotic factors and health status. Climatic data and certain topographical data are entered automatically via the GPS location of the plot. These data are linked using statistical algorithms calibrated by species. These are used to calculate two indices, the IBS (BioClimSol index) and the INB (BioClimSol niche index), which are directly associated with the plot diagnosed for different climate and time horizons. The results are displayed in two modules corresponding to two types of situation encountered: standing stand management and the afforestation module. The BioClimSol indices refer to three classes of soil and climate vigilance: moderate, high and maximum. These vigilances, associated with a risk of dieback or probability of afforestation failure, provide the BioClimSol vigilance. For each vigilance, depending on the type of stand (or afforestation project) encountered and the climatic horizons, silvicultural recommendations are proposed. These recommendations appear as general management advice for the resistance and resilience of forests in a context of climate change, and must then be adapted to the local context. When a level of vigilance is alerted, it is necessary to carry out checks, looking in particular at the parameters that have the greatest influence on the decline of the species studied. The BioClimSol application offers three interdependent results: - A synthetic dieback index resulting from the complete field survey and calculated using a national database of over 5,000 plots; - A choice of potential tree species to be used via its afforestation module, which combines the autoecology of tree species with climatic data; - Silvicultural recommendations for stand management.

Lessons learned (1200 characters max.)	BioClimSol's innovation is to offer managers models to assess the risk of observing dieback. These so-called empirical models can be considered robust because they are based on numerous field measurements. The bioclimsol niche models are based on a highly detailed, quantified database of the ecological requirements of tree species compiled by national experts. The BioClimSol models are built from data collected in the field in defined regions and plots, over a sometimes still small number of points. It has not been possible to take into account all the parameters that compensate for or aggravate the risks, and therefore the level of vigilance, so it will always be necessary to adjust the results using the parameters not included in the model. The probability of observing dieback makes it possible to define the level of vigilance, and BioClimSol should be used as such. The tool exists to draw attention to risks in a future full of uncertainties in a context of climate disruption. The notion of risk is difficult to integrate, and some users are looking for simple 'binary' tools that are purely impossible and dangerous to create.
Contact information	benjamin.cano@cnpf.fr
Links to website/report/video (if applicable)	https://www.cnpf.fr/nos-actions-nos-outils/outils-et-techniques/bioclimsol
Pictures (if applicable)	

ITHub 2 - 2

Title of innovation	**Survey of atypical tree species in Normandy thought to be resistant to climate change**
ITHub	2
FOREST4EU partner (short name)	National forestry property centre (CNPF)
Operational Group (short name)	RAISON
Operational Group (name)	Network of adaptations of original forestry innovations in Normandy
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Advisors (National forestry property centre - CNPF) ; Managers and forest owners (Technical and forestry experimentation centre - CETEF of South Normandy).
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/raison-r%C3%A9seau-dadaptations-dinnovations-sylvicoles
Country, region, city	France, Normandie
Type of innovation	Product
Keywords	Adaptation to climate change , plant production, silviculture, experimentation

Approach and main results (4000 characters max.)	Regional players are increasingly concerned about the multiple effects of climate change, and it seems necessary to increase the number of feedbacks and experiments, and to analyse them, in order to increase knowledge and anticipate the effects of climate change. As part of the RAISON project, an inventory was made of the stands of atypical species present in Normandy. The aim was to study their behaviour in relation to the soil and climate conditions in which they were planted. The ultimate aim was to identify the species that might be best adapted to climate change in Normandy. Lists of potential substitute species were proposed for each forest region and each type of site, including Pubescent Oak, Cormier, Oriental Beech, Tulip Tree, Atlas Cedar, Calabrian Pine, Douglas Fir, Taeda Pine, Nordmann Fir, Western Red Cedar, Japanese Cryptomeria, Evergreen Sequoia and Calocedar. During the summer of 2019, the National Forestry Property Centre contacted all forest managers and owners, as well as forestry contractors and nurserymen, to find out whether such species had been planted. At the same time, an article in a regional technical journal (Bois & Forêts de Normandie) and a page devoted to the project on the CNPF website were published, with an opportunity to fill in a form reporting atypical stands in the study area. The French National Forestry Office (ONF), which is responsible for managing public forests, was also approached. Between December 2019 and May 2021, 384 stands were inventoried from a list of 500 stands of interest. The individual results were systematically sent to the owners. The majority of alerts concerned softwood species, with 317 alerts, compared with 67 for hardwood species. The most common softwood species reported, in order of importance, were Maritime Pine, Atlas Cedar, Western Red Cedar and Evergreen Redwood. Sixteen other softwood species were reported. The most common deciduous species reported, in order of importance, were Virginia Tulip Tree, Corsican Alder, Nothofagus obliqua and Pubescent Oak. Nine other deciduous species were reported. Many species have all their age classes represented, but these are not in balance and may reflect a dynamic in the use of the species. For example, maritime pine was heavily planted more than 50 years ago, but the area planted has since fallen sharply. Western red cedar shows a similar trend, although there has been renewed interest in the species over the last 10 years. Other species reflect a fashion effect. For example, Nothofagus obliqua was planted extensively in 1980, but the harsh winters damaged these plantations and they have not been planted since. Calabrian pine has been put aside in favour of Corsican laricio pine for reasons of quality and branching. Conversely, Sequoia sempervirens and Corsican Alder have been used for silvicultural purposes for some forty years. It is important to have trees in all age classes, so that we can study the behaviour of the species throughout the life of the stand and begin to examine the various possibilities in terms of silviculture.
Lessons learned (1200 characters max.)	The lack of experience of the behaviour of these species means that it is not possible at present to draw up a list of new species to be planted on a large scale, but the monitoring of experiments should enable us to respond with greater certainty in the future. For newly planted species, it is important to continue to monitor the growth of stands when they are young and to restart the planting of those that are no longer used or are used infrequently, in order to improve our knowledge of the behaviour of these species in their first years of life. The number of surveys carried out does not allow statistically robust conclusions to be drawn about their behaviour, but it does illustrate certain trends, particularly for the Atlas Cedar. It is therefore necessary to multiply this type of initiative, already present in public

	forests, within private forests and to pool the results to enable more robust studies to be carried out, for all types of site conditions. Identifying these atypical species and experimenting with different management methods is a long-term project for the forest and requires long-term sources of funding to enable these stands to be monitored.
Contact information	Mr Romain MANI - CNPF. Contact informations : romain.mani@cnpf.fr
Links to website/report/video (if applicable)	https://hautsdefrance-normandie.cnpf.fr/projet-raison
Pictures (if applicable)	

ITHub 2 - 3

Title of innovation	Setting up innovative silviculture trials: planting on waterlogged soil
ITHub	2
FOREST4EU partner (short name)	National forestry property centre (CNPF)
Operational Group (short name)	RAISON
Operational Group (name)	Network of adaptations of original forestry innovations in Normandy (RAISON)
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Advisors (National forestry property centre - CNPF) ; Managers and forest owners (Technical and forestry experimentation centre - CETEF of South Normandy).
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/raison-r%C3%A9seau-dadaptations-dinnovations-sylvicoles
Country, region, city	France, Normandy, Saint Etienne du Rouvray
Type of innovation	Process
Keywords	silviculture, experimentation, adaptation to climate change, planting, costs, hydromorphy

Approach and main results (4000 characters max.)	Waterlogging is a major constraint for many forest species, and can affect stand productivity and even the survival of seedlings. Its impact varies according to criteria such as its intensity and depth of appearance. The effects of climate change could exacerbate this problem by increasing winter rainfall and summer drought. A full soil analysis is essential to determine which tree species are best suited to the site. Soil preparation may also be a solution in the case of reforestation, in order to reduce the waterlogging problem. One of the aims of the RAISON project is to identify the most favourable planting method(s) for developing a production forest stand on waterlogged soil. A property located in the commune of Saint-Gatien-des-bois was selected by CETEF members to set up a system on a 4.6 ha plot, occupied by a Sitka spruce forest planted in 1972 and characterised by fairly acid soil with surface hydromorphy (at shallow depths). Numerous diebacks have led the owner to harvest the spruces in full in 2019, with a view to replacing them with a species more suited to the site. A test comparing 4 planting methods on waterlogged soil was carried out on 1 ha of this plot. The planting scheme involved a row spacing of 3.5 m and a spacing of 3 m between each plant. The initial density was 1143 plants/ha. Each plot has 14 rows with 20 plants/row. Thus, 280 Sessile Oak seedlings will be planted on each of the 4 plots of 25 acres according to the following methods: "1" manual planting without subsoiling, "2" planting on domed ridges, "3" planting on domed posts and "4" planting on domed posts and biological drain (tamping with Willow). The plot for modality 4 had a tamping between each oak plant and 266 willows were therefore planted. There were no replications. In order to avoid edge effects, the lines planted at the edge of the plot were not measured, forming isolation strips. The ends of the plot were marked with 1m20 stakes and the outside trees closest to the plot were marked with a line. Measured trees will be marked by painting a horizontal line at 1.30m and will be numbered once they have reached a sufficient diameter. All the species will be planted at the same time (winter 2021-2022). The plots of land where the system will be installed have been clear-cut, followed by a full-scale shredding operation in the summer of 2020 and renovation of the existing ditches. The waterlogged nature of the soil means that subsoiling is out of the question. The factors studied are changes in growth, shape and the general behaviour of the species. A comparative analysis of the costs of each method will be carried out. At installation, the height of all the trees is measured. Over the following three years, the following variables are measured: the condition of the trees (alive, dead, etc.), their height and the presence of phytosanitary problems. Then, the above variables are measured on a minimum sample of 30 trees, chosen randomly or systematically, as well as the circumference (if the tree reaches 1m30 in height and as soon as ¾ of the trees exceed 10 cm in circumference). Before the 1st thinning, all the trees are measured for the above variables. The height is measured on a sample of 20 trees evenly distributed in 5 diameter classes of the same amplitude. Finally, the silvicultural interventions (protection against game, clearing and thinning) must be the same for all modalities in order to avoid bias when comparing them. Monitoring for at least 30 years is planned.

Lessons learned (1200 characters max.)	This experiment is the only one of its kind in Normandy, and in future it could serve as a reference protocol for increasing the number of experimental planting sites on waterlogged soils. The data measured will be used to assess the impact of planting methods on stand growth. Integrating these data into a database containing all the systems of this type at national level could enable these comparisons to be refined. Experimenting with the effect of different planting methods on the survival and productivity of tree species is a long-term project for the forest and requires long-term sources of funding to enable these stands to be monitored.
Contact information	Mr Romain MANI - CNPF. Contact informations : romain.mani@cnpf.fr
Links to website/report/video (if applicable)	https://hautsdefrance-normandie.cnpf.fr/projet-raison
Pictures (if applicable)	 Title : oak plant in its protective cover. Copyright : Sylvain Gaudin © CNPF.

ITHub 2 - 4

Title of innovation	**Specialised logging trailer - solution for efficient use of transportation resources**
ITHub	2
FOREST4EU partner (short name)	LLA
Operational Group (short name)	IR_MP3
Operational Group (name)	Innovative technical solution in lowering impact to environment by efficient use of long logging trailer for transporting short logs.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Seven (7) private agricultural, forestry and transport companies agricultural and forestry sector, one researcher (Riga Technical university), two NGOs (Latvian Logistics association and Latvian Association of Agricultural Cooperatives)
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/inovat%C4%ABvi-risin%C4%81jumi-lauksaimniec%C4%ABbas-un.html
Country, region, city	Latvia
Type of innovation	Technological innovation
Keywords	Wood mobilization, Climate and climate change, Forestry, Supply chain, Market and consumption, Adaptation to climate change

Approach and main results (4000 characters max.)	Currently there is trend that allowed total loads for trucks on public roads are increasing. That allows transportation of bigger volumes per truck and generates less pollution to environment. OG has developed a version of a long logging trailer that is convenient in use also for transportation of short logs thanks to specific construction of bunks that can be moved closer to lifting crane and away from that when cradles are filled. Innovative technical solution of the long logging trailer provides possibility to fill it 100% also with shorter logs. This is mostly impossible with standard long trailers. Problem is that it is very difficult or impossible to balance short log and load it to far end of a long trailer. You need to hold the log at one end and it is too difficult for hydraulics. In this innovative trailer bunks are movable. Empty cradles can be moved forward, shorter logs loaded closer to the crane and filled cradle moved to far end of the trailer afterwards. Thus trailer can be filled 100% also with shorter logs. Full load results in lower CO2 emissions per cubic meter of transported timber.
Lessons learned (1200 characters max.)	Question that may arise: Why are such trailers not availble widely already now? This is innovation that arose following trends that bigger and bigger loads are being allowed on public roads. This is long trailer and can pick up what is required at the road side only. So far logging trucks often are double trailers where truck has a manipulator for loading timber. Truck may leave a trailer on the road, drive deeper to the forest, pick up logs, transport them to the road side and re-load to the trailer, then drive back and load up another portion on the truck itself. Finaly go back to main road, attach trailer and transport cargo to destination pont. Nowadays often companies use more efficient specialised off-road tractors for transporting logs to the roadside.
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Links to website/report/video (if applicable)	https://youtu.be/nwzEmINFdz0

Pictures (if applicable)	 

ITHub 2 - 5

Title of innovation	**Douglas-fir silvicultural management with strips cuttings to enhance natural forest regeneration**
ITHub	2
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	Do.Na.To

Operational Group (name)	Douglasiete naturali toscana
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, researchers, territorial and public institutions, editorial company, formation company, moral company
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/douglasiete-naturali-toscane-donato.html
Country, region, city	Italy, Tuscany
Type of innovation	Process
Keywords	Mitigation to climate change, Adaptation to climate change, carbon stock, biomass, sustainable forest management, landscape/land management
Approach and main results (4000 characters max.)	Between 1960 and 1980, Douglas-fir (Pseudotsuga menziesii var. menziesii) was the most abundantly cultivated species for abandoned lands reforestation in Tuscany. Given its high growth rate, high productivity and carbon stock capacity, as well as other biological characteristics (adaptability by resisting aridity and wind, phytosanitary resistance) it can therefore be considered for all intents and purposes a viable option for the achievement of sustainable development goals as mitigation and adaptation to climate change in mountain areas. Moreover, Douglas-fir forests constitute an element of landscape diversity in the Tuscan Apennine, enhancing its recreational, naturalistic, runoff-regulating and productive value of the territory, thus contributing to the sustainability and economy. The project Do.Na.To. aims to promote Douglas-fir forests natural regeneration in Tuscany (Italy), through application and adaptation of a silvicultural management systems already tested in other European countries. During the project, a group of technicians travelled to France to get to know the techniques adopted by their colleagues, and subsequently set up 26 demonstrations areas where different silvicultural systems were applied. Currently, Douglas-fir stands in Tuscany are managed with clear cutting and artificial regeneration postponed to the first useful dormant season, with bare-root plantings or phytocells. This is a simple method, but it is not free of problems, both technical and economic. Douglas-fir renews with extraordinary facility, both in full light and in half-shade conditions. The ecological benefits of natural regeneration are numerous and underlie the formation of more resilient forests, rich in biodiversity and genetically better adapted to the environment, being the result of local selection processes from theearliest life stages and occupying each species the micro-stational conditions in which it is most suitable. With natural regeneration, the root system turns out to be more efficient, without damage to the taproot and better interconnected to the mycorrhizal network and root system of the released plants.

	The silvicultural systems tested during the project have been shelterwood cutting followed by seed cutting, strips cutting and selection cutting. The best regeneration results were obtained by clear cuts on strips, on the order of several tens of thousands of plants, with strips of the same width of the height of the bordering plants, not wide as the double-hight as suggested by previous literature (la Marca et al., 2017; la Marca and Pozzi, 2016). The proximity of the strips promotes the formation of a favorable light-shady microclimate, less impacted by atm agents such as drought or wind. The fundamental aspect is the planning of cuttings in order to wait until the seeds are mature, not before, so from late summer onward. In addition, it's preferable to make them in conjunction or the year before the mast year. The entry of natural regeneration occurs massively in the presence of seed and light in the first and in the second dissemination season following cutting, it's not really appreciated by wild ungulates, but it's endangered by weed flora, in particular bramble. In spite of significantly greater technical/executive difficulties if compared to traditional clear cutting, the treatment with strips cutting enhances natural renovation establishment, presents lower environmental and landscape disturbance, and confers greater resilience to the forest.
Lessons learned (1200 characters max.)	The research produced very interesting results, douglas-fir forest natural regeneration can be considered a viable option for addressing the negative effects of ongoing climate change and an opportunity to pursue an ecological transition for sustainable development. Strips cutting system with strips of the same width of the height of the bordering plants, enhances natural douglas-fir regeneration and reduce the environmental, economic, landscape and social conflicts (related to the execution of clear cutting for regeneration). Still, in Italy there are several constraints that limit the method and timing of silvicultural actions, so that, for example, if strips cutting is done, replanting is still mandatory, and often timings of acquiring permits and carrying out the cuttings are slow.
Contact information	Solaria Anzilotti solaria.anzilotti@unifi.it
Links to website/report/video (if applicable)	https://www.progettodonato.it/

Pictures (if applicable)	 *Azienda Podernovo: rinnovazione naturale dopo la pasciona del 2020 (Foto Aprile 2022)*

ITHub 2 - 6

Title of innovation	**Valorisation and energy use of precommercial thinning products in forest stands of Aleppo pine (Pinus halepensis) regenerated after forest fires**
ITHub	2
FOREST4EU partner (short name)	BOSCAT
Operational Group (short name)	GO A.P.C.
Operational Group (name)	OG Aleppo PIne
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners associations, local rural action group,
Link from OGs database	
Country, region, city	Spain; Catalonia, Valencia,
Type of innovation	Product
Keywords	Wood mobilization, biomass, carbon stock, sutainable forest management, regeneration after forest firess, maket and consumption
Approach and main results (4000 characters max.)	The objective of the group is the energetic valorization of the forest residues that are generated when carrying out clearings in Aleppo pine forests. After the forest fires that affect the Mediterranean area, the masses of Aleppo pine usually regenerate spontaneously in very high densities and it is necessary to carry out clearings to increase the resilience of the mass. 2A- Improvement of the economic results of the aforementioned actions and, therefore, the overall results of the farms, generating a product that can be used for the energy self-supply of the farm, for sale in the local or international market. 4A-Return the ecosystems of the burned forests in a state of greater resistance and resilience against climate change and greater biodiversity both of forests included in Natura2000 zones, mountain municipalities, and others. Make feasible and, therefore, be able to carry out clearings on regenerated Aleppo pine, which increases its growth and the role of CO2 sink in these forests. At the same time, it allows concentrating the productive potential of the plot in a number of morphologically selected trees, reducing in the future Obligatorio/ Mandatory the carbon footprint derived from logging, logging and transport of wood from forestry operations. To valorize the waste generated by thinnings, wood and branches of small dimensions, are not currently usable to increase the performance of clearing actions that are urgently needed in the Mediterranean peninsular arc. Analyze the different current

	technologies for the collection and extraction of biomass of small dimensions and define the conditions of applicability. Define the type of forest biomass that can be generated by thinning (small-sized wood) and analyze the physico-chemical characteristics and properties as fuel. Analyze the availability, stock and location of forest stands of Aleppo pine in the post-fire regenerationphase.
Lessons learned (1200 characters max.)	**Improvement of the economy process of exploitation of the regenerated masses Aleppo pine for its use as biomass:** it improves the performance of exploitation, reducing of the number of work phases and means to be used, **Improve the returns of mount with stock of regenerated post pine fire carrasco: i**t is promoted and favored the use of this type of masses, raw material market opportunities are facilitated, the forests are valued with better development and capacity of trees after thinning actions **Environmental improvement of the forests: t**he ecosystem is improved by lowering densities of Aleppo pine and encourage the entry of light to the undergrowth, the risk of fire is reduced by reducing the amount of fuel with a high flammability, the carbon balance is improved by being able to replace the use of fossil fuels for renewable fuels and neutral balance **The environmental quality of rural territories is improved:** the environmental quality of rural territories is improved, the intangible values of the forest are favored by promoting biodiversity, an improvement in the quality of the landscape is promoted, by not abandoning forests (prevention of fires and elimination of pests, as well as mitigation/adaptation to climate change **There is a social improvement of the people, owners, producers and processors of raw materials**: the social perception of concern is improved for improvement and management of the forests, the creation of a market with high impact on rural populations, generating rural employment direct in all phases of management **Improvement of the territory:** the creation of new activities related to the biomass utilization, the adoption of alternatives to fossil fuels is facilitated, promotion of the relationship between different sectors related to the exploitation and use of the forests
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Links to website/report/video (if applicable)	

Pictures (if applicable)	 

ITHub 2 - 7

Title of innovation	**Chestnut forests management for quality products and promote C sequestration**
ITHub	2
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	CASTANI-CO
Operational Group (name)	CASTANI-CO "THE CARBON SEQUESTRATION IN THE SYSTEM OF CHESTNUT FRUIT"
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Chestnut growers, universities, regional institution
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/castani-co-%E2%80%9Cil-sequestro-di-carbonio-nel-sistema.html
Country, region, city	Italy, Emilia Romagna, Bologna Modena Reggio Emilia
Type of innovation	Process
Keywords	Biodiversity, nature management, soil management, functionality, landscape, land management
Approach and main results (4000 characters max.)	CASTANI-CO promotes chestnut groves as a semi-natural system suited to carbon sequestration and as a productive source of quality food (nutritional and environmental). Chestnut tree cultivation is typical of the hilly-mountainous environment of Emilia-Romagna with deep roots in the culture and tradition of these territories. It plays an important role in climate change mitigation, thanks to the high environmental sustainability of the agro-ecosystem characterised by low greenhouse gas emissions (low use of agricultural machinery), carbon sequestration in soil and plants, high environmental biodiversity, thus a good impact within climate change mitigation strategies. Similarly to the Italian situation, it is undergoing a slow and constant crisis caused by the presence of pests and the recurrence of unfavourable weather events that, over time, have led to the abandonment of cultivation. Despite the sharp contraction of cultivated areas and the market, chestnut producers in Emilia-Romagna are very active and have organised themselves into specific consortia of producers committed to enhancing chestnut cultivation, cultivation techniques and specific local varieties as well as promoting the production area. The main objective of the project was the monitoring of the carbon footprint of the chestnut grove, which involves assessing the organic carbon sequestered in soils and plants, depending on the soil environment and also on different management practices of the

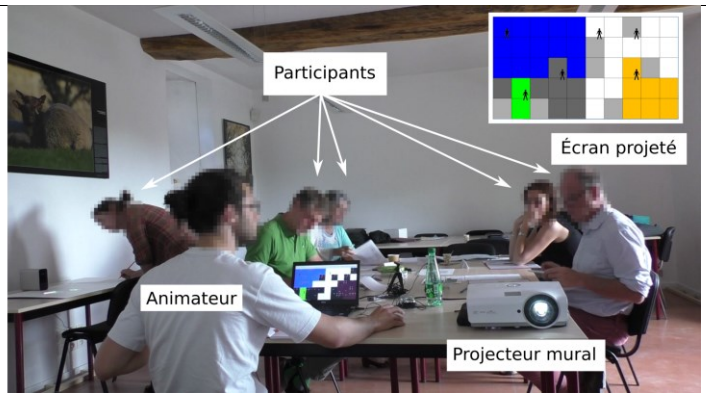
	chestnut grove. Monitoring was carried out through field observations, soil studies, sampling and chemical analyses in the chestnut groves of partner companies located in different soil environments. Finally, 'guidelines for the best management of fruit chestnut groves to obtain a quality product and favour carbon sequestration' were identified and shared.
Lessons learned (1200 characters max.)	CASTANI-CO pointed out how traditional chestnut groves, thanks to their firm soils that are never tilled, can contribute to the storage of carbon in soils and plants. The valorisation of traditional chestnut groves cannot neglect the knowledge and traditions transmitted from generation to generation, which are indispensable for the preservation of the hill and mountain landscape of Emilia Romagna. From the 'voice' of the chestnut growers, custodians of the territory, emerged the need for training activities and suitable tools to improve the management and recovery of chestnut groves, as well as processing and marketing opportunities.
Contact information	Solaria Anzilotti (solaria.anzilotti@unifi.it) Livia Antisari (livia.vittori@unibo.it)
Links to website/report/video (if applicable)	
Pictures (if applicable)	

Title of innovation	**Evaluation of the soil response of different types of pruning of chestnut tree**
ITHub	2
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	Castagni Parlanti
Operational Group (name)	New techniques for monitoring the carbon balance and the state of health of wood and fruit chestnut trees - Talking Chestnuts
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Chestnut growers, universities, regional institution
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/nuove-tecniche-di-monitoraggio-del-bilancio-del.html
Country, region, city	Italy, Emilia Romagna, Bologna Parma Modena
Type of innovation	Process
Keywords	Biodiversity, nature management, soil management, functionality, landscape, land management
Approach and main results (4000 characters max.)	The aim of the Castagni Parlanti is to assess the ecological footprint of chestnut tree recovery in the current crop year with Tree Talkers within a forest matrix, in terms of carbon fixation and sequestration in the soil-plant system, water use and soil cover, drawing concrete indications for effective and sustainable forest management for the joint production of wood and fruit. With regard to the evaluation of the soil response of different types of chestnut pruning, the Tree Talker data revealed advantages and disadvantages of the different forms of pruning proposed for chestnut restoration on small areas. In the project, three pruning methods were therefore compared (in addition to an unpruned control) of different intensity, characterised by a different impact on plant shape and vitality and a different cost of implementation: strong pruning, intermediate pruning, low pruning. Pruned plants reduce their water requirements compared to the control during almost the entire first vegetative cycle following pruning, and then align their water consumption to unpruned plants from the second year onwards. Considering that future climate change conditions foresee an intensification of prolonged drought periods, favouring pruning that has less impact on soil water status could be an adaptation strategy. Lighter pruning (light and medium pruning) ensured a higher C sequestration capacity through the canopy per unit area than more intensive pruning. However, this advantage disappeared at the end of the first vegetative cycle following pruning, in which all the plants subjected to different

	pruning intensities recovered their carbon sequestration capacity on a par with the unpruned ones, maintaining it throughout the second year. Even the most intense pruning does not seem to have compromised the health of the plant canopies, showing transmitted NDVI values that align in the second season for all treatments. The great carbon uptake that occurred in the autumn is interesting: higher temperatures in autumn stimulate photosynthetic activity and delay leaf senescence, thus expanding the useful period for carbon sequestration. The stock of organic C was calculated and normalised to the control value. The soil in which an average pruning was carried out on the chestnut.
Lessons learned (1200 characters max.)	Indicators calculated from the IoT sensor data have proven to be useful and reliable for monitoring plant health and determining the responses of chestnut trees to phenological cycles and different pruning treatments. The data analysis allowed a deeper understanding of the interaction between chestnut cultivation, forest management and the environment.
Contact information	
Links to website/report/video (if applicable)	
Pictures (if applicable)	

Title of innovation	**Participative simulation game "Foster Forest"**
ITHub	2
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	EUROFORNORM
Operational Group (name)	Creating and leading an innovative and operational network of forest areas in Normandy
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	managers, advisors, forest owners, policy-makers
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/euro-fornorm-14-50-61-emergence-et-animation-d%E2%80%99un.html
Country, region, city	France, Normandie
Type of innovation	Service
Keywords	Territorial animation, prospective, modelisation
Approach and main results (4000 characters max.)	Consultation between the various stakeholders in the five areas of Normandy that have signed a Territorial Forest Charter (CFT) has highlighted the need for coordinated action between stakeholders, as well as the need to explain what is being done in the forest. The aim of EUROFORNORM was therefore to create and run a regional network of forest areas in Normandy. "The future of Normandy's forests in the face of climate change" emerged as one of the priority themes. Foster Forest is a role-playing game, a prospective and participative simulation workshop on the evolution of the forest in the face of climate change. It was born in 2015 from the realisation that, in the face of future social, economic and climatic uncertainties, forestry research needed to involve foresters in its work. Prospective workshops would enable a cross-disciplinary approach to be taken, bringing together the visions of environmental, ecological and social sciences, based on modelling approaches. It was developed as part of his thesis by Mr Timothée FOUQUERAY (PhD student in the Ecology, Systematics and Evolution laboratory at UMR CNRS/UPS/AgroParisTech 8079). The "game" consists of taking forest management initiatives in a climate change context and being confronted with simulation results a few decades later. This indoor workshop is led by a facilitator.

	Using a digital platform, each player is given objectives and possible actions and can carry out forestry management activities (regeneration, maintenance or harvesting, as well as hunting, monitoring water quality or biodiversity, certification and/or sales, etc.). Each session includes 5 players whose roles are set out below: - A public forest manager from the French National Forestry Office (ONF), who may be a territorial unit manager, an agent in the forestry department, a planner or a forestry technician. - Two representatives of the private forest, who may be an owner, a manager or an employee of the National Centre for Forest Ownership (CNPF). - One representative of the "environment", who could be an agent from a Regional Nature Park, a conservatory, etc. - A representative of the elected representatives, who may or may not be a forest-owning local authority, a land-use planner, a regional union of forest communities, etc. After each session, a debriefing is held in two stages, with a round-table discussion of the strategies implemented by the participants in relation to the game, as well as free discussion of the elements that they could re-use in real life, the limits and the various contributions of the exercise. Each player can come up with alternatives and suggest changes to the scenarios.
Lessons learned (1200 characters max.)	The actions undertaken have encouraged the sharing of knowledge and a better understanding of the positions and expectations of the various forestry stakeholders. Players highlighted the need to listen to each other and understand the different points of view. Foster Forest tool proved its worth, with very positive feedback from participants. The debriefings highlighted the strengths such as awareness-raising among the players involved through a diversity of specialisations and positions. The discussions enable the perception of the objectives and criteria of the other players and the relevant choices to be made were debated in the context of climate change. Desires to pool technical and financial resources and to build local governance between the public and private sectors emerged. The game puts the players in a situation of uncertainty, which will become increasingly frequent as a result of climate change. Finally, the workshop provided an opportunity for players to discuss issues relating to biodiversity and climate change mitigation.
Contact information	Mrs Laure FERRIER (laure.ferrier@communesforestieres.org)
Links to website/report/video (if applicable)	

Pictures (if applicable)	 copyright : fosterforest

ITHub 2 - 10

Title of innovation	**Theatrical forest excursions**
ITHub	2
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	EUROFORNORM
Operational Group (name)	Creating and leading an innovative and operational network of forest areas in Normandy
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	managers, advisors, forest owners, policy-makers
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/euro-fornorm-14-50-61-emergence-et-animation-d%E2%80%99un.html
Country, region, city	France, Normandie
Type of innovation	Social innovation
Keywords	Territorial animation, communication
Approach and main results (4000 characters max.)	Consultation between the various players in the five areas that have signed a Forestry Territory Charter (CFT) in Normandy has highlighted the need for coordinated action between players, as well as the need to explain what is being done in the forest. The aim of EUROFORNORM was therefore to create and run a regional network of forest areas in Normandy. "The future of Normandy's forests in the face of climate change" emerged as one of the priority themes. The EUROFORNORM project has held a number of meetings in the field, with the aim of raising awareness among a wider audience of the issues associated with the consequences of climate change and the anticipated changes in the region's forests, and encouraging them to express their views, understand their expectations of the forest, and be the driving force behind proposals for the future of local forests. The operational group decided to create and organise dramatised outings followed by debates. These two-hour outings were equally divided between the theatrical performance and the debate between the participants. The theatrical performance, via a pedestrian circuit illustrating certain points with concrete visuals, made it possible to bring out certain points of view, but also to accentuate various character traits of the actors or to make the participants think through the prism of humour. The participants were then encouraged to express themselves and listen to each other, and were able to collectively highlight their points of agreement and disagreement. Two complementary models of outings, one on the

	future of hardwoods in the context of climate change and the other on the future of biodiversity, were developed and organised in 4 different areas of Normandy.
Lessons learned (1200 characters max.)	These outings provided an opportunity to discuss the impact of climate change, how climate change effects can be anticipated and how forests can be adapted, the expectations of the public and the actions and commitments they can undertake. They provided an opportunity to explain the forest of today and the current methods used to try to anticipate and mitigate climate change. These innovative meetings were very well received, with over 150 people attending and participating. These initiatives have also been the subject of regional communications through articles and reports, confirming the general public's interest in this type of subject.
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Links to website/report/video (if applicable)	https://www.collectivitesforestieres-normandie.org/ https://www.youtube.com/watch?v=1k7kGNISGp0&t=1s&ab_channel=CNPF-Centrenationaldelapropri%C3%A9t%C3%A9foresti%C3%A8re
Pictures (if applicable)	 Copyright : URCOFOR

ITHub 2 - 11

Title of innovation	**UAV and multispectral camera to map stressed forest area**
ITHub	2
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-SURF
Operational Group (name)	DECISION SUPPORT TO SUSTAINABLE FOREST PLANNING
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company, NGOs, research institutions, advisor
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/supporto-decisionale-alla-pianificazione-forestale.html
Country, region, city	Italy, Tuscany
Type of innovation	Technological innovation
Keywords	Forestry, Remote Sensing data, digital platform,Decisional Support System, wood mobilization
Approach and main results (4000 characters max.)	In the context of precision forestry, and to monitor potential issues related to stress on a per-tree basis for forest managers, it is necessary to employ tools capable of rapidly mapping this information in order to implement adaptive silvicultural practices. Within the GO-SURF project, conducted in forests directly managed by the operational group partners, the use of drones equipped with multispectral cameras (Micasense) was tested and implemented to map stressed areas. The use of the drone, equipped with automatic flight capabilities, allowed for the creation of high-resolution multi-temporal orthophotos and the identification of areas where a reduction in photosynthetic activity was observed. The multispectral cameras and the use of this data have allowed for the prompt identification during GO-SURF of stressed areas, primarily caused by oak forests. In this context, it was possible to monitor these areas affected by prolonged periods of drought. Monitoring with the use of drones allows for the observation of the development of these stresses and the impacts they have on the forests. Moreover the camera permits to identified not-stressed plant that can be assumed as more resilient.
Lessons learned (1200 characters max.)	The forest managers have highlighted the ease of using drones, even though the multispectral cameras used in the project are quite expensive. Further tests with lower-cost cameras are, therefore, necessary. However, the prompt observation of stress can enable the implementation of silvicultural strategies to mitigate the problem. Furthermore, from the analysis of stress at the individual plant level, it is possible to

	identify the more resilient plants that could be selected as seed plants to produce seedlings for future reforestation efforts
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 2 - 12

Title of innovation	**Educational module 'foresters, it's your turn to play"**
ITHub	2
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	EUROFORNORM
Operational Group (name)	Creating and leading an innovative and operational network of forest areas in Normandy
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	managers, advisors, forest owners, policy-makers
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/euro-fornorm-14-50-61-emergence-et-animation-d%E2%80%99un.html
Country, region, city	France, Normandie
Type of innovation	Social innovation
Keywords	territorial animation, formation
Approach and main results (4000 characters max.)	Consultation between the various players in the five areas that have signed a Forestry Territory Charter (CFT) in Normandy has highlighted the need for coordinated action between players, as well as the need to explain what is being done in the forest. The aim of EUROFORNORM was therefore to create and run a regional network of forest areas in Normandy. "The future of Normandy's forests in the face of climate change" emerged as one of the priority themes. "Forestiers, à vous de jouer" is an educational tool, in the form of a game, specifically on the theme of climate change in forests. It is aimed principally for primary school classes (cycle 3), with a number of players ranging from two to six. The aim is to manage the Normandy forest in the best possible way to protect it from the impacts of climate change. "Forestiers, à vous de jouer" is a board game in which the players have to reach the "Arrival" square by choosing the path of their choice and answering questions on 10 forestry themes. To promote this innovative tool, a copy of the module was given to 200 schools in the 5 departments of Normandy. This tool was designed with the aim of developing an educational resource that could complement other initiatives in the region, such as the "1000 communes, la forêt fait école" programme, developed by the National Federation of Forest Communities, which aims to entrust primary school children with the management of a plot of communal forest in order to raise their awareness of the forest as a central element of their region.

Lessons learned (1200 characters max.)	One of the aims of creating this educational module for schools in the form of a game was to raise young people's awareness of forest management and the changes that can be expected in the face of climate change. Feedback from teachers who have used the game has been very positive, both in terms of the fun aspect of the game, which captures the attention of pupils, and in terms of the rich content of the topics covered. Teachers can integrate the various concepts into their own curriculum. In this way, pupils can learn about forest management and how Normandy's forests are adapting to climate change.
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Links to website/report/video (if applicable)	https://www.collectivitesforestieres-normandie.org/ https://www.youtube.com/watch?v=1k7kGNISGp0&t=1s&ab_channel=CNPF-Centrenationaldelapropri%C3%A9t%C3%A9foresti%C3%A8re
Pictures (if applicable)	 copyright : URCOFOR

ITHub 2 - 13

Title of innovation	**Douglas fir in the face of climate change in Burgundy region**
ITHub	2
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	OG Douglas
Operational Group (name)	OG Douglas : Climate Change, what future for douglas fir in Burgundy?
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/changement-climatique-quel-avenir-pour-le-douglas.html
Country, region, city	France, Bourgogne - Franche Comté
Type of innovation	Process
Keywords	Forestry, Adaptation to climate change, new planting system, sustainable forest management
Approach and main results (4000 characters max.)	In Burgundy, Douglas fir occupies 8% of the forested area (68,000 ha) and supplies the French and European sectors. Its growth rate and the quality of its wood make it a very productive species (up to more than 20m3 of wood per hectare per year) and sought after. However, the successive heatwaves of recent years (2003, 2005, 2018, 2019, etc.) combined with a water deficit have caused sometimes significant dieback in the stands. These observations have encouraged foresters to begin thinking about the sustainability of the sector's supply and the modalities by which the Burgundian territory can be favorable to the continuation of Douglas fir silviculture. From the establishment of a network of 90 reference forest plots in private forests, representative of the diversity of climates, soils, altitudes, etc. The partners intended more specifically to: • Identify the resilience of Douglas stands in a context of climate change using the ARCHI method. • Establish suitable sylvicultural itinerary for Douglas fir in the context of mixed plantings or plantings of replacement species, based on Potential Biodiversity Index (IBP) measurements. • Help private forest owners in their silvicultural choices using the BioClimSol application.

	• Evaluate the carbon stock of a Douglas stand based on its silvicultural itinerary. • Evaluate sustainability for soils under Douglas fir stands. Work analyzing the risks to which Douglas plantations are exposed has notably resulted in a modeling of the risk of Douglas fir dieback due to climate change as well as the production of climate vigilance maps. Intended for decision-makers and planners, these provide an overall idea of the future distribution area of Douglas-fir in Burgundy-Franche-Comté if global warming continues with the same intensity. Finally, an analysis of failed plantings and natural regenerations as well as planting experiments - mixed with other species or with new varieties of Douglas fir - were carried out. Summarized in a synthesis of actions, the results were transferred to Douglas foresters, landowners and forest managers and professionals in the sector through training days, technical sheets and guides including one on the use of the ARCHI method applied to the Douglas.
Lessons learned (1200 characters max.)	From an exhaustive network of reference populations of Douglas fir in Burgundy-Franche-Comté, the project made it possible to collect stationary, dendrometric, ecological and health data which improve knowledge of Douglas fir as well as to launch experiments in order to adapt this important production for the regional wood industry. The studies encourage foresters to mix Douglas-fir provenances and thus diversify the genetic potential, and to use the California provenance under certain conditions, particularly with its potential capacity to withstand high heat. Douglas fir monoculture seems to promote nitrification in the soil, and contributes to the increase in nitrate levels in surface waters. It would be recommended to diversify Douglas fir plantations in full and to have a mixed approach at the scale of small watersheds. Finally, the study made it possible to validate numerous silvicultural concepts indicating that the increase in forest biodiversity and carbon stock in forest soils is favorable to the adaptability of Douglas fir in the face of climate change.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 2 - 14

Title of innovation	**Assisted tree migration : 70 islands of trees of the future**
ITHub	2
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	OG Futur Forest
Operational Group (name)	FuturForest : Adaptation of forests of Grand Est Region to climate change
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners, researchers, advisors
Link from OGs database	https://www.reseaurural.fr/centre-de-ressources/projets/futurforest
Country, region, city	France, Grand Est
Type of innovation	Process
Keywords	Forestry, climate and climate change, genetic resources, adaptation to climate change
Approach and main results (4000 characters max.)	For several years, foresters in the Grand Est region have been witnessing the decline of massifs due to repeated droughts (2018, 2019, 2020 and 2022), heatwaves and other insect attacks (bark beetles or processionary caterpillars). This high mortality affects the main species of the region: spruce, fir, beech and oak. It has now been shown that the climate is changing so quickly that species do not have time to migrate to avoid contexts that become unfavorable for them. Faced with this observation, even if we can hope for a natural adaptation of forests, doing nothing constitutes a significant risk for the forest ecosystem as well as for wood production. To counter, or at least mitigate, as best as possible these mass diebacks, one of the responses consists of setting up islands of the future, controlled experiments allowing the testing of non-native tree species on plots of 0.5 to 2 hectares. OG FuturForEst tested ten new species more adapted to climate change via the creation of a network of 70 islands of the future: 2-hectare plots spread over public and private forests. Five hardwoods (Hungarian oak, downy oak, swamp oak, Byzantium hazel, American sweetgum) and five softwoods (evergreen redwood, Macedonian pine, Calocèdre, Cilicia fir, Arizona cypress) were selected for their potential for tolerance to current climate and adaptation to future climatic conditions, as well as for their ability to produce quality timber.

	A preliminary survey made it possible to identify and characterize 75 plots (exposure, altitude, pedology) with public and private forest owners. The surface area of the devices is between 1 and 2 hectares with a relatively homogeneous station on the island and the planting work took place from November 2020 to January 2023. Identical on all the plots, the preparation of the land consists of: entire grinding of spontaneous vegetation, prior fencing of the plot and the creation of manual pots when placing the plants in pots (2,000 plants/ha). A guide for the maintenance and monitoring of the devices has also been written to guide owners and managers in monitoring the plantation over the first years. This OG was also part of the ESPERENSE research project led by the national AFORCE network (www.reseau-aforce.fr) for the adaptation of forests to climate change, integrating rigorous protocols and banking on the pooling of knowledge to initiate a network of multi-partner experiments . This project aimed to improve knowledge of the behavior of new species and provenances in different forest station contexts.
Lessons learned (1200 characters max.)	The creation of this network of more than 70 islands now makes it possible to test in the long term new species in varied station conditions observe their response to climate change in the Grand Est region. From these experiments, details are expected on suitable silvicultural routes, as well as on the compatibility of species with forest stations. The project also strengthened collaboration between the different managers and allowed all the players in the sector to organize themselves to achieve the production of plants of new species: seed supply sector, processing of batches of seeds, production in the nursery, etc. We can note the supply difficulties (problem of fruiting or geopolitical context) of seeds and plants of the species selected and originating from the Mediterranean basin, central Europe or the United States. The creation of the GO in two phases - emergence then development - made it possible to take the time necessary to establish the partnership and define the common problem among different Franco-Belgian forest management organizations, both public and private, in the service of developing forestry knowledge.
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Links to website/report/video (if applicable)	https://www.youtube.com/watch?v=XYfrtugjksI
Pictures (if applicable)	

ITHub 2 - 15

Title of innovation	**Course on GIS and Remote Sensing Data to monitor forest ecosystem**
ITHub	2
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-SURF
Operational Group (name)	DECISION SUPPORT TO SUSTAINABLE FOREST PLANNING
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company, NGOs, research institutions, advisor
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/supporto-decisionale-alla-pianificazione-forestale.html
Country, region, city	Italy, Tuscany
Type of innovation	Service
Keywords	Forestry, Remote Sensing data, digital platform,Decisional Support System, wood mobilization
Approach and main results (4000 characters max.)	To monitor stress and the impacts of climate change on forests, there is a need to enhance the technical analysis skills of individuals involved in sustainable forest management. In recent years, various tools like Sentinel-2 satellite imagery have allowed for almost continuous monitoring of such stress. However, technological progress has not led to a real change because many technicians do not know how to use analysis tools, even simple ones. In this context, within the GO-SURF project, it was decided to organize a tailored 24-hour course to teach forest management technicians how to use these tools and the related GIS (Geographic Information System) tools for analysis. The course has been highly successful with over 50 participants enrolled. The course was structured with practical exercises conducted in classroom settings tailored to the forestry sector. In particular, the Google Earth Engine analysis platform and data easily implementable into the QGIS system were used. This enabled the transfer of analytical capabilities to the technicians who attended the course, many of whom had no prior knowledge of the potential of these tools.
Lessons learned (1200 characters max.)	The technicians emphasized that courses of this kind are crucial, especially in a forestry context. The strength of the course lay in its practical aspect, with exercises specifically designed to address forestry-related scenarios

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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 2 - 16

Title of innovation	**Evaluation of different microclimatic conditions in a linear planting with rows of hybrid biomass poplars combined with maize**
ITHub	2
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	NEWTON
Operational Group (name)	Agroforestry Network in Tuscany
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farms, research groups, communication company, national forest certification systems (PEFC)
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/network-l%E2%80%99agroselvicoltura-toscana-newton.html
Country, region, city	Italy, Tuscany
Type of innovation	Process
Keywords	Agricultural production system, Farming practice, Climate and climate change, Agroforestry, sustainability
Approach and main results (4000 characters max.)	Linear planting with rows of hybrid biomass poplar trees associated with maize was used to evaluate the effect of microclimatic conditions on the crop's water status and production. The results show that the two poplar rows reduce wind speed by up to 50-70% and that the height of the trees at the end of the shift has a shading effect on approximately one third of the inter-row area. This is the major limiting factor for the crop, but the degree of competition for water also varies within the inter-row, as the presence of the rows changes evapotranspiration: soil moisture is higher in the central part of the inter-row. If on the one hand shading allows the water status to recover, on the other hand it negatively affects production; when compared to the production of the central part of the plot (the least shaded) the decrease in production is more than 25% . The situation is different when compared to the control in 2022, a year characterised by excessive drought: the presence of the rows of trees (and presumably the positive effect on evapotranspiration) makes a difference of 54% when compared to the control.

Lessons learned (1200 characters max.)	Since drought is becoming a more limiting factor in agriculture, there's the need to improve research looking for innovative and traditional solutions. Agroforestry approach is very important in order to mitigate climate change and make ecosystems more resilient to changing conditions.
Contact information	
Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 2 - 17

Title of innovation	Application of SlideforMap for the hydrological risk assessment in sustainable managed forests
ITHub	2
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	BIOSEIFORTE
Operational Group (name)	BIOdiversity and Ecosystem Services in Forests and Territory
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forestry doctors, researchers, doctors in natural sciences, biologists, environmental engineers , Forestry and Agriculture Societies (SAF), Category Associations, Consortiums of local companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/biodiversita-e-servizi-ecosistemici-foreste-e-territorio
Country, region, city	Marche, Italy
Type of innovation	Technological innovation
Keywords	digital tools, multifunctional forest management, water management
Approach and main results (4000 characters max.)	Forests are vital in protecting property and people against hydrogeological slope failure. From this perspective, the importance of forest management is crucial, given the increase in the frequency of extreme rainfall events driven by climate change. Knowing a priori the susceptibility of an area to rainfall-induced shallow landslides is, therefore, a pivotal point in avoiding or limiting environmental and social damage. SlideforMAP is a probabilistic model created by the International Association of Natural Hazard Risk Management, called ecorisQ (ecorisq.org). Its application allows for assessing the probability of shallow landslides triggering on a regional scale, considering the structure and composition of forests as input data in the process. Through the calculation of root reinforcement, both at the scale of individual trees and forest stands, it provides valuable decision support in the planning and managing direct protection forests. In the BIOSEIFORTE project, this model was applied to evaluate how land cover changes over the years have affected slope stability in the Mt. Nerone area and also to assess the effectiveness of the current land cover condition in case of extreme rainfall events. The stability analysis highlighted the central role of forests in warranting slope stability through the contribution of trees root reinforcement. In particular, increased forest cover surface has remarkably stabilized landslide susceptible areas, reducing the impact of hazardous events. The stability analysis through SlideforMAP allowed to detect areas where geo-environmental factors (e.g. morphology and soil properties) are preeminent, like those

	near urban settlements and infrastructures, becoming a potential risk and requiring more careful monitoring.
Lessons learned (1200 characters max.)	Analyzing and quantifying the forest contribution to slope stability is essential in research and practical applications. Knowing the probability of rainfall-induced shallow landslides at a regional scale can help to understand how environmental factors variability can influence such dynamics. Using slope stability models such as SlideforMAP is essential for guiding land use planning and providing quantitative information about the stability conditions of an area. Nonetheless, for even better outputs, more detailed information is necessary, including accurate resolutions of digital terrain and surface models, not always easy to obtain from regional and national databases.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 2 - 18

Title of innovation	**Management manual for stone pine**
ITHub	2
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO PINEA
Operational Group (name)	Improvements and innovation in the production of national pine nut
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	2 organizations representing private forest owners, two technology centres and a research institute, a pine nut producers' cooperative and a private forestry company.
Link from OGs database	Mejoras e innovación en la producción de piñón nacional. | EIP-AGRI (europa.eu)
Country, region, city	Spain, Castilla y Leon y Cataluña
Type of innovation	Service
Keywords	Farming/Forestry competitiveness and diversification, Climate and climate change, Pest/disease control, Adaptation to climate change, Decisional Support System, Non-wood forest product, Multifunctional forest management
Approach and main results (4000 characters max.)	The management of stone pine forests faces important challenges and threats, many of them interrelated and derived from past, present and future climate and socio-economic change. One of the main factors is water restriction due to changes in climatic patterns and due to densification and competition in vegetation, despite the fact that stone pine is a xeromediterranean species. Associated with this, vulnerability to high intensity forest fires is an increasingly relevant factor, despite the natural resistance of the species to surface fires. Finally, pests are the factor that completes the front line of the challenges to be faced with forest management. The direct affectation by Leptoglossus occidentalis is a major problem, but other pests and diseases of great potential that affect these pine forests in a primary or secondary way are also important. **The forest management proposed in this manual aims** to tackle these adversities in an integrated way by improving stand conditions. The regulation of inter- and intraspecific competition, also taking into account the conformation of the forest structure, means an optimisation of the available resources in the most vital individuals and a limitation of the load and continuity of fuel for fires. Integrated biological pest control also requires these management actions that favour tree vitality. However, management must be complemented by other measures established at landscape scale to complement

	mitigation and adaptation actions, such as prevention of large forest fires through strategic management points and integrated pest management at regional level. **The objective of this Management Manual** is to establish management guidelines for *Pinus pinea* stands against biotic threats and for adaptation to climate change, a strategic planning framework for the management of stone pine with the preferential objective of pine nut production. The aim is to provide forest management guidelines both for natural stands and plantations already in production and for the production of other stands with suitable conditions, with the objective of maintaining and improving pine nut production and contributing to the development of its value chain. **Specific objectives:** (1) To define the main characteristics of the types of stone pine stands considered suitable for pineapple production. (2) To establish the general management bases to be implemented in each case in order to optimise pine cone production, taking into account the multifunctionality of the forests. (3) To quantify the estimated production that could be obtained with the implementation of production as described. In order to define the strategic lines of management for pine cone production, and taking into account the surface area considered suitable, **3 typologies of pine cone stands and plantations are defined.** These typologies group together the main situations where this type of management can be considered. In the case of **Productive Plantations**, the following three phases are described: ● Choice and preparation of the land ● Choice of the base material: planting ● Maintenance work. In the case of **natural stands**, there are two types of natural stands. On the one hand, we have mixed natural stands, where stone pine is dominant with a basal area of 50% and 60%. On the other hand, we have pure natural stands, where stone pine is dominant with more than 80% of the basal area. The treatments described for this typology include mixed thinning, resprout selection and scrub control. Finally, **other plantations** refer to those plantations that were originally planted with the objective of producing *Pinus pinea* timber and therefore have a plantation framework and silvicultural treatments focused on this objective have been carried out. The treatments described for this typology include mixed thinning, pruning and phytosanitary treatments. This manual has a didactic and introductory function to inform about the management of stone pine stands, whether they come from plantations or natural stands. Each stand has particular conditions in which its management will depend on the objective of the stand and its conditioning factors, so it is advisable to contact forestry engineers who are experts in stone pine silviculture so that they can carry out a study and/or advice for the specific case of the stand in question.
Lessons learned (1200 characters max.)	There is a positive effect of pruning on growth and production of female strobiles. - Pruning improves the health of the stand, reducing the presence of the fungus Diplodia pinea. - The response of the trees to pruning has been very rapid, with a clear improvement in vegetative and productive response from the first year. However, it is not yet possible to give results on the effect of thinning. This works is a first step to assess in a quantifiable way the interest of recovering production in non-/poorly managed P. pinea plantations. The work will have to be continued for at least two more seasons.
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Links to website/report/video (if applicable)	https://gopinea.org/wp-content/uploads/2023/03/Manual-de-gestion-del-pino-pinonero-OK.pdf
Pictures (if applicable)	

ITHub 2 - 19

Title of innovation	**Reducing Input in Forest Operations: A Valuable Opportunity for Carbon Credit Generation**
ITHub	2
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	CO2 S.Fo.Ma. MARCHE
Operational Group (name)	CO2 STORED in FOREST MANAGEMENT MARCHE
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forestry doctors, researchers, doctors in natural sciences, biologists, environmental engineers , Forestry and Agriculture Societies (SAF), Category Associations, Consortiums of local companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/calcolo-e-certificazione-del-sequestro-del-carbonio
Country, region, city	Marche, Italy
Type of innovation	Process
Keywords	Energy management, Farming equipment and machinery, LCA, Sustainable Forest Management
Approach and main results (4000 characters max.)	"Forest carbon credit additionality projects are initiatives aimed at generating carbon credits through sustainable forest management and conservation activities. These carbon credits are then used in carbon markets to offset greenhouse gas emissions from companies or individuals. Typically, these projects focus on sustainable forest management practices that enhance carbon sequestration within forests, known as "additionality," achieved through activities like silviculture treatments that differ from previous management practises (e.g. conversion between coppices to high forest, enlarging the cut periods, fire-preventions). In the context of carbon emissions, it is not only essential to create additionality projects but also to reduce emissions. Forest operations can contribute to emissions and pollution, even in the context of additionality carbon credit projects. Therefore, employing a "Life Cycle Assessment (LCA)," a systematic and comprehensive methodology used to evaluate the environmental impact of processes, becomes crucial. This assessment helps evaluate the environmental sustainability of forest operations, compare them to the "business as usual (BAU)" scenario, and identify opportunities to reduce emissions. This, in turn, enhances the effectiveness of additionality projects in generating more carbon credits. Within the context of the CO2MARCHE OG as an additionality project for carbon credit generation, a methodology has been created to quantify the reduction of energetic inputs

	in forest operations to generate additional carbon credits. Through this analysis, electric chainsaws and the use of alkylated gasoline have been identified as means to reduce emissions from forest operations when compared to traditional gasoline-powered equipment. In this context, it is also possible to calculate the additionality produced by more sustainable forest operations, leading to the creation of more additionality credits compared to traditional forest operations carried out with traditional gasoline or chainsaws. In this context, CO2MARCHE works within the framwork of Sustainible Forest Management certification under the PEFC standard to set-up the methodology to quantify the additionality carbon credit generate by reduction emission of forest operations via a rigorous LCA that contrasts the BAU scenario with the new, more sustainable tools. Ultimately, if forest operations demonstrate greater sustainability in terms of emissions, forest owners and forest operation companies can generate more carbon credits, resulting in increased revenue. This revenue can not only cover equipment costs but also have a positive impact on the environment as a whole.
Lessons learned (1200 characters max.)	To combat climate change, it is essential to reduce emissions, and within the context of an operational group dealing with CO2 and carbon credits in the forestry sector, it has proven to be of paramount importance to also strive to reduce emissions stemming from forestry operations. Through the use of the Life Cycle Assessment (LCA) approach, it is possible to calculate the Business As Usual (BAU) for forestry activities and promote the use of machinery or fuels with a lower environmental impact. This is crucial, especially in the context of climate change mitigation, to lower greenhouse gas emissions. Besides providing an environmental benefit, this can also lead to the generation of more credits in an additionality project, potentially resulting in greater financial gain as the generated credits are greater.
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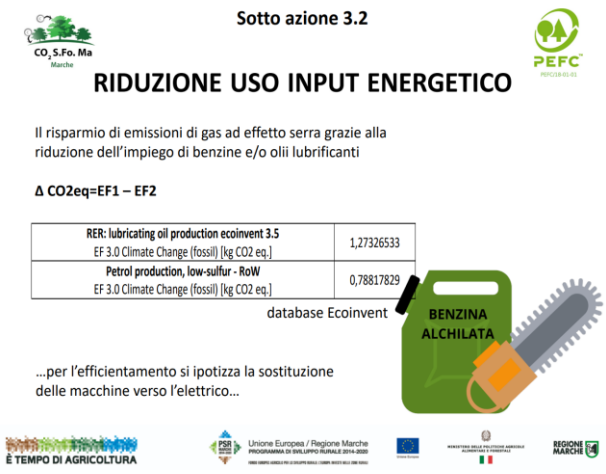
Links to website/report/video (if applicable)	https://www.co2marche.it/
Pictures (if applicable)	

ITHub 2 - 20

Title of innovation	**Cause of the decline of cork oak forests and management strategies**
ITHub	2
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO GEOSUBER
Operational Group (name)	Operational group for Monitoring oak tree forest
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	2 forest owners associations, 4 forest owners, 4 companies related to cork production, 2 universities and 2 entities related to research and development
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/geo-suber-monitoriza%C3%A7%C3%A3o-do-montado.html
Country, region, city	Portugal
Type of innovation	Process
Keywords	Climate and climate change; Forestry; Adaptation to climate change; Non-wood forest product
Approach and main results (4000 characters max.)	The cork oak stands when managed as an agro-forest-pastoral stand creates an ecosystem called “Montado” (Portuguese)/ “Dehesa” (Spanish). This ecosystem allows the creations of different products (timber, livestock, cork, …) and services (carbon sink, biodiversity, water regulation, …). For these reasons this ecosystem as a major impact in the national landscape, environment and economics. In the last decade the geographic distribution of this species has been changing, and the density of the current stands has been declining because the decrease in vitality/increase in mortality and the low success rate of the natural regeneration and the young plantations. The three main reasons are climate change, pests and diseases, and bad management practices. They don’t act alone but in an interconnected way since their effects influence each other. In relation to climate change, the current scenario is characterized by higher temperatures all year round, less precipitation with higher periodicity and in events of higher amount of rain. These factors have as consequences the tree growth starting earlier in the year but also finishing earlier, forest fires are becoming more common, and drought events are becoming more common and intense. In relation to pests and diseases, the increase in their severity is related to better climatic conditions for their growth and reproduction and the more and more common monospecific forests lead to more vulnerable stands. Most of times pests and diseases do not kill the tree, but when in

	conjugation with other factors, such as droughts, it may. In relation to the bad management practices, it is usually the associated with the mobilization of the soil, since ploughing breaks the superficial tree roots (most of the water and nutrient caption is done by them) and contribute to the dispersion of fungi spores, the compaction of the soil, done by the machines and excessive cattle, creates difficult condition for root development, the presence of livestock also decreases natural regeneration and their success, the lack of under story vegetation control may create excessive competition between the trees and other plants, however the lack of under story vegetation may also impact the natural regeneration, since they create better climatic condition (shade, lower soil temperatures) for the growth of young plants. As a solution for this problem two school of thought may be used but remember they should be viewed as a spectrum and not two isolated options. Resilience measures aims to increase the resistance and recovery potential of already established stands to the new climate and natural disturbances. Allowing the ecosystem to endure and keep their characteristics. In the transition school of thought the objective the creating of a new ecosystem more adapted to the foreseen condition that are the result of the climate change scenarios. Three main objectives that should be targeted when creating and applying forest policies and management operations to fight the decline of vitality in cork oak stands. The objectives are: Maintaining the fundamental ecologic functions; Maintaining and improving the genetic diversity; Improving the ecosystem fitness by mixing and transitioning to new species. To achieve the first objective management practices should aim to decrease the effect of droughts, reduce the impact of the operations and the climate change in the soil and in the nutrient cycle. To improve and maintain the genetic diversity, the promotion of natural regeneration will allow the growth of plants more adapted to the site, however given the current climate change, plants from different spots, with the genetic potential to resist more severe conditions, may be more adapted. The ecosystem fitness can be improved by mixing new species in the stand that are more resistant to harsher conditions (higher temperatures, less precipitation) or use the available resources in a different way than the current tree species.
Lessons learned (1200 characters max.)	The management practices that are suggested to fight the decline of cork oak stands are: The reduction of stand density, when the competition between trees is a limiting factor; The promotion of the stand heterogeneity in terms of structure/age and species, allowing the formation a more resistant stand; The control of spontaneous vegetation using methods that don't mobilize the soil, allows a decrease in competition and don't reduce the quality of the soil; The monitoring and correction of the soil pH and nutrients increases the quantity and availability of nutrients to the plants, allowing them to be more vigorous; The correct number of live stoke animals per area or even their exclusion for a period of time in some plots will lead to an increase in natural regeneration success rate. The study of cork oak growth and survivability from different regions and countries is of extreme importance. When more knowledge about this topic becomes available better and more informed choices can be made about what plants/seeds should be used for a certain plot.

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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 2 - 21

Title of innovation	**Geosuber Tool - Monitorization of the vitality of cork oak stands**
ITHub	2
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO GEOSUBER
Operational Group (name)	Operational group for Monitoring oak tree forest
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	2 forest owners associations, 4 forest owners, 4 companies related to cork production, 2 universities and 2 entities related to research and development
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/geo-suber-monitoriza%C3%A7%C3%A3o-do-montado.html
Country, region, city	Portugal
Type of innovation	Technological innovation
Keywords	Climate and climate change; Forestry; Adaptation to climate change; Non-wood forest product
Approach and main results (4000 characters max.)	One of the objectives of this project was the development of an online tool to identify the dead cork oak trees inside a stand. This tool would use satellite images to identify the dead trees annually, efficiently and accurately, at the property scale, producing cartography that can be used as support for the bureaucratic procedure necessary to fill when cork oak trees are going to be cut (the bureaucratic procedure exist because cork oaks are a national protected tree in Portugal). This tool is also projected to have a mobile application/app, allowing it to be easily used in the field. As a secondary objective this tool would allow the collection of vast amounts of data that can be analysed to better understand the decrease of vitality of cork oak stands at different geographical scales. Besides detecting mortality, the project also tried to understand the relation between the change of leaves in the tree canopy and the ideal timing to start debarking, which is when the cork cambium/phellogen starts its activity. In theory the activity should start at the same time as the secondary growth of the tree, however it is very difficult to accepted this as a fact since no technic allows the measurement of the cork growth without also measuring the growth of wood. For the sake of this experiment and the discussion of the results it was hypothesised that the wood cambium/vascular cambium starts the activity at the same time as the cork cambium.

	For the creation of the previously mentioned tool 1 field visit was done to install the continuously measured plots, 24 flights with drones using a multispectral image capturing device were done between 2018 and 2020, and 12 multispectral satellite images from Sentinel-2A and Pleides-1A were analysed. In the plots installed it was quantified, besides the measurements of the trees and the characterization of the plot, variables related to the tree phenological state, such as dead fallen leaves biomass and cork humidity. The data collected was analysed, corrected and different vegetation indexes were created. The data and indexes, plus climatic data, was fitted into different models, possible correlations were analysed and the adjustment of the models was done by verifying their predictions in the field. The results show that the blossoming of new leaves is controlled by the sum of time in which the temperature is above a certain base value. It was proven that the secondary growth of the tree started with the blossoming of the new leaves. By this statement and what was told above we can hypothesise that the cork cambium also starts the activity at the same time. The availability of water is the factor that determines the duration of time in which secondary growth is active. The model created to detect the vitality trees, analysed multispectral images creating vegetation indexes, allowing the detection of dead trees with an accuracy between 85% to 70% (best and worst result in the plots used), however it was demonstrated that the model needs to be fitted to each study area, so a "correction" plot needs to be installed wherever the model is used. From the two time periods that the data was collected (Spring and Autumn), the model differentiated between healthy and unhealthy trees with more accuracy in the period of September to October. The accuracy of the model is affected by the existence of saplings/small trees, because they are miscategorised. This model allowed the tool to differentiate between healthy trees, dead/sick trees, and suspicious trees (maybe dead/sick trees), producing a report and cartography that is delivered to the forest owner.
Lessons learned (1200 characters max.)	Typically forest management is done by plots, with the same characteristics and applied operations. A new management approach, with a more adapted scale in relation to space and time is needed to face the new challenges that are coming with the climate change. By continuously monitoring the trees of a stand, using resources such as LIDAR, Drones and satellite images it is possible to know the vitality state of each individual in a stand, in this way creating a tool that allows the detection of less vigour trees, that can be cause for example by pest and diseases or water deficits, and even detecting the trees that are dead. The tool created by this project is going to allow forest owners and forest workers to have an up to date knowledge about the state of vitality of their property, being able to quickly identify the location of dead trees. This tool has a huge potential in Portugal, since identifying the location of dead cork oak trees is necessary to fill the paper needed to cut dead cork oak trees. In the future, it is of most importance that this tool continues to develop and leaves its prototype stage, for it to be able to be used in the "real world.
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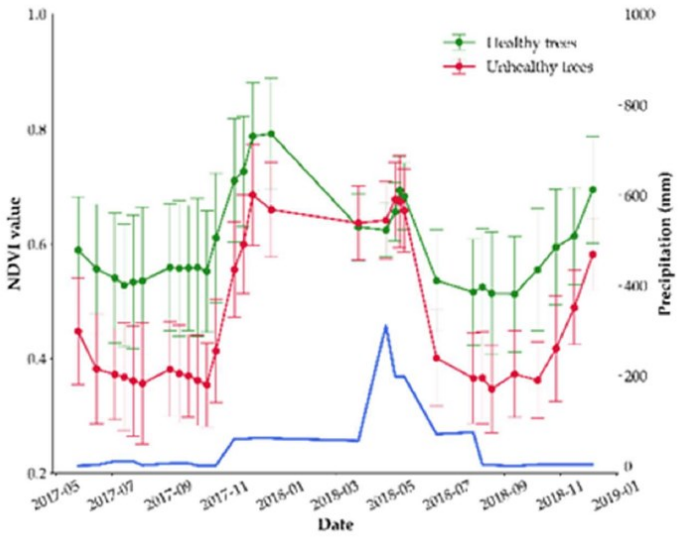
Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 2 - 22

Title of innovation	**Precision fertilization of Cork Oak (Quercus suber L.) in intensive cork production stands.**
ITHub	2
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO REGACORK
Operational Group (name)	Operative Group for precision irrigation of Cork Oak in intensive cork production stands.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Five companies related to cork production and transformation, two universities, six forest owners and five research and development companies.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/rega-de-precis%C3%A3o-de-sobreiros-em-modo-de-produ%C3%A7%C3%A3o.html
Country, region, city	Portugal
Type of innovation	Process
Keywords	Non-wood forest product; Fertilisation and nutrients management; Water management; Precision Forestry
Approach and main results (4000 characters max.)	This project had as an objective the study of irrigation and fertilization in young and old Cork Oak stands, to decrease mortality in new plantations, and increase the vitality, growth and cork production of the trees. Using the least amount of water and fertilizer in function of the site and stand characteristics. In the case of new plantation, irrigation should only be done where water is easily available. If necessary, a ripper can be used to break deep impermeable soil layer, using one tooth until one meter of depth. The density of the plantation should be between 625 trees/ha (4m x 4m) and 1111 trees/ha (3m x 3m). The installation of the irrigation system should be done before the plantation. The plants used should be grown in container deeper than 20cm and should be planted with a maximum of 1 year old. The irrigation and fertilization can be used for at least 15 years, so it is recommended the use of durable materials. Quality materials may be more expensive, but they will decrease the maintenance costs. Drip irrigation is recommended because it is the most efficient method of irrigation. The irrigation can be superficial, optimal in the first years and when the soil is sandy, or it can be underground, more expensive to install but there is no waste of water to evaporation and makes easier the operations of spontaneous vegetations

	control. Underground systems should be buried at 40 cm of depth, and between 30 to 60 cm way from the plantation line. The water flow of the emitters should be 2 L/hour, in the cases that the soil composition is very sandy the flow should be 4 L/hour. Until the subjects reach 5 years old, the water used should be between 20 and 45 m3/ha/week, after that age it should be between 45 and 90 m3/ha/week. The frequency of the irrigation should be between 3 and 4 times a week, in the initial phase it can be applied more frequently in smaller periods of time. The frequency should increase with the percentage of sand in the soil. After the first couple of years the frequency of irrigation should decrease, as an incentive to grow the radicular system. The period in which irrigation should be applied is normally 16 weeks, the summer months, but it can also be applied during the spring, when the precipitation is lower than usual, or it is the first year of the plantation. It is suggested the installation of a monitoring system, continuously sampling the field in different points with a soil moisture profile probe. In general, sandy soils should have higher than 6% relative humidity and clayish soils should have higher than 25% relative humidity. The fertilization should be done closer to the end of the irrigation, as it decreases the leaching of the nutrients, finishing the irrigation with only water for about ten minutes to clean the irrigation pipes. Until the tree reaches 5 years it should be applied 2kg of N/ha in each irrigation. The operations of spontaneous vegetation control should never be done by moving the soil layers. The pruning operation should be done annually and from early ages because the fertigation will increase the growth rate of the plants. The pruning objective is to create trees with a single straight trunk increasing the profitability of the tree cork extraction. The cork produced by the stand submitted to fertigation, is thicker, has higher porosity, and thinner cell walls. However, after processing the cork, it has very similar technological properties when compared to the control samples.
Lessons learned (1200 characters max.)	In plantations the selection of the plants is of extreme importance, never using plants older than 1 year and their root should be well developed. The plantations should only be done after the irrigation system is already in place. The dripping system can be with fix or attachable emitters. Fixed emitters normally are less prone to leak and have less space between them than the distance between the trees, which can lead to an initial waste of water but as the trees develop their radicular system horizontally it will be advantageous to not only irrigate near the tree trunk. For this reason, it is advisable to use fixed emitters. The subjects irrigated when compared to the control subjects have a 12% increased diameter growth in the period which they were irrigated. In the case of sandy soils, the efficiency of irrigation is linked to the frequency and not to the quantity of water used. The irrigation allowed the debark, of some subjects, for the first time in only 8 years after their plantation, which shorter than the normal 12 years. The properties of cork produced by irrigated trees are different from the control, however after processing the cork it has similar characteristics.
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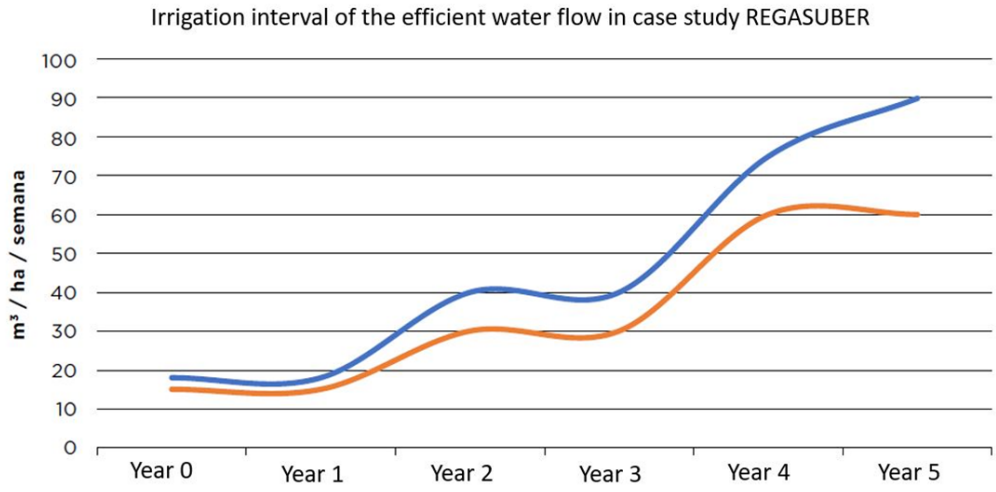
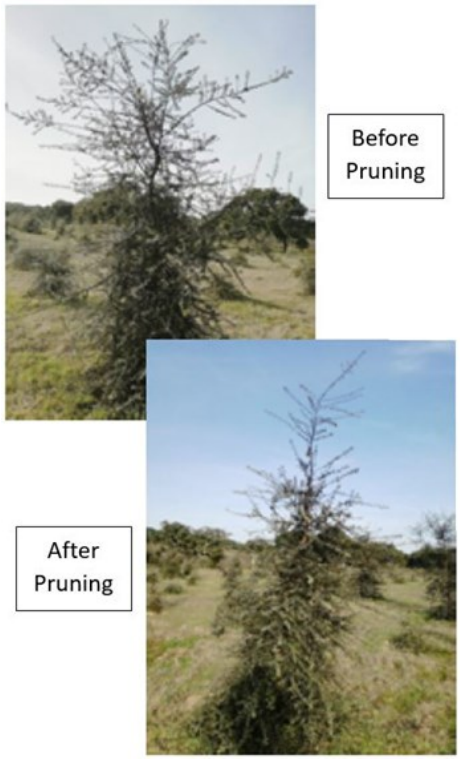
Links to website/report/video (if applicable)	https://www.goregacork.uevora.pt/
Pictures (if applicable)	

ITHub 2 - 23

Title of innovation	**"New" pruning method for fertigated Cork Oak (*Quercus suber* L.)**
ITHub	2
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO REGACORK
Operational Group (name)	Operative Group for precision irrigation of Cork Oak in intensive cork production stands.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Five companies related to cork production and transformation, two universities, six forest owners and five research and development companies.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/rega-de-precis%C3%A3o-de-sobreiros-em-modo-de-produ%C3%A7%C3%A3o.html
Country, region, city	Portugal
Type of innovation	Process
Keywords	Non-wood forest product; Fertilisation and nutrients management; Water management; Precision Forestry
Approach and main results (4000 characters max.)	The irrigation and fertilization of the plants during the dry season leads to an increased growth rate and to the creation of a larger number of branches in the tree trunk. In normal conditions (cork oak stand without fertigation) the trees are pruned with the objective of creating better conditions for the production of cork and acorns, also allowing more sunlight to reach the ground enabling it to be use for agricultural or livestock activities, and creates a tree with a single trunk, few branches and most of the time with 2,3 or 4 ramification, evenly spaced, between the height of 2 and 3 meters. In the case study REGASUBER the pruning applied was different. The “style” of the prune was similar to the ones done in high quality wood trees, prioritizing the formation of a single straight trunk, without ramifications, and leaving most of the branches that are in the horizontal position, cutting any branch inserted in the main trunk with an acute angle, because that kind of branches are the ones that will compete with the main stem for apical dominance. One other matter to take in mind when pruning fertigated cork oak trees is that it is necessary to start the pruning operation at a very young age since the trees grow faster, and it is necessary to do the operation annually to be sure that the tree trunks keep a good shape (straight without ramifications).

Lessons learned (1200 characters max.)	The young cork oak trees under optimal conditions, without water and nutrient deficits, will grow much faster than in normal conditions and will have way more branches. For this reason, a “new” kind of pruning was applied. The results are not yet fully understood since the trees did not reach adulthood, but it is expected that the trees will grow taller, the diameter of the trunk will be higher and with a straight shape.
Contact information	goregacork@uevora.pt
Links to website/report/video (if applicable)	https://www.goregacork.uevora.pt/
Pictures (if applicable)	

ITHub 2 - 24

Title of innovation	Increase and transfer knowledge to producers about precision fertigation of Cork Oak (*Quercus suber* L.) in intensive cork production stands.
ITHub	2
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO REGACORK
Operational Group (name)	Operative Group for precision irrigation of Cork Oak in intensive cork production stands.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Five companies related to cork production and transformation, two universities, six forest owners and five research and development companies.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/rega-de-precis%C3%A3o-de-sobreiros-em-modo-de-produ%C3%A7%C3%A3o.html
Country, region, city	Portugal
Type of innovation	Social innovation
Keywords	Non-wood forest product; Fertilisation and nutrients management; Water management; Precision Forestry
Approach and main results (4000 characters max.)	The production of cork in the last decades have been decreasing in quantity and quality, because of bad management practices, biotic factors (pests and diseases), and harsher weather conditions (less precipitation and higher temperatures). This project had as an objective the study of fertigation in cork oak stands, to increase the profit of the stakeholders and create a simple guide for the landowners to be able to follow. A few landowners, by their own initiative experimented watering some cork oak trees in their lands, which started this experiment. After they have seen some progress, they contacted diverse institutions to share the results and to create a proper trial to evaluate the growth differences. The results were gathered in chapters available online and printed in "Cork Oak with fertigation: Support handbook for the first years." ("Sobreiros com fertirrega: Manual de apoio aos primeiros anos"), "Young stands – Case study REGASUBER" ("Povoamentos jovens – Caso de estudo REGASUBER"), Young stands in pre-first debarking – Case study IRRICORK" ("Povoamentos jovens em situação de pré-desbóia – Caso de estudo IRRICORK"), and "Old stands" ("Povoamentos Adultos"). This chapters were freely distributed to forest owners associations and diverse entities related forestry, which allows the information to reach the landowner.

Lessons learned (1200 characters max.)	This project was a case of success because it allowed the forest owners to have their own initiative and be rewarded for such behaviour. It was a rich experiment in terms of knowledge share because different kind companies, institutions and landowners were involved in this project. The connections and communication between the different concerned parties was one of the key factors for this project success. All the results of the different case studies allowed the creation of different scientific articles, in this way sharing the results with the academic and scientific community. And the creations of handbooks, easily available to the landowners, which allow them to recreate the experiments and see for themselves the results in different stand and site conditions.
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Links to website/report/video (if applicable)	https://www.goregacork.uevora.pt/
Pictures (if applicable)	

ITHub 2 - 25

Title of innovation	**Good practices for the management of pests in Stone Pine (*Pinus pinea* L.)**
ITHub	2
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO +PINHÃO
Operational Group (name)	Operational Group for the integrated management of the biotic agents associated to pine nut production losses
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Three companies related to pine nut production and plant nursery, two universities, five forest owners and four research and development companies.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/gest%C3%A3o-integrada-de-agentes-bi%C3%B3ticos-associados-%C3%A0.html
Country, region, city	Portugal
Type of innovation	Technological innovation
Keywords	Non-wood forest product; Pest/disease control
Approach and main results (4000 characters max.)	The objective of this project was to identify the biotic entities (pest and diseases) that affect the development of the plants and the pine nut production, describing the ways to detect them, and which management practices could be applied for their control. Three major pests were identified: Western conifer seed bug (Leptoglossus occidentalis H.); Pine cone moth (Dioryctria mendacella S.); Pine cone weevil (Pissodes validirostris S.). Three minor pests were identified: Pine processionary (Thaumetopoea pityocampa D. & S.); Common pine shoot beetle (Tomicus piniperda L.); Pine shoot beetle (Tomicus destruens W.). The L. occidentallis can feed on pine nuts, at every stage of the cone development but it a preference for pine cones in the third year of development. It may dry the cones that have 1 or 2 years, however in cones that have 3 years the damage can only be visible in the pine nuts, since no hole or other sign of their attack can be visible from the outside of the pine cone. Their life cycle is the following: adults feed and lay eggs in April/May, in June/July a new generation is created by laying eggs again, if the climate conditions are favourable a third generation may be created in October/November, the adults from the last generation will gather in big groups and hibernate during the colder months. This life cycle leads to small population numbers in the beginning of the cycle reaching a maximum in July/August. It was observed that the adults most of the times will stay feeding in the same branch or tree but are capable to fly more than 15 km per day if searching for new resources. The

	population numbers are very different each year for the same place, no explanation was found for this behaviour. This population dynamic leads to very different production damage each year. As a rule for damage assessment if the insect is detected in one third of the tree in the stand a 25% loss of pine nuts per pine cone can be expected, if they are detected in one fifth of the tree the expected loss is 15%. The specie D. mendacella is affecting the most the pine nut production at a national level, since it's the most numerous pest in our country. The larvae feeds inside the pine cones, mostly in cones with 2 or 3 years, but can also affect cones in their first year. The adult lays a single egg in a pine cone, that hatch between 7 to 10 days. This specie larvae can be identified by their brown body with legs. When leaving the pine cone the hole has an irregular shape, and resin, excrement, silk and sawdust can be seen in the misshaped pine cone. This specie life cycle was not yet fully understood. It is suspected that it has 2 overlapping generations per year, since the insect can be seen in different life stages simultaneously year-round. The maximum population size is reached in June/July, and it stays the winter hibernating. The specie P. validirostris in their adult stage feed on the pine shoots creating small superficial wounds that do not affect the development of the tree. However, when in their larvae stage they feed in the inside of the pine cone. This specie larvae can be differentiated from the larvae of D. mendacella by their white compact body without legs, and can usually be seen more than one larvae inside the pine cone. The hole left in the pine cone is round and usually resin, sawdust and silk is not detected. This specie life cycle has only 1 generation each year, and the adults can live up to 2 year. In April/May the adult lays some eggs in each pine cone, reaching the adult stage in the beginning of the fall, during the winter the adults hibernate in the tree bark. One management practice that helps in the prevention of pests and reducing their impact is the plantation of mixed forest instead of monocultures. Its is not yet quantified its effect, however it helps by reducing the food source availability and creating more habitats for potentials predators.
Lessons learned (1200 characters max.)	Two pest control methods are suggested for the L. occidentallis. In extreme cases of production loss, pesticides with 50% concentration of Flonicamid, can be used to a maximum of 20gr/hl. However, it should be taken in mind that each country has different regulations related to insecticides, in the case of this study (Portugal), only the brand Teppeki is allowed to be used. This brand only kills the nymph stages, after 24 hours, and was proven to not leave residual traces in the pine nut. Another method is installing traps with aggregation or sexual pheromones. This technic has less environmental impact since it targets only the pest and no other living beings. In the case of P. validirostris and D. mendacella the most efficient control method is detecting and collecting the pine cones that have been attacked before the larvae reach the adult stage, and destroying the affected material with the use of fire. For the specie D. mendacella the use of pheromones together with traps in the last years had a huge development. The use of the female sexual pheromone had demonstrated a high success in the capturing of the specie males while they are flying in their reproduction period.

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Links to website/report/video (if applicable)	https://www.unac.pt/index.php/id-i/grupos-operacionais-accao-1-1-pdr2020/pinhao
Pictures (if applicable)	Level of impact each biotic agent as in the different stages of the pine cone development

Year	Month	Insect			
		lepto		dio	piss
		adult	nymph	larvae	larvae
0	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
1	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
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ITHub 2 - 26

Title of innovation	**Good practices for the management of diseases in Stone Pine (*Pinus pinea* L.)**
ITHub	2
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO +PINHÃO
Operational Group (name)	Operational Group for the integrated management of the biotic agents associated to pine nut production losses
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Three companies related to pine nut production and plant nursery, two universities, five forest owners and four research and development companies.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/gest%C3%A3o-integrada-de-agentes-bi%C3%B3ticos-associados-%C3%A0.html
Country, region, city	Portugal
Type of innovation	Technological innovation
Keywords	Non-wood forest product; Pest/disease control
Approach and main results (4000 characters max.)	The objective of this project was to identify the biotic entities (pest and diseases) that affect the development of the plants and the pine nut production, describing the ways to detect them, and which management practices could be applied for their control. For a long time the only significant disease found in the stone pine was from a fungi named Diplodia sapinea. However in the last years diseases related to the dieback of the tree shoots are becoming more common. The main fungi associated to the dry of the apical branches are: Diplodia tip blight (Diplodia sapinea); Pestalotiopsis dieback (Pestalotiopsis pini); Dieback of pine (Sydowia polyspora). Other fungi were identified as minor diseases since the tree normally restore their prior vigour and the fruit production is not affected. They are: Lophodermium Needle Cast of Pine (Lophodermium seditiosum); Blight of Allepo pine (Thyriopsis halepensis); Red band needle blight (Dothistroma septosporum); Black spot needle blight (Heterotruncatella sp.). The fungi D. sapinea normally only affect the tree branches causing them to dry. It can also affect directly the pine cone, misshaping it, reducing its size and the quality of the pine nuts produced. The main visual signs of this fungi presence is the drying of the apical shoots, the leaves get a brownish/greyish colour, the leaves dry from their base, cancers are developed in branches, resin is expel in branches and pine cones are misshaped. The fungi P. pini mainly affects the apical tree branches, causing them to dry and die, it also dries the leaves and creates black spots in them, which are the fungi reproductive structure. The S. polyspora only visible sing is the drying of the apical branches.

	The minor diseases signs and symptoms are described for each fungi as: in L. seditiosum the tree shoots grow slower, the branches dry from the base to the top, the leaves from the second year turn brownish or even die and black oval dots can be seen in the dry leaves; in T. halepensis the leaves turn brown/yellow, creating a uniform yellowing of the crown, it affects particularly the older leaves; trees affected by D. septosporum have apical branches with a "wisp" like formation where a lot of leaves grow from, in initial phases the leaves get a yellow then brown colour, leaving the base of the leaf still green, yellow/brown rings around the leaves are usual; the fungi from Heterotruncatella genus has a signs the yellowing of the branches and the leaves dry from top to bottom. The trees are more susceptible to the different diseases when they are younger or when they are old and there is a deficit of nutrients or water. This means that plant nurseries and young plantations are the ones more affected by diseases than the trees already established in the forest. However severe attacks in adult trees can also lead to their death.
Lessons learned (1200 characters max.)	The control methods to fight the major diseases are the following: Good management practices that keep the vigour of the plants are the best way to prevent infections; Sanitary pruning is the method most used since no homologated fungicides exists in the country (Portugal) for the diseases. The pruning should be applied in the dry season, so the spores are not dispersed, and the removed branches should be burn; in the case of S. polyspora there are some reports with good results of forest owners using calcium chloride when the trees are starting to grow the shoots of the year. It is also known that insects are a vector, contribution for the dissemination of the diseases. Most of the times the diseases described are not powerful enough to kill the trees, however the mixture of the effects of both the disease and other pest are what leads to the dead of adult trees.
Contact information	mrbranco@isa.ulisboa.pt
Links to website/report/video (if applicable)	https://www.unac.pt/index.php/id-i/grupos-operacionais-accao-1-1-pdr2020/pinhao
Pictures (if applicable)	

ITHub 2 - 27

Title of innovation	**Increase and transfer knowledge to producers about good practices for the management of pests and diseases in Stone Pine (*Pinus pinea* L.)**
ITHub	2
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO +PINHÃO
Operational Group (name)	Operational Group for the integrated management of the biotic agents associated to pine nut production losses
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Three companies related to pine nut production and plant nursery, two universities, five forest owners and four research and development companies.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/gest%C3%A3o-integrada-de-agentes-bi%C3%B3ticos-associados-%C3%A0.html
Country, region, city	Portugal
Type of innovation	Service
Keywords	Non-wood forest product; Pest/disease control
Approach and main results (4000 characters max.)	The stone pine is mainly planted for the production of the pine cones, more specifically for the production of pine nuts, since it's the most profitable way to explore this species. However, in the last years the producers and industry have been witnessing the decline in cone production and in the yield of pine nuts per cone. The main objective of this project was to develop strategies of integrated management of pests and diseases, with emphasis in Leptoglossus occidentalis H. creating new ways of detection, damage assessment and control methods. The life cycle of the pest and the stages of development of the pine cone were also studied. The results were gathered in chapters available online and printed in "Technical handbook – Good practices for the management of pests and diseases of pine cones and pine nuts." ("Manual técnico – Boas práticas para a gestão de pragas e doenças da pinha e pinhão"), "Damage in pine cones – How to identify the organism?" ("Danos nas pinhas – Como identificar o agente?"), "Fungal diseases in stone pine – New threats" ("Doenças fúngicas em pinheiro manso – Novas ameaças"), "Western conifer seed bug" ("Sugador de pinhas"), and "Pine cone moth" ("Lagarta da pinha"). This chapters were freely distributed to forest owners associations and diverse entities related forestry, which allows the information to reach the landowner.

Lessons learned (1200 characters max.)	The success of this project was achieved because of the hard work done by the researcher team, the availability of the landowners to participate in the project and the expressed concern of the private companies. The practical knowledge of the forest owners was reported and tested in trials, which opened new "doors" for future experiments. All the results of the studies and research were summarized which allowed the creation of different scientific articles, in this way sharing the results with the academic and scientific community. The creations of handbooks, easily available to the landowners, allows them to have a simple way for a primary identification of sanitary problems in their forests, most of the times being able to identify the specie. It also gives the landowners the methods to control and fight the dispersion and the adverse effects of the pests and diseases.
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Links to website/report/video (if applicable)	https://www.unac.pt/index.php/id-i/grupos-operacionais-accao-1-1-pdr2020/pinhao
Pictures (if applicable)	    

ITHub 2 - 28

Title of innovation	**Identifying the presence of Flathead Oak Borer (*Coroebus undatus* F.) in Cork Oak (*Quercus suber* L.)**
ITHub	2
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO UNDERCORK
Operational Group (name)	Operational Group for the integrated management of Flathead Oak Borer
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	One companies related to cork production and transformation, two universities, four forest owners and three research and development companies.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/gest%C3%A3o-integrada-da-cobrilha-da-corti%C3%A7a-undercork.html
Country, region, city	Portugal
Type of innovation	Technological innovation
Keywords	Non-wood forest product; Pest/disease control
Approach and main results (4000 characters max.)	This project had as its main objectives the development of strategies to detect, monitor, and control the attacks of Coroebus undatus F.. Based on monitorization works developed by this project a guide to identify the specie and its presence was created. The larvae of this specie has a thin white body with ten segments, no legs and can be found in the phellogen (meristem that gives rise to periderm), where it feeds and creates the galleries. This species can attack many different broadleaf trees, such as Quercus spp. (Oaks), Fagus sylvatica L. (European beech), Castanea sativa M. (Chestnut) and Corylus avellana L. (Common hazel). The life cycle is not yet fully understood, since part of its life is spent under the bark. It is suggested the life cycle takes two years to complete, but in favour conditions it may only take one. After reaching adulthood the females lay, generally, a single egg in the cork fissures, between May and July. Two or one year are spent under the bark in the larvae stage. When reaching maturity in the spring, they drill a hole in the cork to pupate. After 15 to 30 days the adults leaves the tree in the end of Spring/ beginning of Summer, living between two to three weeks in this life stage. Clear signs of the presence of this pest can only be found after the debarking of the tree. Galleries in the belly (the part of the cork that is turn to the tree) are clearly visible. From the outside, the back of the cork, scars may be seen, however these scars are from previous attacks and can't give any information if the insect is currently attacking the tree. The

	galleries can measure up to 2 meters in length, are arranged horizontally and vertically, and usually some crossing points are present. The width of the gallery, first is 1 to 2 mm growing as the larvae also grows, reaching 5 to 6 mm. The presence of galleries in the phellogen results in a higher adhesion of the cork to the tree, which complicates the extraction process in some cases breaking the cork boards, ripping the phellogen, and scaring the meristematic tissue for a lifetime. These open wounds increase the tree susceptibility to be colonized by other biotic threats, such was wood borers. Some commonly possible visible signs and symptoms of the pest attack were tested, to check their truthfulness. White spots in the bark, made from exudated compounds, may be related to the presence of the pest however it does not have statistical significance to be used with accuracy. This symptom is also correlated with other biotic and abiotic effects. Woodpecker holes can be related to the presence of insects in the tree however it does not give any information about which specie or its quantity. The bad vigour of the tree, defoliated crown or dried leaves, are not a visible sign since the negative impacts of this pest are not pronounced, only if the tree is under very bad conditions. One other sign, the presence of a "straw" ("palhinha") in the bark, little pupa shell, was believe for many years and by many to be a sign of the pest presence. This sign is not from C. undatus but from a moth specie. A very similar insect is the black-banded oak borer (Coroebus florentinus H.), but its larvae feed on new branches, so it may only impact cork production indirectly by reducing the plant vigour not affecting the quality of the cork directly.
Lessons learned (1200 characters max.)	This work made clear what are the damage, sign and symptoms expected from this insect presence, before and after the attacks. Clarifying some common knowledge forest workers and landowners previously had about this specie. Before debarking the tree, it's very hard to know if the tree is being attacked or not. Some technics were tested, and the results are the following. An acoustic detection tool was used as a non-destructive method, however the results showed a low success. The reason for this was, that in field trials very low noise or no noise at all was detected by the tool, the suggested explanation was the tiny size of the larvae and its low activity in conjunction with the great soundproof qualities of the cork. The other method tested was sampling the cork. This method is still the one that gives the best results. The distribution and quantity of the insects in the tree was found to be higher above the height of 50 cm. Other observations, even though without statistical significance, were higher presence of the insect in the parts of the trunk turned to south. This technic is the one suggested to be used to monitor the presence and intensity of attack in the forest.
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Links to website/report/video (if applicable)	https://www.unac.pt/index.php/id-i/grupos-operacionais-accao-1-1-pdr2020/undercork

Pictures (if applicable)		

ITHub 2 - 29

Title of innovation	**Monitoring the population of Flathead Oak Borer (*Coroebus undatus* F.) in Cork Oak (*Quercus suber* L.)**
ITHub	2
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO UNDERCORK
Operational Group (name)	Operational Group for the integrated management of Flathead Oak Borer
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	One companies related to cork production and transformation, two universities, four forest owners and three research and development companies.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/gest%C3%A3o-integrada-da-cobrilha-da-corti%C3%A7a-undercork.html
Country, region, city	Portugal
Type of innovation	Technological innovation
Keywords	Non-wood forest product; Pest/disease control
Approach and main results (4000 characters max.)	Even though C. undatus does not affect the vigour of the host tree it's the most important pest in cork oak stands, since it creates a defect in cork that decrease its value. No pest control method is yet available, since no pesticide as a viable success rate, because the larvae is protected by the bark, few or none predator and parasitic species are known, and no pheromone is available to be use together with traps. Monitoring technics for this specie are constantly advancing since the pest is increasing its presence in cork oak stands. The knowledge of the population dynamics is of extreme importance to predict future attacks and to evaluate the susceptibility of the stand. In particularly how the population of the insect and its life cycle will react to the changing climate. To monitor the presence of the pest in the stand, three monitorization methods were used, the sampling of cork, traps (nets placed around the tree) and vibrant colour slabs with glue. The data collected form this operation was gather and analyse. In terms of success in capturing the insect, none show potential to be use as a control method. But they were very useful to better understand the population distribution and dynamics. Most of the galleries created by the larvae can be found in the tree between the height of 50 to 100 cm, and there was a preference for the side of the tree exposed to south, it's believed to happen because it is warmer. More attacks were detected in thicker trees, and trees with thicker bark had less attacks, this is thought to happen because vigorous trees (higher bark production) would have enough resources to fight the

	infestation. For thinner barks opposite results were found in different experiments. Debilitated trees (less bark production) would not be nutritious enough for the insect which can decrease the attacks, but on the other hand thinner bark is easier to be drill by the larvae and trees in stress conditions are more susceptible to biotic and abiotic threats. For the same reason trees grown in deeper soils (more vigorous) had less attacks than tree grown in shallow soils (more stressful conditions). In relation to the stand composition different trials found different results. Some results indicate that mix stands with a diverse understory have less attacks, but other studies show the opposite result. More research is absolutely needed to better understand this question. It was shown a big difference in the attack intensity between sites and trees. The lack of a homogeneous distribution of the attacks in the trials, suggest the insect specifically selects the tree it's going to attack. By capturing the insect adults after they emerge from the tree, it was possible to define the ratio between female and male, which was above 1 for every year (meaning the population has always more female than males), and the period in which the adults start to emerge which was between June and July. The data collected from the monitoring operations was crossed with data of the climate, soil, biodiversity and chartography, to establish a relation between the attack intensity and exterior factors. Another model was created to study the variation of the population with the climate change.
Lessons learned (1200 characters max.)	The tested variables with the biggest impact in the population size were: Mean annual temperature, higher population were present in the sites with higher values when compared to sites with lower ones, this variable was the most relevant for the prediction model; Altitude, population were bigger between 200/400m when compared to populations in lower altitudes; Annual mean insolation, the sites with less time of sun light had less attacks when compared to other sites; Type of soil, of all the types of soils present in the sample sites podzo soil was the one that had the smallest populations. In the climate change model, the best prediction variables found were the minimum temperature reached in the winter and the standardised precipitation evapotranspiration index. The conclusions that can be taken from this work is that higher populations are found in places with higher lower temperatures in the winter and in places with severe droughts (in the model the best response of this variable was for a period of 3 years). For these reasons the climate change is expected to increase the population size and speed up their life cycle.
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Links to website/report/video (if applicable)	https://www.unac.pt/index.php/id-i/grupos-operacionais-accao-1-1-pdr2020/undercork
Pictures (if applicable)	

ITHub 2 - 30

Title of innovation	**Innovative Silo for the Supply of Wood Chip (SISE)**
ITHub	2
FOREST4EU partner (short name)	BOSCAT
Operational Group (short name)	SISE
Operational Group (name)	Innovative Silo for the Supply of Wood Chip (SISE)
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest and biomass business, research center and an university
Link from OGs database	
Country, region, city	Spain, Catalunya, Province: Girona and Barcelona
Type of innovation	Technological innovation
Keywords	Forestry, Energy management, business model, biomass, circular bioeconomy, wood mobilisation, sustainable forest management
Approach and main results (4000 characters max.)	The SISE platform, the Catalan acronym for Innovative Wood Chip Supply Silo, is an automated logistics warehouse for chip distribution, which allows quality chips to reach all points of the region, thus optimising the biomass distribution chain and reducing the CO2 footprint from transport. The SISE platform has a storage capacity of 190 m3 chips. The chips are supplied in 90-m3 trailer trucks from the main production plant in Celrà. Next, small, authorised local trucks (30-40 m3) are responsible for local distribution from the SISE platform to the end customer's silo. The SISE platform works without personnel thanks to an automated system that allows the persons responsible for transport, whether loading or unloading the chips, to work without additional help. The platform automation provides significant flexibility in wood chip delivery times to customers' silos, as it depends only on local carriers unloading over short distances. Automation and absence of staff with the SISE platform means a monitoring system had to be developed which was capable of predicting and managing demand, learning automatically as the platform delivers chips to customers, thereby optimising the transport flow to ensure the silo always has enough chips. The SISE platform is strategic for the development of biomass as renewable energy. The actions involved in the SISE project started with drawing up a master plan to provide the technical documentation for its construction. At the same time, while the master plan was being produced, a field study was carried out in order to find the ideal location to build it. Building started once the master plan was complete, the location established and all administrative documents were prepared.Now built and in the testing phase, its operation

	is being analysed. No mechanical deficiencies or problems that impede loading and unloading have been observed.Analyses were also carried out to ensure the chips in the SISE maintain their quality standards and technical specifications.At the same time, a survey system analysed the degree of satisfaction among both logistics operators and end customers. Finally, the carbon footprint before and after the implementation of the SISE was calculated.
Lessons learned (1200 characters max.)	The most conclusive end result from the SISE platform shows that this new logistics distribution model reduces CO2 emissions by over 110%. A standard 7-tonne load of wood chips at 30% humidity transported 120 km by pneumatic truck with 30 m3 (24.59 MWh) of storage capacity, where the chips are kept until delivered to the end customer, produces 94.67 kg of CO2 emissions, while with the SISE system, a standard 7-tonne load of wood chips at 30% humidity over 120 km, 100 km by trailer (90m3) to the SISE and 20 km by 30-m3 pneumatic truck (24.59 MWh) to the end customer, produces 44.51 kg of CO2 emissions. Thus the SISE system cuts CO2 by 50.16 kg per trip (113% reduction in CO2 emissions using the SISE). A further conclusive result found there were no significant differences after testing chip samples obtained from the SISE, based on current regulations (UNE-EN-ISO 17225, UNE-EN-ISO 18122, UNE- EN-ISO 18125, UNEEN-ISO 18134), hence the chip maintains its quality and technical specifications within the SISE. General conclusions regarding the use of biomass as fuel are: - It reduces greenhouse gas emissions - It reduces external energy dependence by improving supply security and internalising the energy bill. - It improves sustainable forest management. Regarding the SISE system in particular, it maybe be concluded that: - It ensures regularity and homogeneity of supply. A frequent problem with the supply of wood after 9-month drying period is that it does not coincide with the period of demand for wood chips in a region (mostly in colder periods). - Biomass reaches the end customer's silo with: - A smaller CO2 footprint. - Guaranteed quality. - Fast order delivery response. - It boots the number of potential customers, who would otherwise not consider biomass as a fuel, thus helping reach established countrywide penetration targets for renewables. - Quality biomass is provided throughout the country. - Data on chip quality and real-time consumption are obtained, which were hitherto unavailable outside the academic world. - Greater reliability, as it is a non-seasonal supply.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 2 - 31

Title of innovation	**An experimental laboratory in forestry on the classified site of Mont Beuvray**
ITHub	2
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	OG Mont Beuvray
Operational Group (name)	Mont Beuvray : An experimental laboratory in forestry on the classified site of Mont Beuvray
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/un-laboratoire-dexp%C3%A9rimentation-foresti%C3%A8re-sur-le.html
Country, region, city	France, Bourgogne - Franche Comté
Type of innovation	Organisational innovation
Keywords	Forestry, Adaptation to climate change
Approach and main results (4000 characters max.)	Covered by a 950 ha forest estate managed by Bibracte, Mont Beuvray constitutes an exceptional archaeological and natural site, recognized for its landscape quality and for its important heritage dimension: it sheltered the capital of the Aedui, a Gaul people Celtic, in the 2nd and 1st centuries BC. The last few years of severe drought have had a strong impact on the forest area. Since 2018, spruce stands (around 100 ha) have had to be fully exploited (clear cuts) following massive bark beetle attacks, while beech and silver fir stands also show serious signs of dieback. Faced with the challenge of adapting forests to climate change, forest stakeholders must also implement multifunctional silviculture, capable of producing quality wood while preserving biodiversity and the environment as well as societal uses of the forest. STRENGTHENING COOPERATION AROUND FOREST MANAGEMENT: In a regional context presenting a strong demand for involvement from civil society in forest management, the project partners have set themselves the objective of setting up an experimental system intended to study changes in the forest ecosystem, to experiment with different sustainable management methods and to open a space for dialogue on forestry subjects. This forest laboratory will take into account in a concerted manner three issues related to forest management in the face of climate change: the preservation of wood resources, the characterization and preservation of ecosystem services, and the social acceptability of silvicultural practices. The 2nd objective of the project consists of setting up observation

	protocols, carrying out a first series of field data collection campaigns and initiating the analysis of this data. Finally, the project partners intend to establish and lead a permanent consultation system in order to consolidate the laboratory and strengthen cooperation between scientists, practitioners and residents. Several actions have already been implemented: 1) Design and organize a laboratory • 50 organic matter sampling points as part of a thesis. • Opening of 30 soil pits and associated analyses. • Installation of 3 soil temperature and hygrometry probes as well as soil respiration measuring devices. • Geological identification of the substrate and petrographic analyses. • Compilation of available data on the history of the forest massif. • Establishment of a shared cartographic tool for sampling soils and forest stands. 2) Observation, collection and analysis of field data • Regeneration of 96 ha of old spruce stands with experimental afforestation methods on 68 ha. • Conducting a wave of measurements of forest stand observation plots (PSDRF protocol). • Monitoring of experimental plantings (1200 permanent seed plots) and dieback. • Summer hunting experimentation on approach in order to contain the deer population. 3) Establish and lead a consultation system • Practical workshops in the forest with the general public. • Study trip to Central Europe to meet forest professionals and experts.
Lessons learned (1200 characters max.)	The project brings together stakeholders wishing to be integrated into forest management around a common subject of concern: the future of forest areas under climatic constraints. The result will be technical forest management decisions, scientifically supported and representative of the diversity of opinions and issues. Carried out on a small territory, the project allows for extensive transdisciplinary experimentation with precise results and easy local action possibilities. The size of the territory nevertheless remains a technical challenge for carrying out certain studies (such as climate modeling) in which the project is part of a larger scale on a cooperative basis. The data could also be shared with the scientific and technical community via the Sentinel Forest Observatory of the Natural Reserves of France.
Contact information	laboratoire-forestier.mont-beuvray@bibracte.fr
Links to website/report/video (if applicable)	https://forestlab.hypotheses.org/
Pictures (if applicable)	

ITHub 2 - 32

Title of innovation	**Pilot silo with an automated biomass (forest biomass) supply system**
ITHub	2
FOREST4EU partner (short name)	BOSCAT
Operational Group (short name)	SPASB
Operational Group (name)	Pilot silo with an automated biomass (forest biomass) supply system
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest industry
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/sitja-pilot-automatitzada-subministradora-dE
Country, region, city	Spain, Catalunya, Province: Tarragona,Lleida,Girona,Barcelona
Type of innovation	Technological innovation
Keywords	Forestry, Biodiversity and nature management, Innovation social systems, Organisational innovation
Approach and main results (4000 characters max.)	To provide a solution to the limitations in the distribution of forest biomass and to optimise the SALA FORESTAL SL Celrà production centre, the aim is to design and plan an automated silo that supplies forest biomass and decreases transport costs outside the current radial distribution area. Objectives: a) To facilitate the supply and use of renewable sources of energy such as biomass (forest biomass) nd promote carbon sequestration in the forestry sector. b) Technology transfer between the Catalan Forestry Technology Centre (Centre Tecnològic Forestal de Catalunya, CTFC) and SALA FORESTAL SL, regarding biomass (forest biomass) storage and supply technologies. c) To design and plan an automated forest biomass supply silo. d) To lower biomass (forest biomass) transport costs from the SALA FORESTAL SL production centre to locations over 100 km away. e) Dissemination and promotion of the automated forest biomass supply silo

Lessons learned (1200 characters max.)	It can be concluded that the project is both technologically and financially viable. And the management and logistics improvements lead to a very significant decrease in CO2 emissions into the atmosphere. On the other hand, the project provides a consolidated and stable method of consuming forest biomass, which revitalises the sector and brings a product that up to now has been undervalued into line with other energy sources. The project also helps revitalise the rural sector, origin of the raw material
Contact information	salaforestal@salaforestal.com
Links to website/report/video (if applicable)	Sitja Pilot Automatitzada Subministradora de Biomassa (estella forestal)- SPASB
Pictures (if applicable)	

ITHub 2 - 33

Title of innovation	**The "sustainable bee forest" concept and implementation**
ITHub	2
FOREST4EU partner (short name)	StMELF-LWF
Operational Group (short name)	Bienenwald (bee forest)
Operational Group (name)	OG Zukunftsfähiger Bienenwald
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	The members of the “sustainable bee forest” OG are: Forest owner “Ruhlengut”, Bee institute Kirchhain in Hesse, Beekeeper “Auenblick”, Beekeeper “Beerow”, Farm community “Niederholzhausen”, and Comunis Projektbüro acting as coordinator for the OG Associated partners are: Justus-Liebig University of Gießen, Association for organic farming, German association for beekeepers, Hesse state enterprise for farming (LLH) technical information unit biological raw material use, Institute for animal ecology (ITN), Forest service Hesse in Kirchhain, Forest owner cooperative Morsch.-Spangenberg, Georg-August University of Göttingen. The main target group are farmers who own small forest lands. Through the cooperation with the regional forestry association, in which numerous predominantly small forest owners are organized, and forestry offices of the state of Hesse, information transfer up to urban forest owners is possible. "Urban forest owners" mostly live in cities. They have inherited forest but have little connection to this property and therefore often take insufficient care of it. The innovative bee forest concept offers the possibility to reach out to the variety of forest owners and encourage them to actively manage their forest.
Link from OGs database	EIP-AGRI Database
Country, region, city	Germany, Hesse
Type of innovation	Process
Keywords	Climate and climate change, Biodiversity and nature management, Non-wood forest product, New planting system, Multifunctional forest management

Approach and main results (4000 characters max.)	The project "sustainable bee forest" develops and implements a new forest management concept that improves the habitat of flower-pollinating insects during re- and afforestation from the very beginning while generating new sources of income from non-wood forest products. The main target group are smallholder farmers who are faced with forest dieback in the face of climate change. Large tracts of forest underwent major disturbances over the last years (pests, storms, fire). The German ministry of agriculture and food (BMEL) estimates that over the next years almost 500.000 ha of forest land will need to be afforested (status: Oct 2023). The German “Länder” (federal states) provide funding opportunities for afforestation measures in forests upon conditions, including the selection among a limited range of tree species. For the “sustainable bee forest”, none of the available tree species ready for funding were selected. The inventors of the “sustainable bee forest” concept perceive of their approach as an innovative, useful and urgently needed idea that differs from the existing forest management concepts in the federal state of Hesse. According to them, the aspect of multifunctional forest management has received little attention in Central Europe. Moreover, the idea of an insect- or bee-friendly forest is a real gap in current silvicultural practices. The “sustainable bee forest concept” is based on the view that forests are ecosystems, in which natural processes such as succession, growth heights, light and shade requirements of the plants are utilized in order to generate an economic benefit in addition to the high ecological benefit right from the start. The “sustainable bee forest” OG focuses primarily on honey and wild bees in a young stage of forest development. In contrast to previous approaches to pollinator promotion in the forest area, however, not only flowering areas are created on the inner and outer edges of the forest or larger areas are planted with flowering shrubs. Instead, profitable stemwood species are combined with other food plants for pollinating insects. This aims at building better linkages between profitability and conservation aspects for forest owners. Initially, therefore, the project examines flowering stemwood trees as well as flowering shrubs and flowering herbaceous vegetation in their early successional stages in order to develop recommendations for area-wide implementation. In addition, older forest stands with already fully flowering stands will be studied in order to investigate the long-term added value of flowering tree species for pollinating insects in addition to their ecological and economic benefits. The OG has afforested a former spruce-dominated forest of 3,5 ha in 2022 with: robinia, chestnut, linden, bird cherry, and walnut. The species composition is based on: (a) BA thesis at University of Gießen, which delivered a data base of bee friendly wood species, (b) insights derived from the recommendations for tree species selection of the forestry institute for north-west Germany, and (c) experiential knowledge of various experts involved in the project (forestry, agroforestry, beekeeping, research). The afforestation includes: preparing the forest land, buying the tree seedlings, planting the tree seedlings, maintenance measures, and building of a fence or other measures to protect the young plants from browsing. The estimated costs for the 3,5 ha amount 20.000€. Because government funding is not available for the selected tree species, the landowners have covered the costs mainly on a private basis. The OG has therefore initiated a donation call, which delivered 3.500€ at mid-project stage (status: Oct 2023).

Lessons learned (1200 characters max.)	One success factor was that the specific idea of a bee forest corresponded very well with the practical needs of small private forest owners. In addition, there was access to various networks of experts who were willing to support the project with their specialist knowledge. Due to the completely new idea, the transdisciplinary cooperation and the different demands of the participants, it was challenging to establish a suitable experimental design that could map the practical research questions. Experienced scientists with the appropriate methodological expertise are absolutely essential for this, so that meaningful results can be generated.
Contact information	Comunis Projektbüro, Judith Treis, info@comunis-projektbuero.de
Links to website/report/video (if applicable)	www.bienenwald-hessen.de
Pictures (if applicable)	

THub 3 – Sustainable forest management & ecosystem services (36 extended summaries)

Table 10. Overview of the extended summaries of ITHub 3.

	Title of innovation	Operational Groups (short name)	Type of Innovation	Country
1	Biomass accounting for Sustainible Forest Managment Plans	GO-SURF	Technological	Italy
2	Keys for Forest Types Classification Schemes to support the reporting of Support Sustainable Forest Management Indicators in Various Contexts	GO-SURF	Technological	Italy
3	The ARCHI method : a tool for diagnosing the vitality of trees	OG SPNA	Technological	France
4	Vigil'encre : Participatory science tool for epidemiological surveillance of chestnut ink	OG SPNA	Social	France
5	Forestry training : Marteloscope and reference sites	OG SPNA	Technological	France

6	Label Bas Carbone : a national forest carbon offsetting framework	OG SPNA	Service	France
7	Specific silvicultural itineraries to optimize the production of quality timber and economic yield of Pinus pinaster.	OG SIGCA	Process	Spain
8	Mapping of forest roads to support tourism activities	GO-SURF	Service	Italy
9	Support multi-object forest management plans through easy-access information	GO-PRI.FOR.MAN	Service	Italy
10	Community forest arrangement as ideal instance for the realization of the profit-sharing model of PRIFORMAN Project	GO-PRI.FOR.MAN	Organisational	Italy
11	Formula proposal for the profit-sharing model for community forest arrangement	GO-PRI.FOR.MAN	Social	Italy
12	Creation of clonal seed orchards for the conservation of Douglas-fir germplasm	Do.Na.To	Process	Italy
13	Good practices in Do.Na.To Project communication and technical formation	Do.Na.To	Service	Italy
14	GO SURF: decision support system for a participatory approach to forest management.	GO-SURF	Social	Italy
15	Characterisation of the genetic diversity of the chestnut heritage, soil biodiversity and biofertility Emilia-Romagna	Biodiversamente Castagno	Process	Italy
16	CASTANIBUS	Biodiversamente Castagno	Social	Italy
17	Use of Bite technology for tree infusion in chestnut groves	INGECA	Technological	Italy
18	Carbon accounting for PES	GO-FOR.TRACK	Technological	Italy

19	Questionnaire for the assessment of the willingness to pay for cultural-tourist ecosystem services	BIOSEIFORTE	Process	Italy
20	Integrated Management of the Pine Forest/Pine wood Nematode	GI (PIN)	Technological	Portugal
21	Assessment of the drudgery of work during the planting phase	PIF	Process	France
22	Innovative tool to reduce the arduousness of technical planting operations: the redesigned planting pickaxe	PIF	Technological	France
23	Technology at the service of forest renewal - mapping with drone and GPS to stake out the stand	PIF	Technological	France
24	Group management trial	FPP-EGG	Organisational	France
25	Innovative tools for collaborative forest management	OG OUI-GEF	Social	France
26	Using UAV photogrammetric data to support multi-objective forest management plans	GO-SURF	Technological	Italy
27	Decisional Support System to support the revision of forest management plans	GO-FOR.TRACK	Technological	Italy
28	A User-Friendly Platform for Bridging the Gap between Carbon Credit Demand and Supply.	CO2MARCHE	Organisational	Italy
29	Developing a Novel Martelloscope for Assessing Biodiversity and Growing Stock Volume with the Aid of a Digital Twin.	BIOSEIFORTE	Technological	Italy
30	Training for Forest Technicians, Researchers, and Employees on Fundraising and Communication Topics as Assets for Ecosystem Services Enhancement Projects.	CO2MARCHE	Service	Italy
31	Training for Forest Operators in Intervention Techniques to Enhance Carbon Credit Generation	CO2MARCHE	Process	Italy

32	Group Certification for Sustainable Forest Management: Promoting Shared Forest Management and Ecosystem Services Enhancement	CO2MARCHE	Process	Italy
33	Enhancing Additionality Assessment of Carbon Credit of Various Interventions by Utilizing Site-Specific Historical Data in Compliance with IPCC International Standards	CO2MARCHE	Product	Italy
34	Efficient Sampling Methodology for Calculating Soil Carbon Credits.	CO2MARCHE	Process	Italy
35	Assesing the efficiency of different prevetion methods of pine pitch canker, and the creation of a manual with the good pratices to follow in plant nurseries	GO +PrevCRP	Process	Portugal
36	Index of Biodiversity Potential (IBP): a practical tool for forest managers	OG Douglas	Technological	France

ITHub 3 - 1

Title of innovation	**Biomass accounting for Sustainable Forest Managment Plans using UAV data**
ITHub	3

FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-SURF
Operational Group (name)	DECISION SUPPORT TO SUSTAINABLE FOREST PLANNING
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company, NGOs, research institutions, advisor
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/supporto-decisionale-alla-pianificazione-forestale
Country, region, city	Tuscany, Italy
Type of innovation	Technological innovation
Keywords	Farming/Forestry competitiveness and diversification; Decisional Support System; silviculture
Approach and main results (4000 characters max.)	Forest biomass and carbon play a crucial role in the development of strategies aimed at implementing multi-objective forest management plans. Estimating forest biomass is essential for assessing carbon sequestration and the potential carbon balance of forest ecosystems. Forests, acting as significant carbon sinks, provide a valuable means to reduce atmospheric carbon levels. Accurate estimation of carbon stored in forests is vital to support climate change mitigation efforts and facilitate the transition to a low-carbon economy. Recent research activities have shown great potential in using 3D data derived from images captured by unmanned aerial vehicles (UAVs) for forest biomass estimation. This approach has proven to reduce costs and improve estimation accuracy. In the context of GO-SURF, UAV photogrammetric data was acquired using an RGB camera in five tested areas (Vallombrosa, Monte Morello, Rincine, Grosseto, Maesano, Pizzorne) to serve as a basis for extracting predictors of forest biomass. GO-SURF has been working on this, as estimating forest biomass is crucial for quantifying carbon credits and additionality within the voluntary carbon market, which is currently the only available market in Italy. Additionally, establishing standard procedures for estimating business-as-usual carbon stocks is necessary according to many voluntary carbon market standards. The UAV data provided very high-resolution data with a derived 3D point cloud density of 50 points/m2, allowing for the creation of a Canopy Height Model (CHM) using an available regional LiDAR dataset for normalization. For each of the tested areas, a high-resolution biomass map with a spatial resolution of 23x23 m was derived using a model approach. The map was created by using forest inventory plots as input data, predictors calculated based on the CHM, and high-resolution forest tree species maps. In each tested area different types of spatialization models were tested, including both parametric (linear) and

	non-parametric models (random forest and k-nn), in order to develop the best model for estimating the biomass. The generated maps were then validated through ground surveys and implemented into the Decision Support System Platform developed by GO-SURF. This resulted in the first high-resolution biomass map for the study area, which can be used in conjunction with additional layers derived in GO-SURF for various analyses in order to establish multi-objective forest management plans. The derived high-resolution biomass map is available within the Decision Support System Platform developed in the context of GO-SURF.
Lessons learned (1200 characters max.)	UAVs provide reliable predictors of biomass. The test areas exhibit diverse forest types and topography, and the Root Mean Square error obtained through the model approach is consistent across all areas. This indicates that the instrument's applicability can be beneficial in various contexts. In the tested areas, the biomass map is highly accurate, as it is calibrated to the specific area. The map offers spatial information that cannot be generated using traditional data sources. It enhances the optimization of forest interventions and provides greater precision. Forest managers in the tested areas have emphasized that the biomass map serves as a valuable starting point for considering carbon credits and designing the business-as-usual scenario.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 2

Title of innovation	**Keys for Forest Types Classification Schemes to support the reporting of Support Sustainable Forest Management Indicators in Various Contexts**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-SURF
Operational Group (name)	DECISION SUPPORT TO SUSTAINABLE FOREST PLANNING
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company, NGOs, research institutions, advisor
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/supporto-decisionale-alla-pianificazione-forestale
Country, region, city	Italy, Tuscany
Type of innovation	Technological innovation
Keywords	Farming/Forestry competitiveness and diversification; Decisional Support System; selviculturale; Multifunctional forest management
Approach and main results (4000 characters max.)	Tree species composition is a crucial indicator for sustainable forest management. It allows for the assessment of forest practices and ecosystem health. It provides valuable information on biodiversity, carbon sequestration, forest health, and social and economic benefits. Tree species composition refers to the types and distribution of tree species within a forest area. It plays a vital role in determining forest structure, function, and ecosystem services. The composition of tree species directly impacts forest biodiversity, as different species provide habitats for various organisms. It also influences the productivity and resilience of the forest, as certain species may be better adapted to specific environmental conditions or exhibit different growth rates. Understanding tree species composition is essential for promoting sustainable forest management. It helps identify potential threats, such as invasive species or imbalances in species diversity. It also informs decisions related to forest restoration, conservation, and the promotion of specific tree species for particular objectives, such as timber production, carbon sequestration, or habitat conservation.

	However, when it comes to Sustainable Forest Management Indicators, different organizations may require different classification schemes for forest tree species. This can pose a challenge for forest managers when reporting data. Therefore, it is important to provide them with user-friendly tools, such as keys or tables, that facilitate the transition between different classification systems and make the process easier for them. GO-SURF, in response to this challenge identified by forest managers involved in forest management plans, has attempted to solve this issue in the Tuscany Region where four different forest types classification schemes are established. These include the European Forest Types classification scheme, the Tuscany Forest Types Classification Scheme, the National Forest Inventory Classification Scheme, and the Corine Land Cover Italy 4-level classification Scheme. In this context, GO-SURF has developed user-friendly tables in collaboration with experts to guide forest managers in classifying forest types according to the different nomenclature systems. This allows forest managers to use the forest types classification system with which they are most familiar, and then use the table to transitioning the types from one system to another. This facilitates the reporting of various Sustainable Forest Indicators in different contexts, such as at the European, national, and regional levels, as required by different authorities.
Lessons learned (1200 characters max.)	In the context of the Tuscany region, the inconsistency of forest classification systems has been identified as a problem by forest managers, leading technicians to duplicate their work in classifying forests. This also sometimes results in the use of different systems that are not comparable. The initiative to develop keys for transitioning between different classification systems has been well received by managers involved in the OG, and these keys are now being utilized by others OG of the project, as they are made available on the GO-SURF website. This issue has also been observed in other Italian contexts, including forest inventories, where different countries employ different classification systems. For biodiversity monitoring, GO-SURF has emphasized the need for standardization efforts, even through simple solutions such as transition tables.
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Links to website/report/video (if applicable)	https://www.go-surf.it/download-2/2-report.html?download=4:quadro-di-riferimento-sulle-tipologie-forestali-e-sistema-nomenclaturale
Pictures (if applicable)	

ITHub 3 - 3

Title of innovation	**The ARCHI method : a tool for diagnosing the vitality of trees**
ITHub	3
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	SPNA
Operational Group (name)	SPNA : Precision silviculture in Nouvelle-Aquitaine
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/sylviculture-de-pr%C3%A9cision-en-nouvelle-aquitaine.html
Country, region, city	France, Nouvelle Aquitaine
Type of innovation	Technological innovation
Keywords	Forestry, Health tree, diagnosis, decision support tool
Approach and main results (4000 characters max.)	Vitality of trees is conditioned by genetics, as well as by two fluctuating factors: aging on the one hand and environmental constraints on the other. Diagnosing vitality is therefore a question of defining both the stage of development and the physiological state. We are able to calculate the age of a tree by counting the rings on a core of wood taken from the base of the trunk. The trouble is that this chronological age is not correlated with development. How long does the youth stage, adult stage and maturity last? Moreover, the classic measurements of diameter and height are of no help, the oldest subjects not being systematically the largest or the tallest. However, the architecture of a tree, that is to say the way in which it is built and repaired, constitutes a real biological signature of its vitality, this is the principle of the ARCHI method. The vitality of a tree must constantly be evaluated. After planting, to judge the quality of the resumption of growth; during development, to adapt the type of pruning, its frequency and its intensity; following an environmental constraint, to anticipate the reversible or irreversible nature of a decline; at the time of a mechanical diagnosis, to estimate the physical resilience capacity of a subject deemed to be fragile; also at the end of life, to recognize the natural or premature nature of mortality. Six physiological states are assigned to the young, adult and mature stages of development. The senescence inevitably leads to a natural death.

	• Healthy: a tree without any significant symptom of crown degradation and whose architecture is in accordance with its development stage. • Stressed: a tree that undergoes stress, which can be seen by changes in its architecture (impoverishment of ramification, mortality, possibly the appearance of epicormic shoots, …), without it being possible for the observer to instantly decide on its future restoration or further degradation, based on the assessment. • Resilient: a tree whose crown development resumes normal architectural dynamics, after a deviation from the normal. This is mainly thanks to the development of orthotropic epicormic shoots in the upper canopy. • Crown retrenchment: a tree in the dynamic formation process of a new, secondary crown below the original canopy, which eventually dies. • Fallback: a tree that does not have a living upper canopy, but continues to function with unaltered lower branches from its original structure. The tree does not form a secondary crown, so it is not in a crown retrenchment process. • Irreversible decline: a tree with a degraded crown (impoverished ramification, abnormal mortality) without any viable restoration process (epicormic shoots are almost absent or, on the contrary, abundant but (almost) all of the ageotropic type).
Lessons learned (1200 characters max.)	The ARCHI method is aimed at foresters, ecologists, arborists, teachers and researchers. There is a good correlation between the six physiological states and the width of the wood rings or the NDVI index (Normalized Difference Vegetation Index) measuring the photosynthetic activity of the foliage. For several tree species, a dichotomous ARCHI key has been developed in order to support, facilitate and objectify the architectural analysis of individual trees. These keys are tree species specific. Currently (2023) ARCHI keys are available for the 18 following species : Quercus (robur, petraea, pubescens, ilex, suber), Fagus sylvatica, Platanus x acerifolia, Castanea sativa, Cedrus atalantica, Pinus pinaster, Pinus sylvestris, Pinus nigra (ssp. nigra, ssp laricio var. corsicana, ssp. salzmannii), Abies alba, Pseudotsuga menziesii, Picea abies. The ARCHI keys can be downloaded from: https://www.cnpf.fr/archi/ . An app based on the principle of ARCHI keys, which can be used on tablets and phones, is under development.
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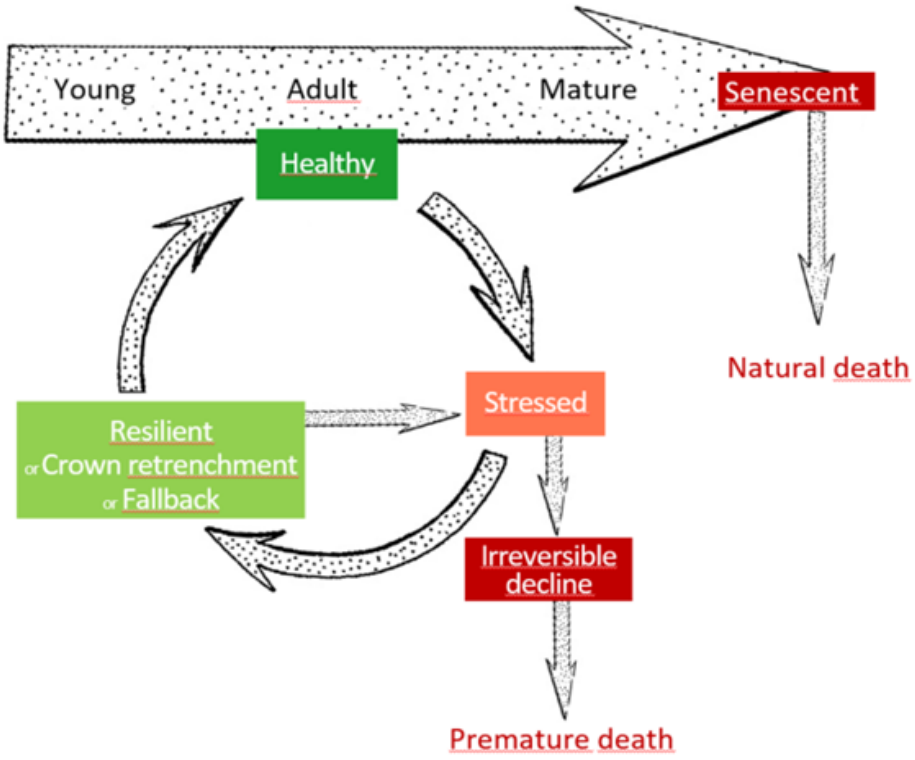
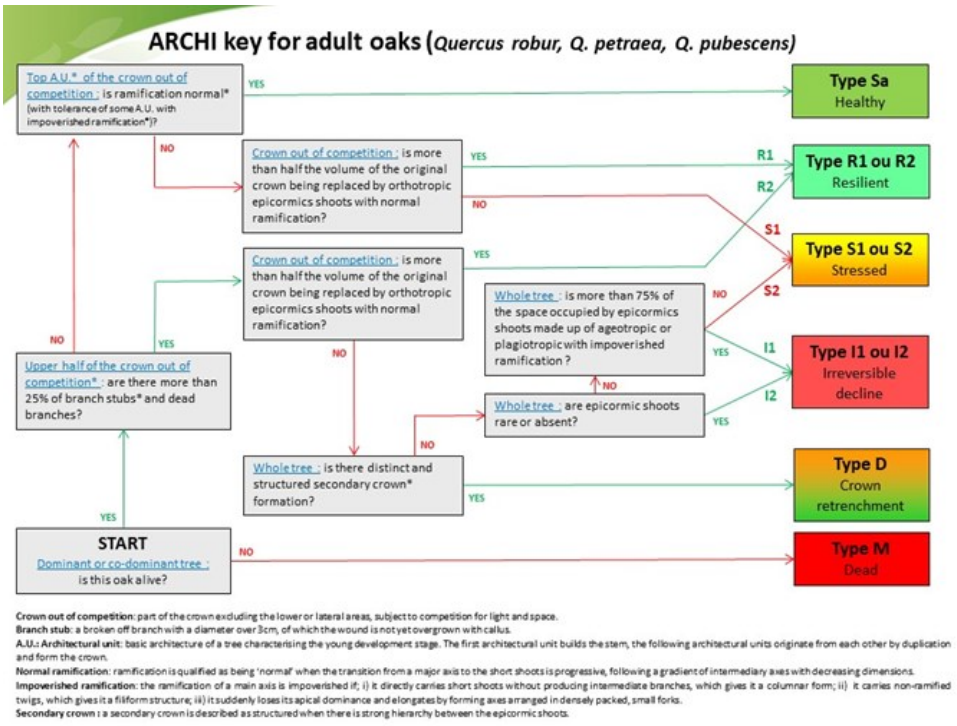
Links to website/report/video (if applicable)	https://www.cnpf.fr/nos-actions-nos-outils/outils-et-techniques/archi

Pictures (if applicable)





Crown out of competition: part of the crown excluding the lower or lateral areas, subject to competition for light and space.
Branch stub: a broken off branch with a diameter over 3cm, of which the wound is not yet overgrown with callus.
A.U.: Architectural unit: basic architecture of a tree characterising the young development stage. The first architectural unit builds the stem, the following architectural units originate from each other by duplication and form the crown.
Normal ramification: ramification is qualified as being 'normal' when the transition from a major axis to the short shoots is progressive, following a gradient of intermediary axes with decreasing dimensions.
Impoverished ramification: the ramification of a main axis is impoverished if; i) it directly carries short shoots without producing intermediate branches, which gives it a columnar form; ii) it carries non-ramified twigs, which gives it a filiform structure; iii) it suddenly loses its apical dominance and elongates by forming axes arranged in densely packed, small forks.
Secondary crown : a secondary crown is described as structured when there is strong hierarchy between the epicormic shoots.

ITHub 3 - 4

Title of innovation	**Vigil'encre : Participatory science tool for epidemiological surveillance of chestnut ink**
ITHub	3
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	SPNA
Operational Group (name)	SPNA : Precision silviculture in Nouvelle-Aquitaine
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/sylviculture-de-pr%C3%A9cision-en-nouvelle-aquitaine.html
Country, region, city	France, Nouvelle Aquitaine
Type of innovation	Social innovation
Keywords	Forestry, Adaptation to climate change, Participatory science tool, health tree
Approach and main results (4000 characters max.)	Chestnut ink disease is transmitted by roots. Pathogens are soil microorganisms originating from Asia introduced to Europe at the end of the 19th century. INRAE scientists have developed a Vigil'encre application to provide information on chestnut tree diseases, identify symptoms and report the location of affected stands. Vigil'encre is available on download platforms. Vigil'encre users thus participate in research carried out by INRAE on chestnut ink. The Vigil'encre application is intended for owners of forest plots or chestnut orchards, but also for all forest users and the general public. It is organized around three functions, which are: - inform about chestnut tree diseases, - identify symptoms and diseases, - report chestnut trees showing symptoms. On the Vigil'encre homepage (Fig. 1A) there are several windows and documentation on the chestnut tree (biology, distribution, use, recognition), ink disease, other diseases (chestnut canker, Phytophthora ramorum, Cynips). An owner, technician or forest manager wishing to have help in establishing a diagnosis on their dying chestnut trees can use the "identify" function (Fig. 1B). The symptoms observed can thus be compared to those illustrated in Vigil'encre. For ink, symptoms can be observed at the roots or crown, at the trunk or leaves. Possible confusion with other diseases or symptoms is indicated on

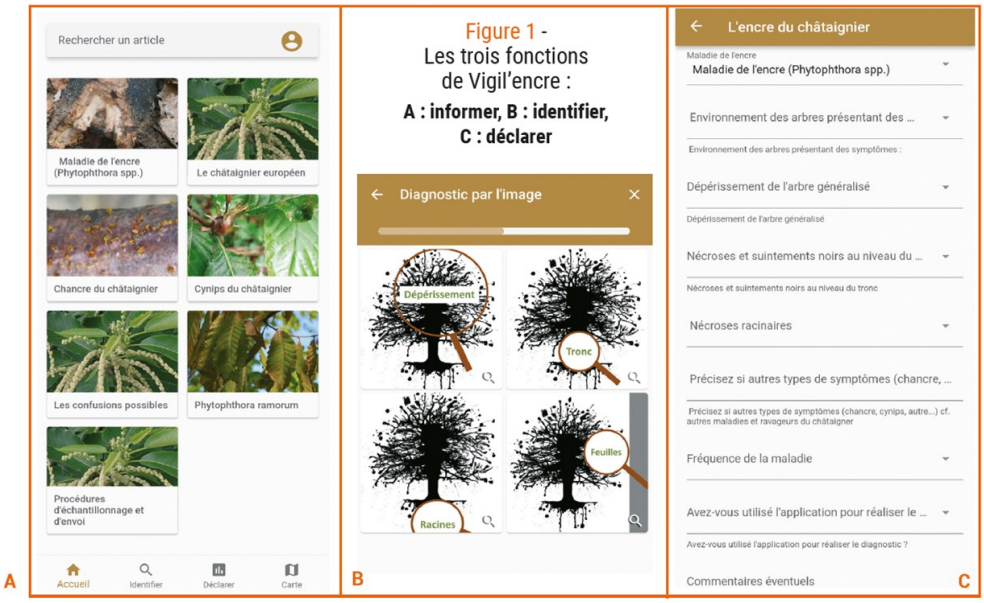
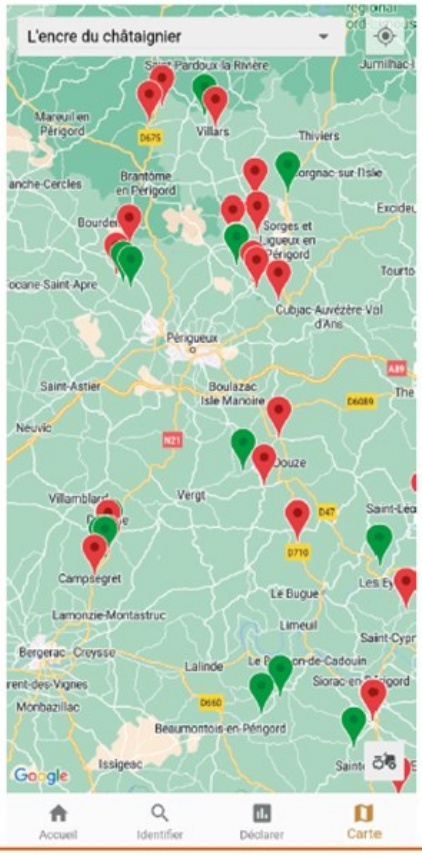
	the home page (Fig. 1A). By opening the "Report" page (Fig. 1C), it is possible to report symptoms attributable to ink, Canker and Cynips. For each problem, precise information is requested on the site where the report is made and the type of chestnut tree stand. It is possible to geolocate the report and submit photos of the symptoms observed. This information will make it possible to confirm the diagnosis carried out and to populate a database. To confirm the diagnosis, INRAE offers Vigil'encre users the possibility of sending soil and/or plant samples in order to carry out a diagnosis in the laboratory. The procedures to follow are detailed on the homepage. The map of the reports made is also provided (Fig. 2).
Lessons learned (1200 characters max.)	Reports of ink and dieback are stored in a usable database for the epidemiological surveillance of Phytophthora. A precise knowledge of the distribution of pathogens will allow us to better understand these mechanisms and to better understand the interactions between drought and ink. The use of material tolerant or resistant to ink would limit its impact in forests or orchards. Chestnut resistance to ink is genetically determined and varies within the species. It is in the outbreaks of the disease that it is possible to identify trees that survive infections and could be resistant. It is therefore necessary to clearly identify these outbreaks!
Contact information	cecile.robin@inrae.fr
Links to website/report/video (if applicable)	The application Vigil'encre is available : https://play.google.com/store/apps/details?id=com.inra.VigiLencre https://apps.apple.com/fr/app/vigilencre/id1471955505
Pictures (if applicable)	

Figure 2 - Cartographie des signalements effectués sur Vigil'encre



ITHub 3 - 5

Title of innovation	**Marteloscope**
ITHub	3
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	SPNA
Operational Group (name)	SPNA : Precision silviculture in Nouvelle-Aquitaine
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/sylviculture-de-pr%C3%A9cision-en-nouvelle-aquitaine.html
Country, region, city	France, Nouvelle Aquitaine
Type of innovation	Technological innovation
Keywords	Foresry, precision forestry, training tool
Approach and main results (4000 characters max.)	A marteloscope is a practical tool for training in silvicultural management. In groups, participants walk through a forest plot and simulate thinning by choosing the trees that they think should be cut (hammering). Software then makes it possible to simulate the impact that this cutting would have on the forest: economic profitability, improvement in the quality of the wood in the long term, preservation of biodiversity, etc. The size of a Marteloscope should be fixed to 1 hectare with side lengths of 100 x 100 m. Size and form should be tailored to the planned use of the Marteloscope and the geography and local conditions. So they may in exceptional cases differ from the regular rectangular shape. A 1 ha plot (chestnut, oak and beech stand) for the marteloscope has been located in Corrèze at Meilhards. This site is now operational to welcome groups and to carry out hammering exercises (first day in April 2023). In addition, 10 reference sites have been located in Dordogne. The interest of these reference sites is that they present a great diversity of types of chestnut stands (pure and mixed) of all ages as well as different types of management applied (renewal with stump crushing for example).
Lessons learned (1200 characters max.)	The interest of marteloscopes and reference sites is that they represent a practical tool for training in silvicultural management.

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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 6

Title of innovation	**Label Bas Carbone : a national forest carbon offsetting framework**
ITHub	3
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	SPNA
Operational Group (name)	SPNA : Precision silviculture in Nouvelle-Aquitaine
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, reaserchers, advisors, private companies
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/sylviculture-de-pr%C3%A9cision-en-nouvelle-aquitaine.html
Country, region, city	France, Nouvelle Aquitaine
Type of innovation	Service
Keywords	Forestry, forest carbon stocking, climate change mitigation
Approach and main results (4000 characters max.)	Carbon sequestration is an ecosystem service that forests and foresters provide to society. This action focuses on assessing the forest carbon balance of the Fumel area. A study on the wood resource was conducted in 2014 on the territory of the community of municipalities of Fumel Vallée du Lot and Montflanquinois. Having such data for this territory is valuable: these measurements were re-mobilized in the framework of the SPNA project to derive information on the "carbon balance" of local forests. The calculations show carbon stocks of 931 ± 120 thousand tons of carbon in the biomass and 672 thousand tons of carbon in the soil and litter. The flux study shows that the territory's forests are still a net carbon sink, although the dieback of chestnut coppice is a concern and could turn local forests into carbon sources. The LBC is a a French standard for carbon offsetting projects. It is used to label the contribution of companies and communities to CO2 sequestration projects in the forest. Currently there are 3 validated methods for labeling forest carbon offset projects: - Afforestation of agricultural land or bushy wastelands; - Reconstitution of degraded forests (storm, fire, intense dieback); - Conversion of good thickets into high forests on stumps.

Lessons learned (1200 characters max.)	The community Fumel Vallée du Lot also sees it as an opportunity to promote the renewal of dying chestnut trees, as the forest is an important local resource for many businesses.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 7

Title of innovation	**Specific silvicultural itineraries to optimize the production of quality timber and economic yield of Pinus pinaster.**
ITHub	3
FOREST4EU partner (short name)	Cesefor
Operational Group (short name)	GO SIGCA
Operational Group (name)	SiGCa: Forest management systems in quality timber producing forests
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest Owners
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/sigca-sistemas-de-gesti%C3%B3n-forestal-en-bosques.html
Country, region, city	Basque Country, Cantabria, Asturias, Galicia and Castilla León
Type of innovation	Process
Keywords	Forest industries; wood mobilization
Approach and main results (4000 characters max.)	Four silvicultural scenarios have been developed that take into account timber quality. The silvicultural scenarios are: Standard silvicultural scenario (M2): In the M2 silvicultural scenario there will be timber harvesting in 3 thinnings and in the final felling. Short shift silvicultural scenario with subsidies (M4): In the silvicultural scenario M4 we will have timber harvesting in 1 thinning and in the final cut. No management silvicultural scenario (M8): The no management silvicultural scenario from the initial planting, with a density of 1250 trees/ha, must assume that there is natural mortality, at least in the poorer seasonal qualities. This effect can be of the order of 10-20 % in number of trees of about 5-10 % in volume at the end of the shift. In this analysis we have assumed it to be 10 % in volume, although this may be lower than values that may occur in reality. We also assume it to be uniform across all grades, although it may be more logical to assume a higher incidence in smaller individuals. In the silvicultural scenario M8 we will only have timber harvesting in the final cut. Multi-product silvicultural scenario (MG2): For the MG2 silvicultural scenario, two possible alternatives will be considered, with plantation and with natural regeneration, which means two totally different economic scenarios.

	MG2 with plantation: In the silvicultural scenario MG2 we will have timber harvesting in 2 thinnings and in the final cut. MG2 with natural regeneration followed by thinning after 5 years: In the MG2 silvicultural scenario with natural regeneration we will have timber harvesting in 2 thinnings and in the final felling.
Lessons learned (1200 characters max.)	Four silvicultural models have been developed taking into account timber quality. The main conclusion we can draw from this economic analysis is that the minimum site quality that ensures economic profit is in medium sites (dominant height from 16 m to 20 years) for any silvicultural scenario of prices and interest on money. In lower quality sites it is only possible to obtain profitability if good natural regeneration is possible and with the help of subsidies for non-self-financing treatments. The next conclusion is that the silvicultural scenario MG2 is the best in all qualities and scenarios, except for quality 7 m with an interest rate of 2 %. With this silvicultural regime a higher profitability is achieved than in the M2 scenario, the second best in all cases, but with the advantage of needing 5 years less to achieve it and it is also achieved with one less silvicultural action. If we compare the MG2 scenarios with and without planting, it shows that natural regeneration is more profitable, mainly because of the savings from not having to plant, which is more expensive than the thinning that has to be done with natural regeneration.
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Links to website/report/video (if applicable)	https://www.sigcamaderadecalidad.info/
Pictures (if applicable)	

ITHub 3 - 8

Title of innovation	**Mapping of forest roads to support touristic activities**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-SURF
Operational Group (name)	DECISION SUPPORT TO SUSTAINABLE FOREST PLANNING
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farming/Forestry competitiveness and diversification; Decisional Support System; selviculturale
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/supporto-decisionale-alla-pianificazione-forestale
Country, region, city	Tuscany, Italy
Type of innovation	Service
Keywords	Farming/Forestry competitiveness and diversification; Decisional Support System; selviculturale
Approach and main results (4000 characters max.)	Mapping forest roads is important for various aspects related to sustainable forest management. In the context of guiding forestry companies towards multifunctionality beyond just production, especially if aiming for certification under PEFC and FSC standards for forest services, it is necessary to map and keep records of other indicators, including forest road infrastructure and their functionality. In this context, expediting the mapping of existing forest roads and identifying potential issues is crucial for intervention. From a tourism and accessibility perspective, it is also essential to determine which means of transportation can be used on these roads (walking, biking, accessibility for people with disabilities). In this context, GO-SURF, in its test areas, used GNSS receivers to map existing roads and classified them based on their functionality, thereby preliminarily identifying existing and potentially accessible routes, while also identifying any maintenance issues. The result led to the mapping of the existing road network and its condition, which is a prerequisite for identifying additional trails to open up within the forest.

Lessons learned (1200 characters max.)	Using low-cost GNSS receivers and/or mobile app development, it is indeed possible to map forest road infrastructure quite easily. Unfortunately, due to a lack of management over the past 30 years, some of the old routes and trails have been lost in certain areas. This discrepancy has resulted in a reduced level of existing and usable road infrastructure for tourism purposes compared to what was expected based on regional technical maps. However, looking to the future, with the assistance of GNSS receivers, it will be possible to identify additional potential routes to be opened up.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 9

Title of innovation	**Support multi-object forest management plans through easy-access information**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-PRI.FOR.MAN
Operational Group (name)	Shared PRIvate FORest MANagement in Eastern Alps
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest companies, advisors, research institutions
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/gestione-condivisa-delle-proprieta-forestali
Country, region, city	Friuli-Venezia Giulia, Italy
Type of innovation	Service
Keywords	Farming/Forestry competitiveness and diversification; Decisional Support System; selviculturale
Approach and main results (4000 characters max.)	To support sustainable forest management aimed at maximizing ecosystem services through new silvicultural practices, it is essential to have access to a range of information that enables forest managers to quickly retrieve data, with the ultimate goal of achieving certification for ecosystem services. In this context, PRI.FOR.MAN, which has developed a decision support system in the Friuli Venezia Giulia region, provides various user-friendly graphical interface access to diverse information. In this context PRI.FOR.MAN DSS provide user-friendly information regarding (i) the **Forest Types Categories that** define the classification of forested areas based on specific criteria such as land use, productivity, conservation; (ii) Availability of E**xisting Forest Management Plans,** that outline strategies and objectives for the sustainable management of forest resources in a specific area, that guide management actions over time; (iii) **Forest Roads:** The network of forest roads is vital for accessibility and forest area management not just for wood mobilization but also for touristic activities; (iv) **Annual Growth of wood**: This value indicates the average annual growth of forest resources and influences the capacity of resource renewal; (v) **Presence of Disturbances:** This may include events like fires, diseases, or insect infestations that affect tree health and require specific management actions; (vi) **Environmental Constraints:** These encompass considerations related to environmental conservation and protection, (vii) **Protective Role of Forest Vegetation:** This concerns the significance of forest vegetation in

	providing ecosystem services such as soil protection and water cycle regulation; (viii) **Location of Biotopes, Parks, and Regional or State Reserves:** These are ecologically significant sites or protected areas requiring special management for biodiversity conservation; (ix) **Natura 2000 Sites:** These are designated sites within the European Union's Natura 2000 network, necessitating specific conservation and development measures based on prevailing regulations. All these elements are fundamental for sustainable forest management, which aims to balance the utilization of forest resources with the conservation of the natural environment. They provide essential information for forest managers to develop multi-objective forest management plans and actions that are not only linked with wood mobilization but also with biodiversity conservation, tourist activities, and the monitoring of forest health. Before the PRI.FOR.MAN, this information was already available online but scattered across various local authority websites. The PRI.FOR.MAN project has allowed for the consolidation of these data into a single container, the Decision Support System (DSS), designed specifically for the forest context.
Lessons learned (1200 characters max.)	Harmonizing information and making it available in user-friendly systems is crucial to ensure data accessibility. Otherwise, users trying to navigate across different portals may struggle to access the information, leading to its underutilization. Without the use of information, it becomes challenging to plan multi-objective management strategies, and there's a risk of abandonment of forested areas.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 10

Title of innovation	**Community forest arrangements as ideal instance for the realization of the profit-sharing model of PRIFORMAN Project**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-PRI.FOR.MAN
Operational Group (name)	Shared PRIvate FORest MANagement in Eastern Alps
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest companies, advisors, research institutions
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/gestione-condivisa-delle-proprieta-forestali
Country, region, city	Italy, Friuli Venezia Giulia
Type of innovation	Organisational innovation
Keywords	Innovation social systems, Sustainable Forest Management, Multifunctional forest management, Cooperation
Approach and main results (4000 characters max.)	Community forest arrangements are tools for the development of business networks in forestry sector, to valorise public and private agro-silvo-pastoral lands, encourage provision of ecosystem services and conservation. They're among the instruments recommended by the TUFF and other provisions of the Italian legal system for the associated management of forests. They offer the possibility of participation not only to companies, but also to small forest owners, regardless of the size of the area of land. This enables small forest owners to ''join forces'' to manage their forests and possibly outsource their management, thus overcoming the problem of 'inactive' owners (lack of physical presence of owners in the area), the problem of 'fragmentation' of forests properties and the possible lack of forestry management knowledge. The creation community forest arrangements, with the application of the profit-sharing model created by PRI.FOR.MAN, gives the possibility of an allocation of profits not limited to timber extraction, but provided by multifunctional management based on the desiderata of the contractors and the reference regulations. This binome 'community forest agreement - profit-sharing model represents a sustainable model both from the economic point of view (as it allows not only a reduction in costs, but also an increase in profits), the environmental point of view (as it ensures proper management of forests), and the social point of view (as

	it represents a form of participatory forest management, which could also help to maintain the population of mountain areas). From the social and technical meetings held during the project emerged some critical issues that need to be addressed in the project follow-up. The first difficulty encountered was to contact all the forest owners. Afterwords was noticed a general owners' mistrust in delegating the management of their funds to third parties for prolonged periods of time, even in the face of clear and reliable legal and technical instruments. Moreover, they showed a common preference to sell the standing forest in order to have a high periodic income rather than opting for an annualisation of profits from shared management, and the preference of purchasing contracts with utilisation companies for individual utilisations, rather than the possibility of taking multi-year management with the associated risks. During the PRI.FOR.MAN project was produced the contract proposal with the application of the profit-sharing model, but it still need to be signed up by forest owners. The now ongoing NET4GO Project, in Veneto, will focus on putting into practice this innovation.
Lessons learned (1200 characters max.)	Community forest arrangements are multifunctional tools that provides economical, environmental and social, allowing to overcome many difficulties linked to forest management. They're the most suitable instrument for the implementation of the profit-sharing model devised within the Project and fot the success of community forest management. However, to be applied and overcome the general owners' mistrust it's higly necessary to explain the given possibilities, by giving examples of realities that achieved positive outcomes (D'Adderzio, 2023).
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 11

Title of innovation	**Sharing-profits methodology for community forest arrangement**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-PRI.FOR.MAN
Operational Group (name)	Shared PRIvate FORest MANagement in Eastern Alps
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest companies, advisors, research institutions
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/gestione-condivisa-delle-proprieta-forestali
Country, region, city	Italy, Friuli Venezia Giulia
Type of innovation	Social innovation
Keywords	Innovation social systems, Sustainable Forest Management, Multifunctional forest management, Cooperation
Approach and main results (4000 characters max.)	The economical objective of PRI.FOR.MAN Project was to develop a new sharing-profit methodology to recognise the adequate profit from timber harvesting to each private forest owner in the context of community forest management. The concept of "condominium" associated with forest areas has already been used in some initiatives of shared forest management, but in this case the innovation regards the method of profit-sharing. In fact, the easy profit-sharing method by adopting a millesimal system, thus based on surface area alone (similar to that used in condominium management), would have penalised small owners, who represent a very significant portion in the italian context. In order to reach forest owners it's necessary to guarantee them a congruous timber annual payment that could induce them to assign the management of their area to an external logging company (private or public). On the other hand it's necessary to guarantee the external manager adequate financial reward for timber logging and harvesting. The wood stock is determined by using drone and photogrammetry, then its effective value is expressed in function of the main relevant variables: accessibility, assortments and timber market value.

	With regard to the annual quota due to each owner, it is made up of two components: a fixed one and a variable one. The fixed one is directly proportional to the surface of the shared forest (and will tend to be low), while the variable component is directly proportional to the ratio between the volume of each individual parcel (Vui) and the total volume of the forest area. Some issues about the application of the sharing-profits methodology emerged in the case study in Tarvisio and need to be addressed in the project follow-up. Forest owners showed a common preference to sell the standing forest (in order to have a high periodic income rather than opting for an annualisation of profits from shared management), and the preference of purchasing contracts with logging companies for individual utilisations (rather than the possibility of taking multi-year management with the associated risks).
Lessons learned (1200 characters max.)	The application of the sharing-profits methodolody created by PRI.FOR.MAN gives the possibility of an allocation of profits not limited to timber extraction, but provided by multifunctional management based on the desiderata of the contractors of the community forest agreements and the reference regulations. It represents a sustainable model both from the economic point of view (as it allows not only a reduction in costs, but also an increase in profits), the environmental point of view (as it ensures proper management of forests), and the social point of view (as it represents a form of participatory forest management, which could also help to maintain the population of mountain areas). Even if underlying this proposal there is a careful assessment of available forest resources, a planning of their utilisation and timber market evaluation, still social awareness that need to be implemented because it's not easy to face the initial mistrust of the forest owners.
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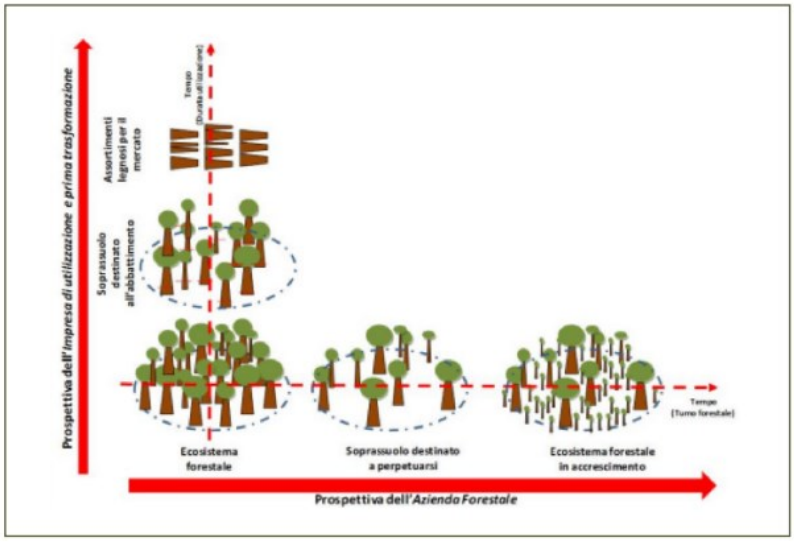
Links to website/report/video (if applicable)	
Pictures (if applicable)	$$q_i = q_{f_i} + (Euro_{tot} - \sum_{i=1}^{n} q_{f_i}) \times \frac{V_{u_i}}{\sum_{i=1}^{n} V_{u_i}}$$



Timber capital seen by the forest owners' perspective and the utilisation and first transformation company.

ITHub 3 - 12

Title of innovation	**Creation of clonal seed orchards for the conservation of Douglas-fir germplasm**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	Do.Na.To
Operational Group (name)	Douglasiete naturali toscana
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, researchers, territorial and public institutions, editorial company, formation company, moral company
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/douglasiete-naturali-toscane
Country, region, city	Tuscany, Italy
Type of innovation	Process
Keywords	Mitigation to climate change, Adaptation to climate change, sustainable forest management, new planting system, organizational innovation
Approach and main results (4000 characters max.)	Many Douglas-fir stands are more than sixty years old, and traditional silvicultural approaches cannot be separated their regeneration from the availability of suitable seedlings. At present, Douglas-fir seedlings are mainly purchased from foreign nurseries, which does not always guarantee their suitability/adaptability to the Tuscan environment. For this reason, it is essential to have FRM of high phenotypic, genetic and adaptive quality suitable for the Tuscan areas. In order to qualify the regional forest nursery chain for the production of Douglas-fir planting stock, it is important to introduce innovation and quality into the Tuscan nursery chain of this species. With the technical support of CREA-FL (Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria Foreste e Legno), the Do.Na.To project has created two clonal seed orchards, located at two contrasting altitudes above sea level, for the conservation of Douglas fir germplasm starting from material selected within the best phenotypes of the IUFRO field experiment of provenances and progenies, located at Faltona (Arezzo) and Vallombrosa (Firenze), and constituting the reference for the ex-situ germplasm bank at national and international level. Scions collected from superior phenotypes were collected from the most higher branches in the crown and used for these clonal seed orchards. They were created on public land managed by the Unions of Mountain Municipalities of Mugello and Pistoia Apennines. These grafts

	will assure Douglas fir germplasm conservation and the medium- long term supply of genetically tested propagation materials.
Lessons learned (1200 characters max.)	Genetic conservation and production of high-quality propagation material is very important for Douglas-fir, as it is usually managed by strip clear-cutting followed by seedling plantation (strongly integrated by natural regeneration in good seed years). Instead of buying seedlings from abroad, it's very important to reduce the chance of pest introduction by FMP and guarantee the conservation of local adapted genetic material, especially in the current context of climate change.
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Links to website/report/video (if applicable)	https://www.progettodonato.it/
Pictures (if applicable)	

ITHub 3 - 13

Title of innovation	**Good practices in Do.Na.To Project communication and technical formation**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	Do.Na.To
Operational Group (name)	Douglasiete naturali toscana
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, researchers, territorial and public institutions, editorial company, formation company, moral company
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/douglasiete-naturali-toscane
Country, region, city	Tuscany, Italy
Type of innovation	Service
Keywords	Sustainable forest management, organisational innovation, Multifunctional forest management, Cooperation
Approach and main results (4000 characters max.)	Agro-forestry innovation projects are very important from a technical, operational and even experimental point of view, but if there is no way of transferring the knowledge and the scientific results obtained to the territory and to the supply chains, they are an end in themselves. For this reason, the importance of communication on the management of Douglas fir forests has proved to be crucial for the dissemination of knowledge and innovation in Tuscany, a region where this species has a long history of over 100 years of silviculture and still a great potential. Within the Do.Na.To. project, Compagnia delle Foreste, a publishing company specialised in the forestry sector, was the partner in charge of communication, with the aim of reaching as many stakeholders as possible through various information products and platforms. In particular, it took care of the image of the operating group and provided information on the activities carried out and the results achieved through: website, newsletters, brochures, interviews and videos. The Accademia dei Gergofili also organised three conferences to promote the initial, intermediate and final results of the project, with publication of the proceedings attended by academics, researchers and forest managers on the themes of: The role of Douglas-fir in climate change mitigation and adaptation; Future perspectives for Douglas-fir cultivation in Tuscany; Valorisation of Tuscan Douglas-fir wood products; Revitalisation of the Tuscan regional nursery for the production of quality seedlings; Historical Vallombrosa stands contribution to the Do.Na.To. project; Demonstration areas for natural regeneration of

	Douglas-fi. In addition, in order to stimulate knowledge acquisition within the partnership, a series of guided tours were organised in Germany to show demonstration sites to stakeholders with the aim of learning new knowledge about Douglas fir management and exchanging views with experts from other European countries. This was very important to visualise the medium to long term effects of the silvicultural protocols applied and to obtain detailed information on the possible impacts of Douglas fir management.
Lessons learned (1200 characters max.)	The contacts and experience gained by the partners are an important asset, as are some communication products that, by highlighting the potential of the species and the know-how acquired, will be able to publicise the results of Do.Na.To. and the experts who contributed to it, even after the project has ended. Good communication is certainly useful for involving partners and stakeholders. The project was successful and had a very structured communication strategy, which gives it a good chance of being replicated in other Italian and Mediterranean contexts.
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Links to website/report/video (if applicable)	https://www.progettodonato.it/
Pictures (if applicable)	

ITHub 3 - 14

Title of innovation	**GO SURF: decision support system for a participatory approach to forest management**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-SURF
Operational Group (name)	DECISION SUPPORT TO SUSTAINABLE FOREST PLANNING
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company, NGOs, research institutions, advisor
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/supporto-decisionale-alla-pianificazione-forestale
Country, region, city	Tuscany, Italy
Type of innovation	Social innovation
Keywords	Innovation social Systems, Sustainable Forest Management
Approach and main results (4000 characters max.)	The European Forests, Biodiversity and Social Strategy, together with the Italian National Forest Strategy, recognize the critical importance of sustainable forest management in addressing new challenges. These challenges include the increased severity and frequency of natural disturbances such as windstorms, droughts, and insect infestations, as well as the diverse and sometimes conflicting social demands placed on sustainable forest management and forest systems. So, it is essential to engage both public and private forest owners and forest company and civil society in the decision-making process give them also access to stadardized information regarding forest resources.Among the possible innovations useful to the sector, Decision Support Systems for Forestry (DSSF), which are complex computer systems designed to assist users in decision-making processes through a set of tools, data, and analysis models, are recognized as an important tool for the implementation of forest management for the provision of multiple ecosystem services . In fact, FDSS represent a useful tool for enhancing the environmental, economic, administrative, legal, and social aspects associated with sustainable forest management.However, despite the availability of advanced technologies, in the past, other examples of Forest Decision Support Systems (FDSS) have disappointed end users' expectations, mainly because their use was limited to experts due to excessive complexity or logic that deviated from the users' perspective. This often highlighted how the gap between the world of research and practical application is seen as one of the reasons why SSDs are not effectively implemented. In this context, GO-SURF adopted a participatory

	approach in the development of the DSS, allowing for open dialogue among all stakeholders involved in forest management and the creation of a system based on the actual needs of identified users. It should be noted that, on the scientific side of the partnership, it would have been possible to develop a more complex system. However, this would have risked not being adopted by the target users because it would have been too complicated and less relevant to their actual needs. In this approach, every phase of system development was discussed to ensure it met the real needs of users. In details, for the development of the SSDF, the four key components were examined: the problem analysis system, the knowledge management system, the results presentation system, and the development language. The four key components were analyzed recursively to guide the development process, employing a participatory approach for each of them. Firstly, the "problem analysis system" was examined by identifying the target users of the GO-SURF system and the needs to be addressed (Table 1). The identification of target users was carried out by involving ten individuals within the partnership, while analyzing the results and architecture of similar SSDF systems developed in other territorial contexts. The analysis of the actual needs of each of the target users then guided the "knowledge system," which in the case of GO-SURF consists of the data hosted within the SSDF and the analysis tools used to query the data and generate information for decision-making. Subsequently, a detailed analysis of the "results presentation system" was conducted, which guided the technical implementation of the SSDF. During this analysis, it became evident that the application should have a web-based Geographic Information System (Web-GIS) interface designed to streamline the use of spatial analysis tools and enable report generation. Finally, considering the first three key components of the SSD, the technicians responsible for developing the platform chose the "system development language,".
Lessons learned (1200 characters max.)	In the case of the GO-SURF project, the participation of various stakeholders involved in different aspect of forest management has improved the outcomes in the development of FDSS. However, a participatory approach also has some disadvantages: it requires time and resources (Carberry et al., 2002), the identification of appropriate stakeholders is necessary , and stakeholders must agree on process objectives. In the case of GO-SURF, the opportunity to establish an Operational Group within the PEI-AGRI initiative allowed for the identification and involvement of various stakeholders from the inception of the operational group through measure 16.1 of the PSR. This helped create alignment in process objectives, which were realized through measure 16.2 of the PSR in the development of the application.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 15

Title of innovation	**Characterisation of the genetic diversity of the chestnut heritage, soil biodiversity and biofertility Emilia-Romagna**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	Biodiversamente Castagno
Operational Group (name)	Biodiversamente Castagno: "Guidelines for the preservation and valorisation of chestnut biodiversity in Emilia Romagna".
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Chestnut growers, universities, regional institution
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/biodiversamente-castagno-linee-guida-la-preservazione-e
Country, region, city	Emilia-Romagna, Italy
Type of innovation	Process
Keywords	Biodiversity, nature management, soil management, functionality, landscape, land management
Approach and main results (4000 characters max.)	The aim of the project was to set up a collective study shared by the scientific community and chestnut growers to find out about the genetic variability of chestnut germplasm and to enhance and promote the role of the chestnut grower as a 'guardian' of biodiversity and land protection. The scientific data collected characterised the genetic diversity of Emilia-Romagna's chestnut-growing heritage and the broad biodiversity and biofertility present in the soils, highlighting the genetic variability of the region's different varieties of chestnut fruit and identifying for each variety the most suitable soil characteristics for its cultivation. In particular, the analyses highlighted the 'diversity' of chestnuts and distinguished all the different varieties in the area under study, from the 'Carrarese' 'to the 'Pelosa', the 'Svizzera', the 'Pastanese', the 'Biancherina' and others. DNA analyses have shown that the different types of Marroni, a typical product of Emilia-Romagna, share the same DNA profile with extraordinary precision, proving that all plants derive from a single strain of marroni from the Apennines. Varieties recognised as being at risk of extinction were taken from the collection fields available in Emilia-Romagna (Granaglione and Zocca) and were placed in special catalogue fields at two actual partner companies that became their custodians.

	Subsequently, the quality of the organic substance was verified by applying indices that provide indications of the capacity of the soil to conserve or dissipate the organic carbon present. Thus, after specific sampling and analysis, the microbial biomass, metabolic quotient (qCO2), microbial quotient (qMic), mineralisation quotient (qM) and soil biological fertility index (IFB) were evaluated, to highlight alarm and early warning situations with regard to organic matter content and possible loss through mineralisation. In addition, soil and its biodiversity were studied using the biological quality index (QBS-ar) at some geo-pedologically different sites, suitably selected from those from which genetic material is taken. It emerged that the soil of the chestnut grove is a habitat for an enormous quantity and variety of organisms.
Lessons learned (1200 characters max.)	For companies in the Apennines a niche strategy is needed, built on the exclusivity and excellence of local products, in particular chestnuts, through the valorisation of traditional chestnut cultivation, for better environmental sustainability, soil care and protection of biodiversity, adaptation to climate change and product quality.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 16

Title of innovation	**CASTANIBUS**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	Biodiversamente Castagno
Operational Group (name)	Biodiversamente Castagno: "Guidelines for the preservation and valorisation of chestnut biodiversity in Emilia Romagna".
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Chestnut browser, universities, regional institution
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/biodiversamente-castagno-linee-guida-la-preservazione-e
Country, region, city	Emilia-Romagna, Italy
Type of innovation	Social innovation
Keywords	Biodiversity, nature management, soil management, functionality, landscape, land management, cooperation
Approach and main results (4000 characters max.)	CASTANIBUS unites the CASTANI-CO and BIODIVERSAMENTE CASTAGNO projects, whose primary objectives are to identify and share "guidelines for the study, preservation and valorisation of the chestnut tree and the best management of chestnut groves to obtain a quality product", to revalorise the "culture of chestnut cultivation" and the role of the chestnut grower as a quality producer and guardian of the mountain territory. Castanibus was a two-day journey that networked all the realities that revolve around the chestnut tree and the need for protection and development in the Apennines, from carbon sequestration to the protection of biodiversity, fostering a proactive and constructive exchange between researchers, GO partner farmers and regional officials, with the main players involved in chestnut cultivation in Emilia Romagna. Concentrating the participants on the coach made it possible to favour an exchange of experiences and opinions on the reality of chestnut cultivation, but above all to bring the comparison to the field by visiting chestnut groves and metati. Concentrating the participants on the bus made it possible to make the best possible use of the travelling time from Bologna, the place of departure, to Marola, facilitating an exchange of experiences and opinions on the reality of chestnut cultivation, but above all to take the comparison to the field by visiting chestnut groves and metati. The trip was full of speeches and moments of discussion concerning the current situation and future prospects of regional chestnut cultivation after extremely difficult years for producers due to the

	Chinese wasp, which has now been eradicated thanks to the interventions of the Regional Phytosanitary Service.
Lessons learned (1200 characters max.)	The partnership between the actors of the operational groups demonstrated the effectiveness of 'networking', a fundamental condition for sharing and integrating in practice market requirements with environmental and scientific innovation, and human, historical, cultural and landscape heritage. The bus tour with the various territorial actors active in the chestnut sector was a good way to stimulate and bring them into the field. One of the most important result was the desire and the concrete possibility of activating a Regional Plan for Chestnut Growing as a result of the cooperation between the Emilia-Romagna Region and the Consortia of Chestnut Growers, some of which were united in a coordination, and other public and private stakeholders.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 17

Title of innovation	**Use of Bite technology for tree infusion in chestnut groves**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO INGECA
Operational Group (name)	Innovative Low-Impact Strategies for the GEstion of Adversity in Chestnut Fruit Forests
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farms, research groups, communication company, national forest certification systems (PEFC)
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/strategie-innovative-basso-impatto-la-gestione-delle
Country, region, city	Tuscany, Italy
Type of innovation	Technological innovation
Keywords	Sustainable Forest Management, pest/disease control
Approach and main results (4000 characters max.)	Traditionally, in fruit tree crops phytosanitary control has always been done by canopy spraying, that caused a high product dispersion in the environment, high delivery time of application, less absorption and lower results in responding to phytosanitary attacks. In chestnut groves this control method is either too burdensome and inapplicable due to the considerable size of the plants or even non applied at all. Endotherapy can be applied to chestnut trees regardless of their height and location, take less time than traditional methodology and don't dissipate the product, with better results. A single tree treatment requires roughly 10 minutes and, since more trees can be treated simultaneously, a chestnut farmer can manage to treat a chestnut grove in 1 or 2 days. The device requires no electricity to operate and reduces water consumption by more than 99% compared to spraying treatments (water consumption is a few ml per tree, therefore an absolutely negligible quantity). The cost of the device is around 1300 € and the cost of a commercial Thrichoderma package is around 200 €; however, as the product is very concentrated (billions of spores) it will be sufficient for 5 years or more, depending on the scale of application. One of the advantages of using the Bite technology, is that unlike other pressure endotherapic tools, it penetrates the internal tissues of the tree with a very thin needle that causes a little wound, that can be recovered in about a week. For rapid and optimal

	absorption of the injected suspension, it is necessary that the treatment is carried out during the vegetative season, when the trees are at their maximum transpiration rate.
Lessons learned (1200 characters max.)	This innovative, low-impact instrument has shown very good results in the phytosanitary control of tree diseases, with no environmental impact, a minimum impact on the plant, and a reduced time-consumption for the application. Given the reduced time required for the treatments, the high cost of the instrument can be reduced by organizing chestnut growers in a consortium, in order to make a community purchase to recover the expense.
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Links to website/report/video (if applicable)	https://www.psingeca.it/it
Pictures (if applicable)	

ITHub 3 - 18

Title of innovation	**Carbon accounting for PES**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO.FOR.TRACK
Operational Group (name)	DECISIONAL SUPPORT SYSTEM TO MAP FOREST RESOURCES
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company, NGOs, research institutions, advisor
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/sviluppo-di-un-sistema-di-supporto-decisionale-la
Country, region, city	Italy, Calabria
Type of innovation	Technological innovation
Keywords	Farming/Forestry competitiveness and diversification; Decisional Support System; silviculture
Approach and main results (4000 characters max.)	Forests offer more than just wood and non-wood materials; they provide a wide range of additional services, including creating habitats for biodiversity, purifying water, and regulating floods and climate. Their ability to sequester carbon, provide cooling effects, and supply renewable raw materials, food, and medicines is essential in combating climate change, transitioning to a circular bioeconomy, and promoting overall societal health. The economic sustainability of the EU's forest sector continues to be a fundamental aspect of sustainable forest management. Moreover, this economic sustainability is critically significant for preserving the various advantages that forests offer to society, particularly for ensuring the livelihoods of rural communities. Both public and private payments for forest ecosystem services offer an alternative means to secure funding for multifunctional and protective forest management and the sustainable upkeep of ecosystem services. In this context, it is important to establish methods for quantifying these ecosystem services. Among the services with a potential market, carbon is the most developed. In Italy, there is no formalized market yet, and activities are primarily in the voluntary sector. In this scenario, calculating the Business as Usual (BAU) and offsetting resulting from management is crucial. To have a picture of the BAU, it's essential to find methodologies as standardized as possible and accurately quantify carbon. In our case, using ground biomass data, we were able to derive a model using an area-based approach, integrating remote sensing data (Sentinel-2 satellite) for various tree species, and then converting this

	value into carbon as 0.5 of the biomass. At this time, this data has not been used to enter the carbon credit market but solely to establish a reference framework for the BAU and to initiate proposed management changes, with the intention of calculating offsets later on.
Lessons learned (1200 characters max.)	Remote sensing data can be valuable in quantifying biomass at the company level when integrated with ground data. This approach has enabled the precise assessment of biomass and the identification of various forest types. However, to date, it has not been possible to quantify the credits resulting from management offsets, but rather to establish an initial reference framework.
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Pictures (if applicable)	

ITHub 3 - 19

Title of innovation	**Questionnaire for the assessment of the willingness to pay for cultural-tourist ecosystem services**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	BIOSEIFORTE
Operational Group (name)	BIOdiversity and Ecosystem Services in Forests and Territory
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forestry doctors, researchers, doctors in natural sciences, biologists, environmental engineers , Forestry and Agriculture Societies (SAF), Category Associations, Consortiums of local companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/biodiversita-e-servizi-ecosistemici-foreste-e-territorio
Country, region, city	Marche, Italy
Type of innovation	Process
Keywords	ecosysyem services, sustainable forest management
Approach and main results (4000 characters max.)	The GO conducted an experimental analysis on the Monte Nerone area to evaluate the willingness to pay for the implemetation of tourist-recreational services. The study area is located in the Marche Apennines, 60 km from the coast (a very touristic area), it's easily accessible and has a good road network. The object of the research was to assess the value of the ecosystem services provided by the forest. The data collection was done through a questionnaire to the visitors, preceded by a brief description of the area attempting to inform visitors of its cultural, architectural and environmental, naturalistic and landscape values. The questionnaire asked for biographical information, educational qualification, average income bracket, frequency of visit, and an evaluation of the main ecosystem services the area was able to provide (providing a grid of ecosystem services characterising the area as support for the answer). The evaluation was carried out with a double key, on the one hand assessing the evaluation of the importance of the various ecosystem services for the users (e.g. the landscape, biodiversity, etc., with answer scores of 1-7), and on the other asking how the Nerone area responded according to their perception. These two parameters were considered as fundamental to determine their willingness to pay. In the end, participants were asked to survey express their interest and their willingness to pay for a parking space

	(assessment per vehicle not per person, per day). The money collected would be reinvested in the area to improve services and maintain the area.
Lessons learned (1200 characters max.)	After the data analysis, a willingness to pay 7/8 euros was estimated. Most visitors are willing to pay for an access point with information and toilets and then go on an excursion. There was no ostracism only very few answers the environment belongs to everyone and they are not willing to pay. No real implementation has followed so far. Difficulties in data collection (number of questionnaires about 90 completed, some filled in poorly, not usable). The thesis collector who collected the data took advantage of the possibility of collecting the information at events, but in general it is very difficult to find people. An attempt was made to collect data on Facebook but they were not found to be reliable. The people interviewed were very willing to answer, but these questionnaires are often too long for people who were passing by on holiday. It is also difficult to balance between the level of detail one would like to achieve and the immediacy of the answers. If you want very large samples and detailed information, the period is very long.
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Pictures (if applicable)	

ITHub 3 - 20

Title of innovation	**Pine wood nematode**
ITHub	3
FOREST4EU partner (short name)	SOLUTOPUS
Operational Group (short name)	GI (PIN)
Operational Group (name)	Integrated Management of the Pine Forest/Pine wood Nematode
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	researchers; business; advisors; NGOs
Link from OGs database	https://inovacao.rederural.gov.pt/2/114-gi-pin-gestao-integrada-do-pinhal-nematode-da-madeira-do-pinheiro
Country, region, city	Portugal North and Centre
Type of innovation	Technological innovation
Keywords	nematode; pine wood
Approach and main results (4000 characters max.)	**Objectives:** This project aimed to overcome the constraints caused by PWD, combining new forms of forest management, fight, methods of early detection of infected trees and decrease their impact, control the natural dispersion of the insect vector (Monochamus galloprovincialis), reduce costs of disease control actions and contribute to restore the confidence of landowners for the maintenance, plantation and management of new areas of maritime pine. It is also intended to analyze the types of trees that can be infected, the influence of forest fires on the natural dispersion of PWN, to evaluate the emergence and flight of the vector under different climatic conditions, to minimize the risk of forest operations during their flight period and to create zones of active containment where it is possible to act more effectively to avoid the dispersion of PWN to the non-infected pine forests. **The approach had the following main phases and respective conclusions**: 1- Creation of an Active Containment Zone (ZCA), with borders, and it was observed that the Pine Wilt Disease (MPD) spread approximately 6 km in a year, within a maritime pine (Pinus pinaster) stand, without roads paved and with very limited access. Arrangement of multi-funnel traps along the border area of the transect. 2- Determination of early tree detection methods potentially infected- Assess the risk of disease installation in trees with different ages/dimensions. It was observed that larger pine trees are more likely to be selected by Monochamus galloprovincialis and becoming infected by the Wood Nematode Pine (NMP), mainly in populations with a low incidence of DMP. 3- Evaluation of new methods for controlling the natural dispersion of vectors infected with MPN- Evaluate the

	period of emergence and flight of the vector in different climate conditions. During 2021, 527 were captured in the traps installed in Seia. specimens of M. galloprovincialis. The largest number of insects was captured in the second week of October (131 copies, corresponding to 24.9% of the total captures). In the traps installed in Soure, only 62 specimens were captured and the peak of catches (61% of the total) occurred earlier than in Seia, between 11 June and July 9.
Lessons learned (1200 characters max.)	Based on the commercialized trap model, and taking into account the results obtained in the test carried out in 2020, two changes were made to the collection cup to test the decrease in catches of non-target species. The experimental design used was the Latin square with rotation of the position of the traps weekly and the Galloprotect 2D-Plus attractant was identical for all. The results obtained reveal that the three trap models used captured 44 specimens of the target species M. galloprovincialis, in quantities statistically similar. It can be concluded that the use of the collection cup modified by the manufacturer is suitable for obtaining a targeted capture of the target species, which is the insect vector of PMN, being a considerable evolution with ecological importance as it causes a residual impact in the remaining entomofauna, namely auxiliary species (predators) or protected. The results of the project were afected by the delay in the financial subvention, Several presentations were made, but lacks of a broad dissemination of the lessons learned.
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Links to website/report/video (if applicable)	https://inovacao.rederural.gov.pt/images/imagens/Docs_GO/29-_OG_GI_PIN.pdf
Pictures (if applicable)	

		

ITHub 3 - 21

Title of innovation	**Assessment of the drudgery of work during the planting phase**
ITHub	3
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	PIF
Operational Group (name)	Innovative forest plantations
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Researchers, forest managers, advisors, forest operators
Link from OGs database	https://www.reseaurural.fr/centre-de-ressources/projets/plantations-innovantes-en-foret-innover-pour-installer-des-plantations
Country, region, city	France, Grand-Est
Type of innovation	Process
Keywords	Plantation, Working conditions, Societal expectations
Approach and main results (4000 characters max.)	In the context of climate change, planting appears to be a major tool for guaranteeing the adaptation and sustainability of forests, with species that will respond better to tomorrow's climates and provide a response to situations where natural regeneration is blocked. In recent years, planting has been given a boost with the introduction of the recovery plan, with the aim of planting 45,000 hectares in addition to the 50,000 hectares already planted annually. However, these operations are causing difficulties, as expressed by the various players, particularly forestry operators. Indeed, these operations are recognised as arduous and give rise to work-related illnesses and accidents, such as musculoskeletal disorders. The aim of the PIF project was to develop plantation management methods that meet the social and environmental expectations expressed by stakeholders. One of the aims of the project was to identify the phases of work carried out by the workers during planting and to assess the arduousness of each of them, in order to identify possible recommendations for reducing this hardship. Seven work sites were monitored between the end of the winters of 2020-2021 and 2021-2022. The aim was to study contrasting work sites in order to assess the effects of different conditions on the difficulty of the work (posture, duration or number of strokes required to put the soil in the ground). Two or three workers were monitored and filmed for one hour. This monitoring made it possible to complete an evaluation grid and thus obtain an overall rating for the arduousness, duration and average number of movements for each stage of the planting process. The phases encountered during the various monitoring sessions

	include moving between each plant, stripping, digging the hole, planting and compacting. The average duration of a tree planting cycle on the various sites is 32 seconds. This time may vary depending on the site, the individual and the attention given to planting. The phases of making the hole and planting the seedling appear to be the most arduous and the most repetitive. Posture, but also repetitiveness and therefore the duration of the phases, are major factors in the arduousness. The different contexts studied do not seem to have had any major effect on the postures of the planters. This difficulty is accentuated when there are stumps, coarse elements or slash on the site. Mechanised preparation of the soil has a direct impact on reducing the number of strokes, and therefore reduces the workload. Difficulties in moving around the sites, carrying heavy loads and the distance from the plant storage area also increase the workload. The 'individual' factor is still the main result when it comes to the actual difficulty of the practices. This effect varies according to body size, age, level of experience in the job, but above all the 'manner' in which the work is carried out by the forestry operator. This could also be linked to the effort put into the pickaxe by the planter, which could not be measured during the study.
Lessons learned (1200 characters max.)	The assessment of postures and durations highlighted the arduous nature of the act of planting, particularly when work sites are unprepared, in terms of slash management. Difficulties in moving around (no path in the plot or difficult access to it) combined with carrying heavy loads cause additional difficulties for the planter. The numerous trips to and from the planting site also make the work even more time-consuming. Preparing the planting site, when it is very cluttered (with many stumps or coarse elements), directly facilitates the planter's work. We can assume that slower work, with gestures that are sometimes more adapted, and less repetition of tasks carried out during and between days, would allow forestry workers to spare their bodies to a greater extent. Another lever could be to optimise the planting tool, in particular the pickaxe, which is the only possible tool on unprepared land. We can also work at plot scale and on the organisation of the work site, in particular by looking at the management of the seedlings, the cleaning of the plot and the clearing of paths for the planters. Following this study, technical sheets were drawn up to reduce the difficulty of the various stages encountered during a planting project.
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Links to website/report/video (if applicable)	https://renfor.hub.inrae.fr/projets/pif
Pictures (if applicable)	 Copyright : Sylvain Gaudin © CNPF.

ITHub 3 - 22

Title of innovation	**Innovative tool to reduce the arduousness of technical planting operations: the redesigned planting pickaxe**
ITHub	3
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	PIF
Operational Group (name)	Innovative forest plantations
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Researchers, forest managers, advisors, forest operators
Link from OGs database	https://www.reseaurural.fr/centre-de-ressources/projets/plantations-innovantes-en-foret-innover-pour-installer-des-plantations
Country, region, city	France, Grand-Est
Type of innovation	Technological innovation
Keywords	Plantation, Working conditions, Societal expectations
Approach and main results (4000 characters max.)	In the context of climate change, planting appears to be a major tool for guaranteeing the adaptation and sustainability of forests. In recent years, planting has undergone a major boom with the introduction of the economic relaunch plan. However, the various players involved, particularly forestry operators, have expressed difficulties with these operations. These operations are acknowledged to be arduous and give rise to work-related illnesses and accidents, such as musculoskeletal disorders. Frontal bending is the main biomechanical stress to which operators are subjected. The aim of the PIF project was to develop plantation management methods that meet the social and environmental expectations expressed by stakeholders. One of the aims of the project was to determine the various characteristics of the planting tool that would improve ergonomics and optimise the efficiency of the actions carried out by the operator. Three tools were selected and two series of tests were carried out with two different teams of workers in contrasting soil and climate conditions. The tool characteristics evaluated were: the length of the handle and its composition, the weight of the tool, the width of the pick and the width of the axe. The workers highlighted the need for a light, easy-to-handle pickaxe with a wide blade (necessary for stripping and making manual pot planting), as well as a long axe and a wooden handle. They also expressed the desire to be able to test other tools with longer handles. The aim of the second test was to determine the effect of the length of the tool handle on the operators' frontal flexion.

	Workers were asked to plant first with a conventional tool with a handle measuring one metre and then with a longer handle measuring one metre and thirty centimetres. Four experienced workers had to strip the soil using the tool's pick to gain access to the soil (stripping phase) and then split the soil with the axe and pick to create the location for the seedling (planting phase). Frontal flexion was measured by filming the operations during these two phases, and the videos were processed using Kinovéa software. The angular kinematics data showed that the length of the tool handle had an effect on the planter's posture, and that a longer handle would allow the planter to straighten up and reduce biomechanical stress. There were differences between individuals, which can be explained in part by the size of the individuals, but also by the techniques and postures adopted. However, the number of workers tested was not sufficient to carry out statistical tests and therefore to establish the significance of the results.
Lessons learned (1200 characters max.)	This work enabled us to identify a type of pickaxe that would optimise the planting of forest plants. The length and width of the pane and the axe were reworked to improve seedling placement and limit the number of pickaxe strokes. The length and material of the handle will be adapted to the user. The length of the handle and the material of the handle will have to be adapted to the user. It is important to note that the prototypes created during the PIF project were a great success with the operators, some of whom have continued to work with them. The various results suggest that workers need to have a range of different tools at their disposal, rather than a single tool, in order to adapt to the different sites and conditions they encounter. It would also be useful to continue testing these tools on a wider panel of operators, and also in contrasting soil and climate conditions, in order to be able to statistically determine the benefits and limitations of the tool, and also to refine the recommendations according to operator profiles.
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Links to website/report/video (if applicable)	https://renfor.hub.inrae.fr/projets/pif
Pictures (if applicable)	 Copyright : Sylvain Gaudin © CNPF.

ITHub 3 - 23

Title of innovation	**Technology at the service of forest renewal - mapping with drone and GPS to stake out the stand**
ITHub	3
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	PIF
Operational Group (name)	Innovative forest plantations
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Researchers, forest managers, advisors, forest operators
Link from OGs database	https://www.reseaurural.fr/centre-de-ressources/projets/plantations-innovantes-en-foret-innover-pour-installer-des-plantations
Country, region, city	France, Grand-Est
Type of innovation	Technological innovation
Keywords	Plantation, Working conditions, Societal expectations
Approach and main results (4000 characters max.)	In the context of climate change, planting appears to be a major tool for guaranteeing the adaptation and sustainability of forests. In recent years, planting has undergone a major boom with the introduction of the French recovery plan. Most of the work carried out to renew forest stands is conducted manually, and the work site preparation phase has not benefited from any major technological advances, allowing the areas to be planted to be mapped while taking into account the constraints of the terrain. Foresters have expressed a strong interest in improving the staking stage, which accounts for 35% of the time spent during the planting process and is traditionally carried out using a compass and a decametre. As part of the PIF project, the ONF and the FCBA have developed a new mapping and staking method, based on the use of a drone and a centimetre-accurate GPS. The first stage of this method involves flying over the area to be planted using a drone capable of providing photos with optimum resolution (1 to 2 cm/pixel) and geo-referenced using RTK (Real Time Kinematic) to around 1 cm. It takes ten minutes of flying time to cover 15 hectares. If the drone is not RTK-compatible, it is possible to add positions taken from a mobile GPS, as long as these points have been marked out on the ground beforehand. The photos taken during the flight are then assembled using software and the GPS coordinates recorded, to produce an orthophotograph. The orthophotograph produced will be used to define the future planting scheme. It will make it possible to identify the contours of the plot and the traffic routes, as well as to calculate the area to be planted

	and to position the future planting lines. This is a longer stage, depending on the complexity of the plot. The information gathered will enable a more accurate assessment to be made of the quantity of plants required and the time needed to complete the work properly. Following computer processing, a map will be generated incorporating the planting scheme. The data will then be transmitted automatically to a GPS via a server, and can be used directly by operators in the field to position the planting lines. The use of the drone combined with the use of a centimetre-precision GPS by the worker has made it possible to optimize the installation of the planting lines, with productivity three times higher than with the traditional method, and to improve its ergonomics.
Lessons learned (1200 characters max.)	The use of a drone, combined with the use of a centimetre-precision GPS by the worker, has made it possible to optimize the installation of the planting lines, with productivity three times higher than with the traditional method, and to improve ergonomics. Nevertheless, the use of drones remains costly and requires staff trained in their use. Flights require significant material and financial investment, as well as special administrative arrangements. This new mapping and staking method is currently being tested in the Grand Est region by several ONF work agencies. Work is also underway to develop these tools and integrate them into machines for mechanized preparation before planting, plantation maintenance or even to keep track of the location of partitioning networks on a plot of land.
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Links to website/report/video (if applicable)	https://renfor.hub.inrae.fr/projets/pif
Pictures (if applicable)	 Copyright © INRAE

ITHub 3 - 24

Title of innovation	**Group management trial**
ITHub	3
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	FPP-EGG
Operational Group (name)	Private and public forest - grouped forest management trial
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/fpp-egg-for%C3%AAts-priv%C3%A9es-et-publiques-essai-de.html
Country, region, city	France, Normandie
Type of innovation	Organisational innovation
Keywords	territorial animation, management
Approach and main results (4000 characters max.)	The fragmentation of private forest properties, with no sustainable management document, represents a real challenge for the development of sustainable forest management. To involve small owners, it is necessary to rely on dynamic local owners. The originality of this project is that the owner is a municipality, which could potentially lead to a revival of forestry on a massif-wide scale and thus provide information on an applicable method and on the juridical difficulties of this type of initiative. In fact, there are around 300 communal forest properties in Normandy not subject to the forestry legislation, for which the mayors often have ambitions, which could be inspired by this initiative and simultaneously lead many small neighbouring private forests towards sustainable management. This operational group aims to support the development of sustainable public-private management of forests in Normandy. The aim is to create a regional approach based on experiments in grouped public-private forest management, as well as common tools for consultation between the various organisations involved. The area selected was the upper part of the Becdal ravine in the communes of Quatremare and Mesnil Jourdain (27). The massif comprises 35 hectares of forest divided into 38 properties, with 10 hectares belonging to the municipality and more than thirty private forest owners owning the remaining area. The stands, soil and climate (current and future) were characterised, in order to define potentially interesting silvicultural projects. The majority of participants expressed the wish not to disrupt the landscape of the valley, and a financial balance will be pursued between income and expenditure to enable renewal

	without investment by the owners, apart from income from harvesting. Initially, there was no support for owners to join a structure, as each owner wanted to maintain his or her autonomy. If actions can be grouped together without being modified, then the possibility of a regrouping will be conceivable.The French National Centre for Forest Ownership (CNPF) was able to identify a strong desire from owners to conserve a high level of biological diversity. Stands and forest management in general were discussed and demonstrated in the field. Landowners were given technical factsheets corresponding to their stands, which raised a high degree of interest, and were analysed and discussed during individual interviews. The stands for which silvicultural action is accepted are those affected by dieback and/or biotic attacks. In order to offset the cost of reforestation and ensure sufficient revenue, it was proposed that living trees should be harvested by thinning. For non-declining stands, thinning was also proposed on the basis of biodiversity conservation criteria. The volume of wood cut is likely to be small and from a variety of species, which makes it difficult to commercialise. However, by grouping together, it is possible to offer sufficient volume to interest buyers. The CNPF has launched a call for proposals to estimate the volume and value of the thinning. This was sent to all the owners to obtain their agreement before the call for proposals was launched. However, the municipality's agreement could not be obtained before the end of the project. As a result, the worksite in the communal forest could not be approved, blocking the effective launch of the overall worksite.
Lessons learned (1200 characters max.)	The municipality's commitment enabled a calm and effective dialogue, leading to the mobilisation of a number of private owners. To gain the trust of the owners, the preferred method was to approach them collectively and individually. This method led to a felling and reforestation project being proposed for 4 landowners representing 15 hectares in the commune. In communal forests, the procedures for submitting land to the forestry legislation are very demanding, generating a caution and a long reflection period. In the absence of submission to the forestry legislation and of a Standard Management Agreement, it is not possible to draw up a sustainable management document for the communal forest, which then remains ineligible for subsidies. It seems difficult to envisage joint management unless private owners align themselves with the worksites, service providers and buyers identified by the national forestry office. The current situation is that the forestry code is designed to completely and systematically separate public management from private management. A national review of changes to the forestry code should therefore be considered in order to envisage joint management.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 25

Title of innovation	**Innovative tools for collaborative forest management**
ITHub	3
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	OG OUI-GEF
Operational Group (name)	OG OUI-GEF : Innovative tools for collaborative forest management
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/outils-innovants-pour-une-gestion-concert%C3%A9e-des.html
Country, region, city	France, Auvergne Rhône Alpes
Type of innovation	Social innovation
Keywords	Forestry, precision forestry, sustainable forestry, training
Approach and main results (4000 characters max.)	Wood production, biodiversity conservation, protection against natural risks, public reception for recreational activities, carbon storage... The forest provides multiple services at the origin of sometimes contradictory management issues which can generate conflicts between players. To reconcile all of these issues, the tools available to forestry stakeholders are increasingly numerous: remote sensing, field protocols, models, participatory approaches, etc. If these tools are co-constructed, articulated between them and shared with all stakeholders, they can contribute to the success of sustainable forest management. BETTER UNDERSTANDING THE FOREST, ITS SERVICES AND ITS PLAYERS LiDAR technology, Sylvacess model, diagnosis of the sensitivity of a stand to logging, protocol for characterizing mature forests... So many tools available to stakeholders in the territory and the timber industry to better understand and manage their forests. The OUI-GEF project aimed to help these actors take advantage of these tools and create multi-partner and concerted forest management. Carried out in three Regional Natural Parks (PNR), OUI-GEF is structured around three specific objectives. The first consisted of providing a more detailed understanding of the forest resource, its ecosystem services, the behavior of certain species sensitive to climate change such as

	spruce or fir, and knowing where the islands of old wood necessary for the preservation of the biodiversity. The second objective was to identify the conditions for mobilizing the resource (access, slopes, dragging distance) and the potential economic, environmental and social impacts of logging, and to study the behavior of private forest owners in order to determine their motivations for exploiting their forest. The third objective aimed to promote the sharing of knowledge between stakeholders, an essential issue to achieve multi-partner and concerted forest management in the territories. OUI-GEF has resulted in the creation of numerous tools and methods for the benefit of stakeholders and managers, including: • An innovative method for carrying out a forest inventory, based on LiDAR technology. • Automatic mapping of the accessibility of forest stands in mountain areas using Sylvaccess software. • A method for diagnosing the sensitivity of a stand to felling and estimating the effect of the intervention. • Operational models to map forests with a protective function (avalanches and rockfalls). • A simplified field protocol to identify mature forests, an essential element of the old woodland network. • An analysis of approaches to valorizing local wood resources which highlights the processes by which the value of local wood is built during the creation of a Wood Energy platform or an AOC (controlled designation of origin). • An online educational game to understand how forest wood, properly managed, transported, stored and burned, can advantageously replace other non-renewable resources to heat our homes. The challenge for the years to come is to continue the dissemination of tools and the sharing of knowledge resulting from the project. An online geocatalogue to encourage transfer. This geo-referenced metadata base brings together information on the data used by researchers and stakeholders involved in forest management: maps, field surveys, stand analysis grid, etc. It is accompanied by appropriate instructions for concrete issues in order to support the realization of forestry projects.
Lessons learned (1200 characters max.)	OUI-GEF has made it possible to develop operational and transferable tools offering stakeholders and managers the opportunity to better understand forests, their populations, their functions, etc. The active involvement of PNR project managers has encouraged strong mobilization of local stakeholders to participate in tests, respond to surveys and provide feedback on project output.
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Links to website/report/video (if applicable)	https://www.psdr-ra.fr/boite-a-outils/filiere-bois-foret

ITHub 3 - 26

Title of innovation	**Using UAV photogrammetric data to support multi-objective forest management plans**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-SURF
Operational Group (name)	DECISION SUPPORT TO SUSTAINABLE FOREST PLANNING
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company, NGOs, research institutions, advisor
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/supporto-decisionale-alla-pianificazione-forestale
Country, region, city	Italy, Tuscany
Type of innovation	Technological innovation
Keywords	Farming/Forestry competitiveness and diversification; Decisional Support System; selviculturale
Approach and main results (4000 characters max.)	In the Italian and European context, there is an increasing demand for forest and agroforestry companies to focus on multifunctionality. Furthermore, in recent years, the possibility of certifying some ecosystem services and multifunctional services has emerged. The first step toward certification is to have a sustainable forest management plan that details these aspects. In the case of the GO-SURF project, to obtain spatial data covering the entire forested areas within the project intervention zones, a fixed-wing UAV was used to derive some of the multifunctionality indicators. High-resolution orthophotos, for instance, were utilized to map forest types linked to biodiversity and conservation. Infrared orthophotos were employed to identify the presence of standing deadwood, which serves as a proxy for biodiversity analysis related, for example, to saproxylic insects. Additionally, roads and trails were mapped to identify potential tourist routes. The UAV has enabled the accurate mapping of some of these indicators, which are subsequently integrated into the decision support system. These data can be used to develop multifunctional and multi-objective management plans.

Lessons learned (1200 characters max.)	The cost of the UAV used for mapping is indeed quite high, but companies have the option to collaborate with service providers rather than purchasing one themselves. The generated data, however, are crucial for developing multi-objective management plans. Compared to traditional survey methods, these data save time in terms of fieldwork. The use of this data also provides standardized information across the entire area, which is valuable for working towards certification of ecosystem services.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 27

Title of innovation	**Decisional Support System to support the revision of forest management plans**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO-FOR.TRACK
Operational Group (name)	DECISIONAL SUPPORT SYSTEM TO MAP FOREST RESOURCES
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, forest company, NGOs, research institutions, advisor
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/sviluppo-di-un-sistema-di-supporto-decisionale-la
Country, region, city	Italy, Calabria
Type of innovation	Technological innovation
Keywords	Farming/Forestry competitiveness and diversification; Decisional Support System; silviculture
Approach and main results (4000 characters max.)	The Common International Classification System of Ecosystem Services (CICES) categorizes ecosystem services into three primary groups: i) provisioning, ii) regulation and maintenance, and iii) cultural. Ecosystem services can be evaluated both in terms of their physical attributes and their economic value. A physical assessment relies on biophysical models of ecosystem services that take into account the functions and processes of ecosystems necessary to provide the specific service. Within the GO-FORTRACK, were employed various spatial approaches to quantify physical aspects related to some ecosystem services. Specifically, we developed maps for carbon, biomass, and forest types, which can be associated with ecosystem services related to prediction, regulation, and maintenance. These maps were then integrated into a simple decision support system within the project's test areas, enabling forest managers to access this information at the individual forest parcel scale. It was decided to derive this information at the forest parcel scale because, in the context of Italian forestry laws, which require that a forest management plan be approved by the relevant public authority, it is always necessary to describe each individual parcel and provide quantitative data. This system can help maintain parcel records and automatically generate the parcel cards/reports required by law.

Lessons learned (1200 characters max.)	This straightforward report automation tool allows forest managers to save time on report and plan writing, which can then be allocated to other forest management-related activities. It can significantly reduce the costs associated with the drafting and development of a forest management plan. Additionally, the availability of various maps within the system aids in the analysis of plan objectives and interventions, providing a more detailed knowledge framework.
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ITHub 3 - 28

Title of innovation	**A User-Friendly Platform for Bridging the Gap between Carbon Credit Demand and Supply**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	CO2 S.Fo.Ma. MARCHE
Operational Group (name)	CO2 STORED in FOREST MANAGEMENT MARCHE
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forestry doctors, researchers, doctors in natural sciences, biologists, environmental engineers , Forestry and Agriculture Societies (SAF), Category Associations, Consortiums of local companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/calcolo-e-certificazione-del-sequestro-del-carbonio
Country, region, city	Marche, Italy
Type of innovation	Organisational innovation
Keywords	business model, carbon stock, digital platform, Managing ecosystem services, Multifunctional forest management, Sustainable Forest Management
Approach and main results (4000 characters max.)	At the beginning of CO2 Marche project, the market of additional Carbon credits was still not very popular in Italy. For that, in the context of sustainable forest management certification, was created a new platform for the voluntary sustainability credit exchange. The goal of the platform is to connect demand and supply of carbon credits deriving from Sustainable Forest Management in a voluntary trading market for tonnes of stored carbon with additionality criteria (not counted by the Italian government under the Kyoto and Paris Agreements). Also for the offer, the platform is accessible not only to the project partners, but to any operator wishing to undertake the carbon certification and counting route. When an acquirent is interested in supporting a specific additional project, the first thing is to specifically identify the area's characteristics and the kind of activity that will be put in practice, in order to quantify the entity of the positive impacts generated. The control of the quality of the additional credits is accounted by the Inspection Body, which will annually verify compliance with the requirements of the PEFC standards. Forests certified according to Sustainable Forest Management (SFM) are able to store more carbon than unmanaged (i.e. uncut) and untended forests; they contribute to climate change mitigation; they prevent natural and environmental hazards such as forest fires, hydrogeological disruption, soil erosion; they protect biodiversity and the landscape;

	they offer tourist-recreational attractions and forest products and by-products, along with culture, traditions and work for skilled forest workers.
Lessons learned (1200 characters max.)	From the point of view of the ecosystem services generated, if these values were confirmed for all the certified areas of the project, Bosco di Marca Group, the active management actions would lead to the absorption of several thousand tonnes of CO2, contributing in parallel to the creation of new business opportunities for forest managers. In fact, taking into consideration the additional actions, in terms of management (e.g. conversion of coppice to tall trees), that could be carried out in beech forests and areas with mixed deciduous trees (which account for approximately ⅔ of the certified surface area), it would be possible to store up to a maximum of approximately 24,000 tonnes of CO2 more each year (i.e. 24,000 sustainability credits). This is without taking into account the presence and increase of other co-benefits derived from Forest Sustainable Management that are not directly measured, such as increased biodiversity, improved water resource management, reduced erosion phenomena, and a positive image linked to tourism related to nature enjoyment.
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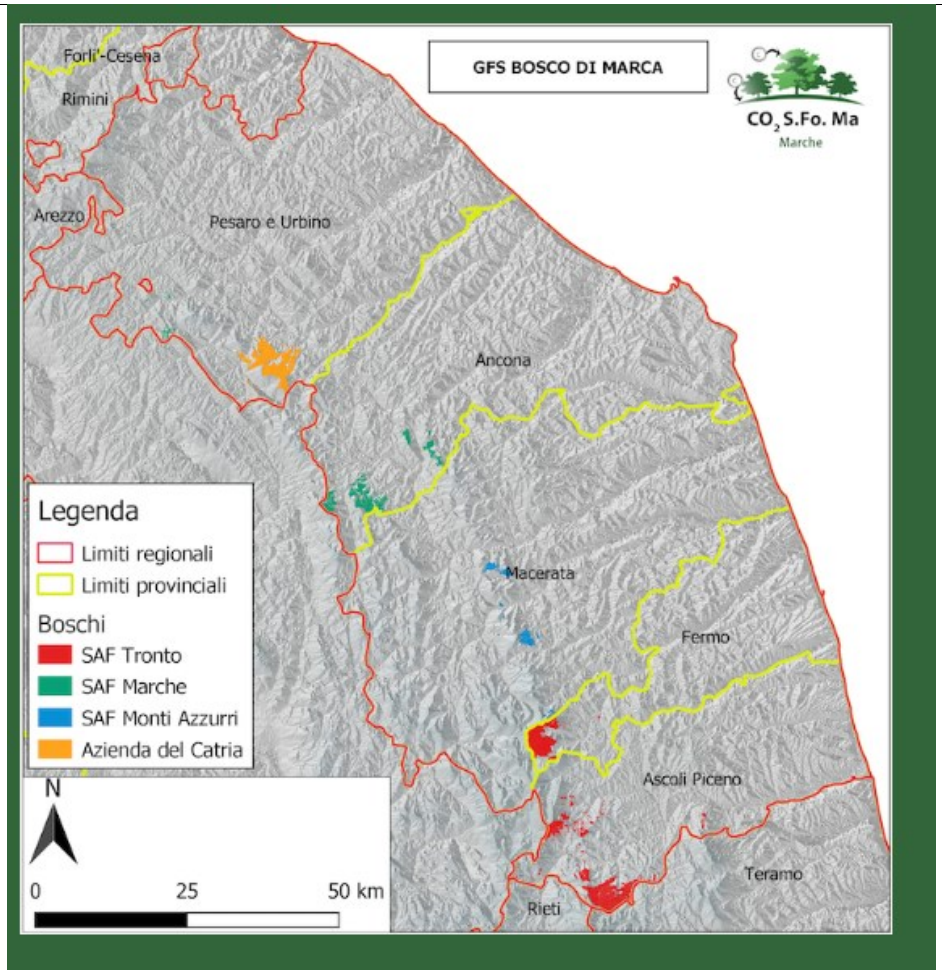
Links to website/report/video (if applicable)	https://www.co2marche.it/
Pictures (if applicable)	

ITHub 3 - 29

Title of innovation	**Developing a Novel Martelloscope for Assessing Biodiversity and Growing Stock Volume with the aid of a Digital Twin**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	BIOSEIFORTE
Operational Group (name)	BIOdiversity and Ecosystem Services in Forests and Territory
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forestry doctors, researchers, doctors in natural sciences, biologists, environmental engineers , Forestry and Agriculture Societies (SAF), Category Associations, Consortiums of local companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/biodiversita-e-servizi-ecosistemici-foreste-e-territorio
Country, region, city	Marche, Italy
Type of innovation	Technological innovation
Keywords	Digital tools, Sustainable Forest Management, Ecosystem Services, biodiversity
Approach and main results (4000 characters max.)	As part of the GO, an experimental marteloscope was used, where trees were surveyed through acquisition with the Geoslam ZEB Portable Laser Scanner system, which made it possible to recreate a 3D digital twin. Then, for each of the trees surveyed and forming part of the marteloscope, dendromicrohabitats were then obtained by means of traditional surveying, which made it possible to derive the Index of Potential Biodiversity (IBP) for each tree, in order to be able to introduce the quantification of biodiversity into the forest management plans and provide the users of the "gymnasium" an output in relation not only to productive interventions (wood growing stock) but also silvicultural interventions that take into account the biodivesity parameters. Operationally, in a 1-hectare area of transitional beech stand, each individual tree (tree or sucker) was numbered, measured (crown insertion height and total height) and georeferenced, and its calculated volume and position data recorded in special software. In addition, each individual tree or stump was checked for the presence of dendrothelia (alterations, cavities, cracks in the stem and branches) that may constitute microhabitats for various plant and/or animal species and increase the ecosystem value of the stand in terms of biodiversity.

Lessons learned (1200 characters max.)	The use of new technologies is becoming more and more widespread in the analysis and monitoring of forest stands, and in particular forestry application of mobile LiDAR is becoming more widespread as it allows a considerable reduction in survey time and costs and returns good data accuracy, whereas up to now it has been used mainly in the building and infrastructure sector. Furthermore, the monitoring and quantification of biodiversity variation based on silvicultural choices made with the marteloscope is a useful added value for forest sustainable management, ecosystem services enhancement, as well as production aspects.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 30

Title of innovation	**Training for Forest Technicians, Researchers, and Employees on Fundraising and Communication Topics as Assets for Ecosystem Services Enhancement Projects**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	CO2 S.Fo.Ma. MARCHE
Operational Group (name)	CO2 STORED in FOREST MANAGEMENT MARCHE
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forestry doctors, researchers, doctors in natural sciences, biologists, environmental engineers , Forestry and Agriculture Societies (SAF), Category Associations, Consortiums of local companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/calcolo-e-certificazione-del-sequestro-del-carbonio
Country, region, city	Marche, Italy
Type of innovation	Service
Keywords	cooperation, ecosystem services, innovation social system, sustainable forest management, communication, formation
Approach and main results (4000 characters max.)	During the project a specific internal training within the GO focused on fundraising and formation on the transfer of knowledge, in order to increase communication skills of the partnership aimed at disseminating the concept of the environmental service of forests and a collective recognition (also economic) of this service, thanks also to the creation of a carbon credit exchange platform. The main focus was enabling the forest technicians, researchers and employees involved in the project to raise funds and seek financing for forest sustainable management, with a view to attributing a recognised economic value to the storage of carbon (PES - Payment for Environmental Services) in order to improve the communication approach towards interested entrepreneurs, to involve forest and private individuals potentially interested in both the purchase of Sustainability Credits and the PES (Payment for Ecosystem Services) of Ecosystem Services. Beside that, many field iniciatives were organized and a series of digital and paper material have been shared in order to disseminate the project results in the territory and raise awareness amd interest on sustainable forest management and ecosystem services.

Lessons learned (1200 characters max.)	The sale of sustainability credits and payment for ecosystem services, other than the traditional sale of timber,is an important objective of the G.O. and can be improved thanks to a good communication strategy and empowering specific communication skills of G.O. members. During the formation participants have learnt new useful knowledge that will be put in practice adding value to the project. and showed interest in The subjects addressed showed interest in the meetings, even if were held online in webinar mode due to the Covi-19 emergency.
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Links to website/report/video (if applicable)	https://www.co2marche.it/
Pictures (if applicable)	

ITHub 3 - 31

Title of innovation	**Training for Forest Operators in Intervention Techniques to Enhance Carbon Credit Generation**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	CO2 S.Fo.Ma. MARCHE
Operational Group (name)	CO2 STORED in FOREST MANAGEMENT MARCHE
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forestry doctors, researchers, doctors in natural sciences, biologists, environmental engineers , Forestry and Agriculture Societies (SAF), Category Associations, Consortiums of local companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/calcolo-e-certificazione-del-sequestro-del-carbonio
Country, region, city	Marche, Italy
Type of innovation	Process
Keywords	ecosystem services, sustainable forest management, carbon stock, formation
Approach and main results (4000 characters max.)	A project aimed at generating ecosystem credits requires approval from a verification body. Among all the criteria necessary for project approval, additionality is perhaps the key factor: it must be demonstrated that without the implementation of the project and specific management measures, no environmental benefit would be achieved. Therefore, in the context of ecosystem credit generation, it is necessary to develop additionality projects through silvicultural interventions that increase carbon storage and improve biodiversity within the canopy. These silvicultural interventions, as opposed to conventional forestry practices, require specific training for the operators working in the forest. Within the framework of GO CO2MARCHE, which has the goal of enhancing carbon credits, it was considered important to provide specific training for forestry operators in silvicultural choices and forest interventions aimed at generating additionality. The training included activities such as selective harvesting, thinning, conversion to high forest, and the selection of trees to promote biodiversity aspects. The training was conducted directly in the forest through a practical course. The training allowed for practical activities to explain how to carry out additionality projects and to educate operators who typically work in the forest only on conventional silvicultural interventions. This has enabled the operators to become self-sufficient in implementing specific additionality interventions in

	the designated GO CO2MARCHE project area, as well as to make them self-sufficient for future additionality projects in other areas.
Lessons learned (1200 characters max.)	The course was useful for pursuing qualitative growth in the work of forestry workers with a view to sustainable forest management and the improvement of ecosystem services and the carbon stock. The practical course was considered useful by the operators because it was conducted directly in the forest. Furthermore, it allowed for the expansion of the operators' skills.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 32

Title of innovation	**Group Certification for Sustainable Forest Management: Promoting Shared Forest Management and Ecosystem Services Enhancement**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	CO2 S.Fo.Ma. MARCHE
Operational Group (name)	CO2 STORED in FOREST MANAGEMENT MARCHE
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forestry doctors, researchers, doctors in natural sciences, biologists, environmental engineers , Forestry and Agriculture Societies (SAF), Category Associations, Consortiums of local companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/calcolo-e-certificazione-del-sequestro-del-carbonio
Country, region, city	Marche, Italy
Type of innovation	Process
Keywords	Carbon stock, cooperation, ecosystem services, multifunctional forest management, sustainable forest management, certification
Approach and main results (4000 characters max.)	In Italy one of the main obstacles to forestry management is fragmentation and small forest area of private properties. For overcoming this problem, the project CO2 Marche promoted a Group Certification between different forest owners. The Group Certification is specifically designed for small and collective forest properties, is the result of great teamwork related to the ability to unite public and private forces, overcoming territorial fragmentation for a common goal in order to simplify and share the organisational aspects of Sustainable Forest Management Certification and to reduce its costs. It is an alternative approach to individual certification, allowing certification of several forest owners as a group. It requires a Lead Partner representing the group, with responsibility for ensuring that the forest management practices of individual owners within the certified area comply with PEFC requirements. In the context of the project, the 'Bosco di Marca' was created, a forest consortium of 9208,25 ha that achieved the goal to obtain the PEFC Sustainable Forest Management Group Certification. Forest Group Certification is a good opportunity for forest owners to manage forests and the ecosystem services produced, by increasing carbon storage, prevent forest fires, hydrogeological instability, soil erosion, protect forests and biodiversity, contribute to good water and air quality, mitigate temperatures and climate change, enhance the landscape and offer better tourism and recreational services. Moreover, in the context of the project, a particular attenction was

<table>
<tr><td></td><td>put in promoting the exchange of sustainability credits and create employment and wealth in the mountain areas of the Marche Region, with a special focus on the 2019 earthquake crater area. The certification highlights the effort put to enhance ecosystem services: it demonstrates concretely how forests and woodlands can be not only an environmental but also an economic resource, and how everything is interconnected. Forest owners and managers will then be able to calculate the forest's carbon storage capacity and offer credits to be sold to organisations or companies wishing to neutralise their emissions. In this way, forest communities will be able to survive and not abandon the inland areas of the country.</td></tr>
<tr><td>Lessons learned (1200 characters max.)</td><td>This group certification model allowed the achievement of the largest group certification in central Italy with 9,208.25 ha. This certification is proof of the possibility of overcoming territorial fragmentation for a common objective by uniting public and private forces. In these areas, obtaining and maintaining GFS certification will guarantee not only the application of a continuous monitoring system but also the implementation of a continuous improvement programme.</td></tr>
<tr><td>Contact information</td><td>Marco Perrino (perrino@dream-italia.net) Solaria Anzilotti (solaria.anzilotti@unifi.it)</td></tr>
<tr><td>Links to website/report/video (if applicable)</td><td>https://www.co2marche.it/</td></tr>
<tr><td>Pictures (if applicable)</td><td>
<table>
<tr><th>Membro del gruppo</th><th>Superficie certificata (ha)</th></tr>
<tr><td>SAF Marche</td><td>2.184,72</td></tr>
<tr><td>SAF Monti Azzurri</td><td>419,29</td></tr>
<tr><td>Saf Tronto</td><td>3.941,56</td></tr>
<tr><td>Az. Speciale Consorziale del Catria</td><td>2.662,68</td></tr>
<tr><td>TOTALE</td><td>9.208,25</td></tr>
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ITHub 3 - 33

Title of innovation	**Enhancing Additionality Assessment of Carbon Credit of Various Interventions by Utilizing Site-Specific Historical Data in Compliance with IPCC International Standards**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	CO2MARCHE
Operational Group (name)	CO2 STORED in FOREST MANAGEMENT MARCHE
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forestry managers, researchers, doctors in natural sciences, biologists, environmental engineers , Forestry and Agriculture Societies (SAF), Category Associations, Consortiums of local companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/calcolo-e-certificazione-del-sequestro-del-carbonio
Country, region, city	Italy, Marche
Type of innovation	Product
Keywords	Forestry, Sustainible Forest Management, Carbon accounting,
Approach and main results (4000 characters max.)	In carbon credit additionality projects, it is essential to use precise quantification methods to avoid incorrect estimations. In this context, within the framework of the CO2MARCHE Operational Group, an international methodology based on the IPCC standards has been chosen as reference fo the quantification of carbon credits. However, to arrive at a more accurate estimation of carbon credits, the international ICPP methodology has been link with a site-specific metholdology developed within the CO2MARCHE OG. The site-specific methodology takes into account site-specific data for each of the additionality measures proposed concerning the Business As Usual (BAU) scenario (e.g., converting coppice/stand, extending the harvesting rotation, and wildfire prevention). Indeed, the CO2MARCHE project covered 9,000 hectares of forests managed in the past for which historical dendrometric data were already available. These historical data pertained to forest parcels managed in the past with practices similar to those proposed in the additionality measures. This enabled the adjustment of the IPCC models to the actual biomass and CO2 increases recorded in the project areas. This approach allowed for more accurate carbon estimates and the calculation of additionality based on real growth data. From a credit quantification perspective, this approach is, therefore, more rigorous compared to the usual methods applied in other certification standards. In this context, CO2MARCHE has also contribute to develop the national certification standard of PEFC for carbon credits that can be request just if the forest are manage under the sustainible forest

	managment PEFC national standard. Moreover, at the moment in Italy there is a National Carbon Credit Registry.
Lessons learned (1200 characters max.)	In the context of carbon credits, it is necessary to have quantification methodologies for the carbon credits generated by additionality measures that are as rigorous and transparent as possible to avoid speculation. In this context, the CO2MARCHE operational group worked to develop a methodology that aligns with the IPCC standards but is also informed by site-specific data. This was made possible because the forests had been managed in the past, and historical dendrometric data allowed for the quantification of the increases resulting from silvicultural interventions. The project highlighted that it is indeed active forest management that generates additionality and, consequently, carbon credits. Furthermore, these evidence-based methodologies using real data ensure that the generated credits can be certified, particularly under the new PEFC standard in Italy, which is based on stringent methodologies compared to other standards.
Contact information	Marco Perrino perrino@dream-italia.net - Antonio Brunori info@pefc.it - Francesca Giannetti (francesca.giannetti@unifi.it)
Links to website/report/video (if applicable)	https://www.co2marche.it/
Pictures (if applicable)	

ITHub 3 - 34

Title of innovation	**Efficient Sampling Methodology for Calculating Soil Carbon Credits**
ITHub	3
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	CO2MARCHE
Operational Group (name)	CO2 STORED in FOREST MANAGEMENT MARCHE
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forestry managers, researchers, doctors in natural sciences, biologists, environmental engineers , Forestry and Agriculture Societies (SAF), Category Associations, Consortiums of local companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/calcolo-e-certificazione-del-sequestro-del-carbonio
Country, region, city	Italy, Marche
Type of innovation	Process
Keywords	Forestry, Soil, Carbon stock and sink, Soil Organic Carbon (SOC), Sustainable Forest Management (SFM), Ecosystem services, New value chain
Approach and main results (4000 characters max.)	Soil Carbon Credits are additional carbon credits that enhance ecosystem services, such as C stocking and improving rural economy, and SFM applicability. Soil Carbon Credits are additional carbon credits that enhance ecosystem services, such as C stocking and improving rural economy, and SFM applicability. Data from 5 different C pools of forests were estimated for the quantification of total organic C in 3 forest sites: Above and below ground biomass (AGB; BGB), litter, dead wood and soil. AGB C was estimated in sample plots on an INFC model, BGB C was calculated using specific root-to-shoot ratios (RSR), dead wood by field analysis (measurements of the diameter of dead wood >2.5 cm and the classification based on decomposition classes on a transect) followed by the application of a function to calculate the C stored; litter C stock through the ratio of organic C mass to surface area and SOC by collection of composite samples taken at 3 different depths (0-5 cm, 5-15 cm, 15-30 cm)and rock% and Bulk Density (BD) calculation, followed by SOC estimation through elemental analyzer. Thanks to this analysis it was possible to calculate the total C content of the forest ecosystems and compare the C storage capacity of conventionally managed forest plots (unmanaged or coppiced) and plots under SFM (transitional forest).

Lessons learned (1200 characters max.)	SFM supports C storage in the various forest compartments, (soil, biomass and necromass) increases the provision of ecosystem services, forest productivity, and contributes to climate change mitigation while providing support to the local rural economy.
Contact information	Gregorio Fantoni (gregorio.fantoni@unifi.it) Solaria Anzilotti (solaria.anzilotti@unifi.it)
Links to website/report/video (if applicable)	https://www.co2marche.it/
Pictures (if applicable)	

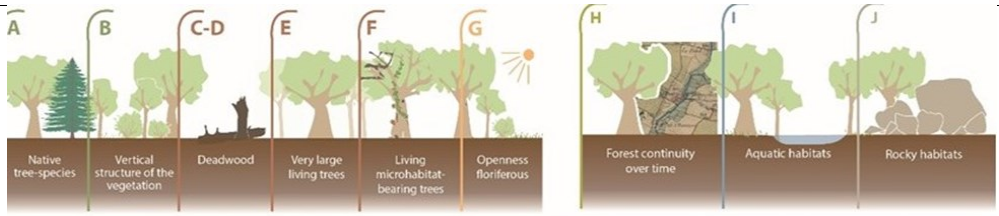
ITHub 3 - 35

Title of innovation	**Assesing the efficiency of different prevetion methods of pine pitch canker, and the creation of a manual with the good pratices to follow in plant nurseries**
ITHub	3
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO +PrevCRP
Operational Group (name)	Operational group for the development of integrated strategies to prevent pitch canker on pine
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	2 Forest Owners Associations, 4 Plant Nurseries, 2 Universities and 5 research and development companies
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/desenvolvimento-de-estrat%C3%A9gias-integradas-para.html
Country, region, city	Portugal
Type of innovation	Process
Keywords	Pest/disease control; plant production and horticulture
Approach and main results (4000 characters max.)	Pine pitch canker is a disease caused by the fungi *Fusarium circinatum*, which is a quarantine disease, that can lead to serious problems in the production of plants by the nurseries and a shortage in the availability of seeds. The fungi can be dispersed by wind, water and insects, however the most common way is by transporting/using seeds and plants that are infected but don't show signs and symptoms of the disease yet. This project had was its objectives the creation of standard procedures to disinfect the seeds, plant containers and the water used to irrigate. To achieve this goal various technics were tested in different pine specimens (*Pinus pinaster, Pinus pinea, Pinus radiata, Pinus sylvestris*), and their result were reported in a manual that summarizes the results of the different experiments and has the description of the techniques used with the most success. The success of the technique was measured by different factors, first of all was if the fungi was present after the treatment, then the germination rate, and for last, the size of the plants created. The methods that had a high success in the lab experiments were put to the test in the field, in this case the plant nurseries, to check their feasibility in the "real world". The seeds are one of the most important ways of dispersion of the fungi inside a plant nursery, therefore the disinfection of seeds is way to avoid and minimize the infection of plants by the disease. The treatments that will be described should be applied before the hydration of the seeds and after the treatments they are ready to be seeded. From the different approaches used the most successful ones were:

	Heating water until 60°C and submerging the seeds for 15 minutes maintaining the water temperature; Submerging the seed for 30 minutes in a solution of 20% H_2O_2 (Hydrogen peroxide); Submerging the seeds for 5 minutes in a solution of 60% C_2H_6O (Ethanol) or 70% in the case of *P. pinea*; Submerging the seeds for 5 minutes in a solution containing 1,9g of Captana (Captana 800 WDG) per litter of water. From the different techniques used in the disinfection of the plant containers, hydrogen peroxide was the substance that showed the best results and didn't affect the growth of the plants. To achieve the expected result the containers should be submerged for 30 minutes in a solution of 20% H_2O_2 (Hydrogen peroxide). To disinfect the irrigation water the treatments should be applied in the reservoir of the water that is going to be used. The most effective treatments were: Appling 10,2 litters of Desogerme (Desogerme SP Vegetaux) per 1000 litters of water (1% solution); Appling 42 litters of Hydrocare (Intra Hydrocare) per 1000 litters of water (4% solution). Pine bark is used a lot by plant nurseries as a soil component that gives porosity to the soil, however because it comes from a host plant it may contribute to the dispersion of the disease. Different components that can do the same function as pine bark were tested, the maximum percentage of each tested component in the soil are: 30% for Perlite (2-6mm), Polystyrene foam grains (8-12mm), ADT cork grains (1-2mm) and 15% "falca" (shredded cork from the first debark).
Lessons learned (1200 characters max.)	From this project a standard procedure was created to combat the infection by *Fusarium circinatum* in plant nurseries. Various techniques were tested for the different ways of this fungi dissemination, which are, in the case of pant nurseries, by infected seed, plant containers and the water used in irrigation. The ones that were effective in the elimination of the fungi and didn´t effect the germination rate or plant growth, were summarized and described in detail. All the results of the different case studies allowed the creation of different scientific articles, in this way sharing the results with the academic and scientific community. And the creations of a manual, easily available to plant nurseries workers with the methods tested. This manual "Technical manual for the suppliers of forestry reproduction materials – Prevetion of pine pitch canker" ("Manual técnico para fornecedores de materiais florestais de reprodução – Prevenção do cancro-resinoso-do-pinheiro") is available online and printed. It was freely distributed to forest owners associations, diverse entities related forestry and plant nurseries, which allows the information to reach its target audience.
Contact information	info.projetos@icnf.pt
Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 3 - 36

Title of innovation	**Index of Biodiversity Potential (IBP): a practical tool for forest managers**
ITHub	3
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	OG Douglas
Operational Group (name)	OG Douglas : Climate Change, what future for douglas fir in Burgundy?
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/changement-climatique-quel-avenir-pour-le-douglas.html
Country, region, city	France, Bourgogne - Franche Comté
Type of innovation	Technological innovation
Keywords	Forestry, Biodiversity and nature management, Decision support system
Approach and main results (4000 characters max.)	The IBP was created in 2008 (Larrieu & Gonin, 2008) in order to help forest managers to take into account ordinary taxonomic biodiversity into routine management. It is an indirect and composite indicator which pools ten factors, identified as influencing the capacity of forest stands to support animal, plant and fungal species. IBP scoring is simple, fast and requires no particular taxonomic knowledge. In practice, it suffices to go through the stand by counting the elements relating to each of the ten factors and to give a score between 0 and 5 for each one. The sum of these scores gives the IBP and helps to place the stand in a range from low to high capacity. The IBP is usable in a range of contexts, as much in productive forests as in areas given over to conservation. It can also be used as a teaching aid in that it permits making certain principles that govern taking biodiversity into account easier to understand. The sampling method is chosen according to the objectives and the characteristics of the forest, the best way is to score IBP at the same time as another operation in the forest. For example, IBP can be scored during the visit of a stand before a thinning. The IBP will help the manager to identify the elements favourable to biodiversity to be preserved, in particular the trees of biodiversity interest, and the factors that could be improved. A radar diagram created with IBP scores is a good way to identify these differences between the factors.

	A few ways to improve each factor are proposed in the IBP educational document (Emberger et al., 2016). More generally, the diversity of ordinary species can be improved by multiplying the living habitats corresponding to the ten factors, and by ensuring their continuity, in time and space. In the end, the IBP gives the manager a new look at the forest, and this is the reason why the IBP is often used to explain biodiversity, not only to professionals but also to owners and more generally to all people concerned with forest biodiversity.
Lessons learned (1200 characters max.)	The IBP was created in France, for all types of forests in the different biogeographical regions. Soon after, the stakeholders from different European and Mediterranean countries made clear their interest in acquiring an IBP definition adapted to their own contexts. For this purpose, a methodology was proposed and an international organisation was created: the International Committee of Experts. This Committee ensure the consistency of IBP extension projects, (i) by providing scientific and technical advice on new IBP versions, (ii) by discussing ongoing projects, (iii) by pooling resources. The first IBP extension was carried out through two Life projects: BIORGEST in Catalonia and GoProFor in Italy. Currently, this extension continues for the whole Spain and Greece through Life GoProFor Med project, while other countries are also testing IBP. Thus, these programmes help to create synergy at the international level on a common issue: the consideration of biodiversity in forest management.
Contact information	pierre.gonin@cnpf.fr
Links to website/report/video (if applicable)	
Pictures (if applicable)	 **Fig. 1: The 10 factors of the IBP (following Emberger et al., 2016). 7 factors related to stands and forestry management (from A to G) and 3 factors related to context (from H to J).**

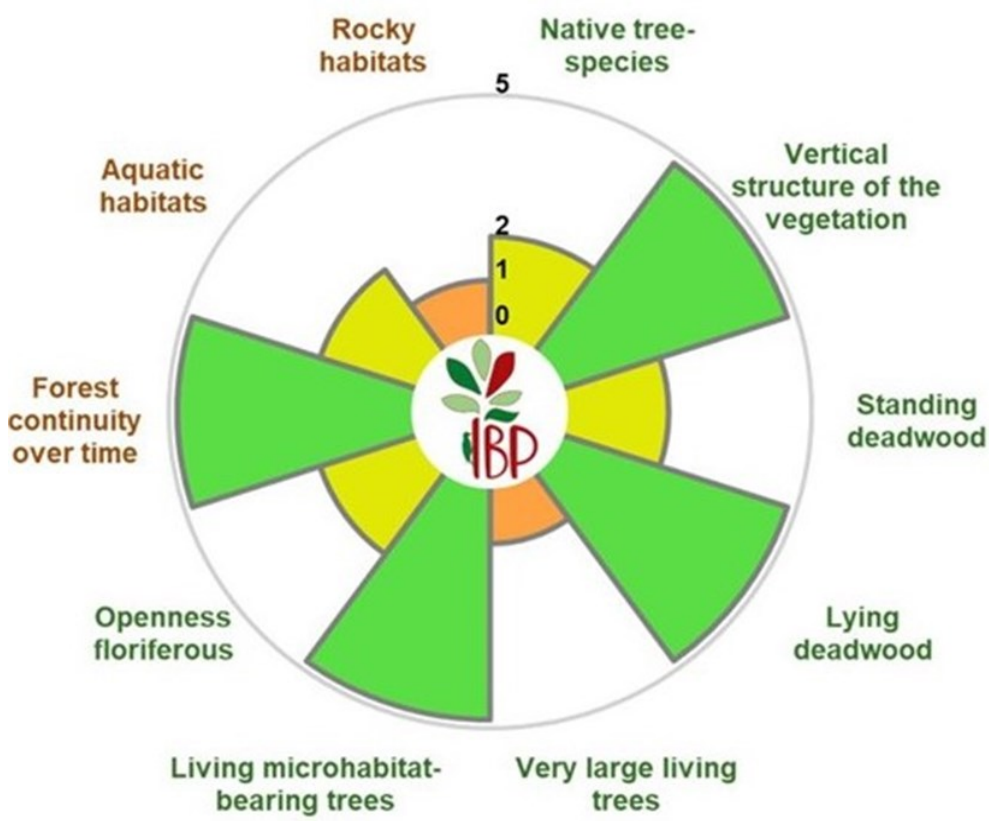


Figure 2: an example of the radar diagram for the Index of Biodiversity Potential (IBP)

ITHub 4 – Non-wood forest products (36 extended summaries)

Table 11. Overview of the extended summaries of ITHub 4.

	Title of innovation	Operational Groups (short name)	Type of Innovation	Country
1	Resin Data Observatory	GO RESINLAB	Service	SPAIN
2	Mechanised resin extraction method	GO RESINLAB	Process	SPAIN
3	Identification of compounds of industrial interest	GO Pinus Resina	Technological	Portugal
4	Post harvest cotings from mushroom by products	Micocoating	Technological	Portugal
5	Valuate the traditional chestnuts production	VolorCast	Process	Portugal
6	The Burgundy truffle, a quality product with high added value	OG BIJOU	Product	France
7	Fertilization recommendations for cork oak	OG NUTRISUBER	Service	Portugal
8	Brochure for the collection of soil samples in cork oak forests	OG NUTRISUBER	Service	Portugal
9	Brochure for the collection of soil samples in stone pine	OG FERTIPINEA	Service	Portugal
10	Pinea ClimaDAT. A tool for pinion harvest prediction	OG PINEA	Service	SPAIN
11	Smartbasket. An app for mushroom lovers	OG MIKOGEST	Technological	SPAIN
12	Visor Mikogest	OG MIKOGEST	Service	SPAIN

13	Mushroom collectors association	OG MIKOGEST	Organisational	SPAIN
14	App Micontrol	OG MIKOGEST	Service	SPAIN
15	Exchange between chestnut growers	OG INGECA	Social	Italy
16	Integrated management of resources (water and soil) in nuts production	EGIS	Process	Portugal
17	Biological Treatment of cancer chestmenut (Cryphonectria parasitica) in Portugal	Bio-Chestnut- IBM	Technological	Portugal
18	Mobile kiln prototype for local biochar production	GO INGECA	Technological	Italy
19	Endotherapic treatments with *Trichoderma* spp. to control fungal diseases in chestnut groves	OG INGECA	Technological	Italy
20	Methodology for plantations	ClimCast	Process	Portugal
21	Valorization of a neglected plant	SambucusValor	Product	Portugal
22	Valorization of dried nuts with hard skin	ValNuts	Product	Portugal
23	Mechanised cork extraction method	OG SUBER	Process	SPAIN
24	Quality cork guide	OG SUBER	Product	SPAIN
25	Mechanised resin extraction method	OG ACREMA	Process	SPAIN
26	Wood-resin compatibility model.	OG ACREMA	Product	SPAIN
27	Analytical techniques based on nir technology for the characterisation of resins and their derivatives.	OG ACREMA	Technological	SPAIN
28	New cork uses guide	OG SUBER	Process	SPAIN

29	Establishing new business models with NWFP	Bienwald (Bee forest)	Product	Germany
30	Interactive Pinus pinaster resin production simulator	OG ACREMA	Service	SPAIN
31	Methods for managing cork oak forests with platype attacks from the Sor region (Process; technique)	PLATISOR	Technological	Portugal
32	Diversification of edible wild mushroom cultivation with new native species	OG TEb Verd / BoletBenFet	Product	SPAIN
33	Improving productivity and sustainability of black truffle plantations by microbiological handling of the rhizosphere	not found (project of 2015)	Product	SPAIN
34	Geolocation and monitoring of animals to identify possible incidents and improve the management of animals and pastures	OG CLIM'AGIL	Technological	SPAIN
35	Development of a system to remove TCA from cork stoppers using adsorbents and biosorbents	OG TCA	Product	SPAIN
36	Evolution of oxygen transfer in the various cork stopper manufacturing conditions. Effect of this parameter on still and sparkling wine	GO OTR	Product	SPAIN

ITHub 4 - 1

Title of innovation	**Resin Data Observatory**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO RESINLAB
Operational Group (name)	Operative Group for the creation of new products, services and infrastructures adapted to the real needs of the natural resins sector.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two resin processing industries, representation of forest owners (2 entities, national and regional), resin producers' cooperative and two forestry technology centres.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/grupo-operativo-resinlab-para-la-creaci%C3%B3n-de.html
Country, region, city	Spain
Type of innovation	Service
Keywords	Non-wood forest product; Decisional Support System; Cooperation digital platform
Approach and main results (4000 characters max.)	Throughout 2022 and 2023, GO Resinlab has worked, as one of its main objectives, on the construction of a tool for knowledge transfer, sector transparency, scientific and technical cooperation and decision support. This tool has finally materialised in the form of a collaborative digital platform called "Resin Data Observatory". This web platform gathers quantitative and qualitative information on the resin sector in Spain and seeks to meet the needs of the different stakeholders involved in the resin value chain. The Resin Observatory is structured in four main blocks: (i) Databases on harvesting for consultation and a geographical viewer. (ii) A network of experts who provide the observatory with data and information relevant to the sector. (iii) A repository of scientific, technical and dissemination publications that provide information on the resin sector. (iv) Digital tool for decision making and estimation of the profitability of the operation of the exploitation. (v) A section with news and current information on training, ongoing projects and other news of interest to the sector. The **data panel** section provides relevant information including a snapshot of the national situation in terms of trade in this raw material. Includes (i) Resin-producing areas (ii) Processing industries (iii) experimental plots for resin innovation (iv) Production by province (v) Resin prices (vi) P. pinaster area and potential forest area for tapping activity (vii) international trade data. Much of this information can also be consulted through the **web viewer**. Through this tool we can also identify the location and main results of the experimental plots where different trials for the technological improvement of resin extraction have taken place in

	the last 10 years. It is also worth highlighting the elaboration of an optimal potentiality map for Spain. This map is the result of a theoretical model that needs field work to verify its results. The **knowledge repository** shows more than 50 titles that can be consulted through different filtering methods that allow easy use. This section of the website will be constantly fed by the expert group that constitutes the platform core. The **group of experts** brings together more than 60 professionals who contribute knowledge and experience to feed this platform, generate knowledge transfer and scientific and technical cooperation and solve problems that new resin producers, owners or industry may have. These experts have signed collaboration agreements with this observatory to provide quality and stability to this tool. A subgroup of this group of experts called the **Core Group (steering committee)** is responsible for the tasks necessary for the correct functioning and veracity of the data shown, as well as for the communication and promotion of the observatory itself. Finally, the **decision support tool** is developed in order to help the three main actors in the resin value chain: resin producers, owners and the processing industry. It is organized in two distinct parts: on the one hand, it answers the main questions that may affect each of them in order to start their activity, receive aid or develop resin production in the most efficient and sustainable way. On the other hand, it offers a profitability calculator that will allow the resin worker and the forest owner to know if the resin activity will be profitable in the area where they want to establish it. This tool is also a living element in the care of the group of experts, so that over time it will incorporate new information that is considered useful.
Lessons learned (1200 characters max.)	The development of this tool has highlighted some of the sector's weaknesses, such as the lack of transparency and lack of organization. In Spain this sector is small and underdeveloped, however, its potential to make our forests living, sustainably managed territories, reduce the risk of fire and contribute to the bioeconomy is indisputable. The development of this web site has required the collaboration of many resin sector stakeholders and many limitations have been detected in order to obtain reliable information. Furthermore, the dissemination of its existence and usefulness has been limited by the end of the project and it remains to be seen whether the acceptance, legitimacy and maintenance of the Observatory by potential users will be confirmed in the coming years. It has been identified that the active involvement of a minimum number of people representative of the sector is essential for the success of this tool, but it remains to be seen whether this will be achieved. A number of measures have been implemented by the project to minimize the risk of abandonment: commitment documents, organization of regular meetings and events. However, once the project has been completed, the project leaders will take a back seat to these tasks and it will be the actors in the sector themselves who will determine the future of the observatory.
Contact information	aida.rodriguez@cesefor.com
Links to website/report/video (if applicable)	https://observatorioresinasnaturales.es/

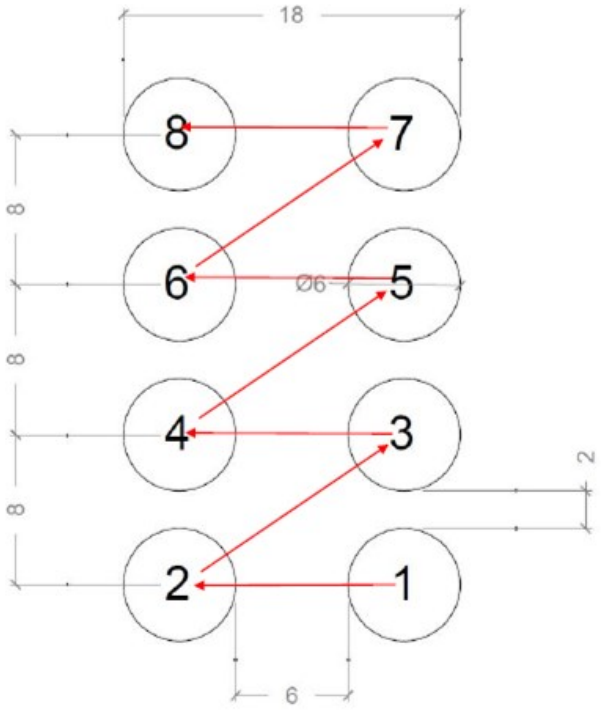
Pictures (if applicable)	

ITHub 4 - 2

Title of innovation	**Mechanised resin extraction method**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO RESINLAB
Operational Group (name)	Operative Group for the creation of new products, services and infrastructures adapted to the real needs of the natural resins sector.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two resin processing industries, representation of forest owners (2 entities, national and regional), resin producers' cooperative and two forestry technology centres.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/grupo-operativo-resinlab-para-la-creaci%C3%B3n-de.html
Country, region, city	SPAIN
Type of innovation	Process
Keywords	Non-wood forest product, Multifunctional forest management
Approach and main results (4000 characters max.)	The mechanized resin extraction system is proposed as an alternative to the traditional method in the study area that could be scalable at a national level. This method originated at the end of the 20th century in the USA, consists of drilling circular holes of different diameters and depths. The tissues in which the resin is stored (resin canals) are broken and the resin flows out as a consequence. In these holes, different resin collecting elements are installed, usually closed, unlike the traditional method. In this OG, the method is standardized with specific characteristics: the incisions are made with a circular drill with a diameter of 6 cm and in relation to the depth, bark and phloem are removed until reaching the depth where the xylem or wood begins, without penetrating it. Once the perforation has been made, a connecter with a hermetic bag is introduced, which will allow the resin to be collected with a higher degree of purity. To improve production, a stimulant is applied to the exposed area. The resin flow starts immediately after stimulation and can be prolonged over a period of several weeks. This drilling operation will be repeated over the months of the tapping season (about 6) every 21 days on average (these two parameters can be altered depending on site conditions). In the first two wounds, a connector and a bag were placed (day 1 and day 21). From the third hole onwards, the bags are moved from the first to the third and from the second to the fourth and so on. Only 2 bags are used for the whole resin period unless a new bag is

	needed because the resin collected volume exceeds the capacity of the bag. The main advantages of this method are: (i) Resin with a higher turpentine content and a lower percentage of contaminations. (ii) Elimination of pre-extraction debarking tasks. (iii) Simplification of worker training, facilitating the incorporation of new resin workers. (iv) Reduction of physical effort, facilitating the incorporation of women. (v) Greater compatibility with timber harvesting and thinning activities. Main disadvantages of the mechanized method: (i) Higher investment in materials (bags, appliqués, drill). (ii) Management of waste (bags and connectors). (iii) Lack of industrial development for the transformation of resin contained in bags (iv) Lower production yields (gr/tree). The results show a loss of production of around 20% compared to the traditional method measured in gr of resin per tree and season. This extraction method is still under study, but it is likely to become a reality in the short and medium term; for the moment, the mechanized method is not completely defined. The processing industries are not fully prepared to receive resin in bags due to the large amount of plastic waste generated and the complexity of the bag draining process, and there is still no clear market demand for a higher quality resin. In the light of these results, it should be noted that a full assessment of the cost-effectiveness of this mechanized process still requires an evaluation of factors that have not been taken into account, such as the execution times or the costs associated with each methodology. At the same time, the significant differences identified between the different study areas require increased efforts to assess the possible interactions with other climatic, soil or stand parameters that may explain the differences found. The project proposes the evaluation of such a technique in specific area and socio-economic contexts, as it is considered to be a good alternative to the traditional method in certain cases. However, the current results do not allow it to be considered as a mature method at present without taking into account the conditions described above.
Lessons learned (1200 characters max.)	The generation of innovation in resin extraction processes requires long-term trials and a large number of individual specimens (trees) studied. Resin production is affected by numerous variables, including climatic, edaphic, dasometric and, of course, human factors. This means that in order to extrapolate an innovation in this field to different scenarios, it requires longer study periods than those currently provided by the OG. On the other hand, the complexity of scientific and technical cooperation has become manifest. Good communication of the real interests of the parties is essential for the success of these processes. On the scientific side, data collection in the field, which is carried out by the tapping workers, as well as the execution of the work, is essential to scientific work. Without reliable data, all research results will be useless. On the other hand, the researchers developing the experimental designs must know and communicate frequently and closely with the tapping workers or the designs cannot be realistically implemented.
Contact information	aida.rodriguez@cesefor.com
Links to website/report/video (if applicable)	https://vimeo.com/754512934/3447f5cb73

Pictures (if applicable)	



ITHub 4 - 3

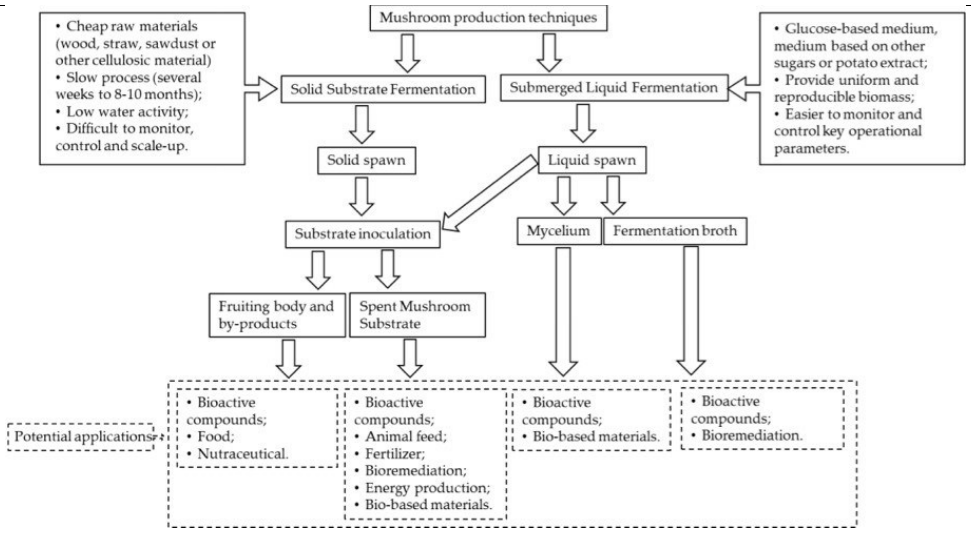
Title of innovation	**Identification of compounds of industrial interest**
ITHub	4
FOREST4EU partner (short name)	FC.ID
Operational Group (short name)	PinusResina
Operational Group (name)	GO-PinusResina
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest company, NGOs, research institutions, research companies
Link from OGs database	https://pinusresina.blc3.pt/
Country, region, city	Portugal
Type of innovation	Technological innovation
Keywords	Forestry, Biorefinery, Bioecnomy, Resin, Pine forest, Bark residues
Approach and main results (4000 characters max.)	The bark of Pinus radiata is an under-utilized forest residue that is renewable, abundant and has the potential to become a source of sustainable high-value chemicals. However, the use of this bark within a biorefinery for advanced applications is hindered by its intractable characteristics: high integrity, complex composition, and high heterogeneity. Most of the bark is burnt to provide energy and heat. The bark contains a high portion of phenolic extractives, constituting a potential source of valuable compounds. It also contains the heteropolymer suberin, a source of unique building blocks for developing innovative materials with potential broad bactericidal properties. Removal of phenolic extractives and suberin from bark simplifies down-streaming pulping processing of bark's lignocellulosic part. The GO implemented an effective green strategy to sequentially extract the lipophilic bark constituents and suberin, exploring scCO2 (40, 50 or 60 ◦ C / 200, 350 or 500 bar) and a biocompatible ionic liquid catalyst. The obtained scCO2 extracts had similar diversity of lipophilic compounds and predominantly contained resin acids. Further extraction of the scCO2 extracted bark yielded suberin amounts of 2.25% wt. The bark's suberin structure shows archetypal chemical features yet has an idiosyncratic high abundance of alkanoic acids, which is not common in most sources. The findings of this opening bark biorefinery study deserve further development and complementary techno-economic analyses to secure new value chains for the bark's major lipophilic compounds consisting of resin acids and bark suberin

Lessons learned (1200 characters max.)	The amount of underused bark globally is impressively large. The United Nations Food and Agriculture Organization (FAO) estimated that in 2020, round wood production was 3.97 billion m3, with a growth rate of 5.8% since 2015 (Food and Agriculture Organization, 2018). Considering a 10% bark by wood mass, it has been estimated that more than 190 million tons of pine bark are produced annually. This study demonstrated the dual potential of Pinus radiata bark for sequential recovery of scCO soluble constituents (up to 5.2% wt) and cell wall polymer suberin (2.25% wt). Using green solvents in a multistep approach is essential to creating sustainable bark biorefineries, with two "state of the art" green technologies. The potential to convert underexploited bark residues into a rich portfolio of bio-based compounds through multistep green extraction technologies can directly support the future development of sustainable bark biorefinery concepts (schematically shown in Fig. 6). Importantly, removing the scCO2 soluble constituents and suberin from Pinus radiata bark is expected to produce a material displaying higher thermal sta- bility with further uses in polymer-wood composites (Shebani et al., 2008). Further studies are required to understand the optimal value chains, besides the lignocellulosic-based leftovers after suberin extrac- tion, for the major bark scCO2 soluble compounds: resin acids, and bark suberin.
Contact information	João Nunes (info@blc3.pt)
Links to website/report/video (if applicable)	https://pinusresina.blc3.pt/; https://www.rederural.gov.pt/centro-de-recursos?task=download.send&id=2129&catid=115&m=0
Pictures (if applicable)	 Schematic model of a potential sustainable bark biorefinery

ITHub 4 - 4

Title of innovation	**Postharvest coatings from mushroom by-products**
ITHub	4
FOREST4EU partner (short name)	FC.ID
Operational Group (short name)	Micocoating
Operational Group (name)	Micocoating - Volorization of the forest and myco resources to produce coatings
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest owners, Associations, Research institutions, Research companies
Link from OGs database	
Country, region, city	Portugal
Type of innovation	Technological innovation
Keywords	Forestry, Mushroom production, Coatings, Mushroom by-products, Preservation methods
Approach and main results (4000 characters max.)	The MicoCoating initiative aims to apply bioactive compounds of natural origin, via mushrooms that produce functional compounds, in edible coatings for the food market. Currently, the increase in shelf life, via the organic market, through the significant reduction of preservatives in the context of the cleanlabel market, and even the consumer demand for healthier foods, is one of the main challenges of the food industry. The use of edible films and coatings has proven to be a technology with great potential to achieve longer shelf lives, while ensuring food safety and quality attributes. Market demands have led to the need to invest in alternative compounds for application in coatings that inactivate the deteriorating reactions in food while guaranteeing the quality attributes expected by the consumer. The compounds that make up the coatings must meet certain requirements, namely having a natural origin, being renewable and edible, and should also, if possible, give the coatings bioactive and preservative properties. The search for new compounds opened new opportunities for the incorporation of natural preservatives derived from plants, animals, bacteria, algae and fungi that act as antioxidant and antimicrobial agents. Among fungi, mushrooms are generally consumed as food and it has been demonstrated, namely by the operational group, that they have the potential to be used as a source of antimicrobials and antioxidants. Thus, the bet on mushrooms of wild species (forest co-products, with no food value) and production mushrooms (using agroforestry substrates) as a source of functional compounds presents itself as a great opportunity with high added

	value. Taking into account the most recent developments, the main objective of this initiative was the application of bioactive compounds of natural origin, via mushrooms that produce functional compounds, in edible coatings for the food market, to increase shelf life. Operations for sorting mushrooms at the industrial level usually generate large amounts of bio-residues not conforming to strict morphological criteria for commercial purposes, even though their biological content is not compromised. In this context, the present work aimed at evaluating the potential for reutilizing industrially discarded Agaricus blazei Murill (ABM). Thus, the content of essential nutrients and the chemical composition were determined, and MTT and LDH assays were used to evaluate the viability and cell death of Caco-2 and HT29 cell lines of an ethanolic extract prepared from ABM (preliminary safety tests for nutraceutical applications). The extract was incorporated into a semi-solid base cosmetic cream and cell viability effects of the extract, and of the final cream formulation, on a keratinocyte cell line (HaCaT) were studied (preliminary safety tests for cosmeceutical applications). Essential nutrients, such as proteins and carbohydrates, and a low fat content were determined for ABM. Twenty-two fatty acids were detected, with polyunsaturated fatty acids (PUFA) (~53%) being the most abundant fraction. The cell viabilities of Caco-2 and HT29 cells were maintained up to 100 µg mL−1. After incorporation into the base cream, a formulation with a pale yellow colour and favourable pH was obtained. The cell viability of HaCaT cells in the presence of the extract and the final cream formulation was maintained in a concentration dependent manner, which indicates the safety of this extract for cosmeceutical applications. The results suggest that ABM residues can be used as an inexpensive and sustainable source of nutraceutical and cosmeceutical ingredients.
Lessons learned (1200 characters max.)	Despite the discovery of many medicinal mushrooms and the identification of their bioactive polysaccharides, there are only a handful of functional food products where these polysaccharides are used. This is probably because there are several concerns regarding the application of these important molecules in final food products, such as the diversity of the biopolymers, the unstable quantity, quality and availability of these mushroom polysaccharides, the impact of the purification process and food processing on the bioactivity of the biopolymers and their production costs. Additionally, safety issues and regulation are essential for considering the marketing of functional food products. An example of this point is the limited practical applications of ergosterol and vitamin D2 from mushroom by-products, which requires further work to achieve food and pharmaceutical industries applications. The majority of the studies concerning the mushrooms potential bioactivity are conducted with samples of fruiting bodies. Nevertheless, the by-products generated from mushroom production also represent a good source of valuable compounds. These bioactive compounds could originate from solid substrate fermentation (caps and stipes from fruiting bodies, mycelium from SMS and SMS) or from submerged liquid fermentation (fermentation broth and surplus mycelium).
Contact information	João Nunes (info@blc3.pt)
Links to website/report/video (if applicable)	http://www.micnatur.pt/

Pictures (if applicable)	 Workflow of the extraction of bioactive products from mushrooms

ITHub 4 - 5

Title of innovation	Valuate the traditional chestnuts production
ITHub	4
FOREST4EU partner (short name)	SOLUTOPUS
Operational Group (short name)	ValorCast
Operational Group (name)	ValorCast – Valorização da castanha e otimização da sua produção
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Producers, universities, associations, enterprises from agrifood value chain, imagery techniciens
Link from OGs database	https://www.utad.pt/gpfe (indirect)
Country, region, city	Portugal/ Trás-os-Montes
Type of innovation	Process
Keywords	Food quality/processing and nutrition; forestry; Supply chain, market and consumption, Waste, by-products and residues management
Approach and main results (4000 characters max.)	**Approach:** This project aimed at improving the chestnut mechanical harvesting process, improving the preservation of nut quality between harvesting and the consumer, as well as promoting other presentation forms of nuts for consumption in kind. **The objectives** were: 1) to improve the chestnut mechanical harvesting process.; 2) to improve the preservation of nut quality between harvest and consumer, by (a) developing a new disinfestation method as an alternative to the current one (thermal shock) that it is inadequate to current business requirements; and (b) creating a protocol for an efficient fungal control during the chestnut storage at room temperature or in the cold room, allowing to prolong its commercialization and consumption period in an effective and efficient way; and (c) find a way to minimize water loss from the chestnut. 2) Promoting other ways of presenting chestnuts for consumption in kind, such as smoked chestnut and soft chestnut, or in the form of flour, which allows the appearance of the chestnut in a larger market scale due to its incorporation in derived products such as bread, biscuits, beer, etc. **Results**: 1) Harvesting- when the soil of the grove is very humid and covered with thick dead blanket, there is an increment of elemental time inoperative (from 8.7% to 12,04% of the total time), which may impair the ability to work. However, in the tests carried out, increment did not result in loss of field efficiency which remained the same – 82%, a fact that is due to the percentage reduction in the elementary turning time between the rows and the percentage

	increase in the elementary harvest time. In regard to the warehouse cleaning and degreasing equipment, it was observed that: the working capacity of this equipment ranged from 1000 to 1500 kg/hour- the lowest values when the nut came from older groves and with more debris; the highest values were obtained in more recent groves and with less amount of debris. Also, there were aggregates harvested with the fruits that damage them, which makes necessary a second cleaning of the harvested production and a manual selection, before delivery to the industry. 2) Post-harvest vermin control and essay of prototype - due to the technical difficulties associated to the adjustment of the prototype, no scientific conclusions were extracted. 3) Chestnut rot- Hydrophobic coatings based on paraffin and beeswax were very effective in preventing water loss when nuts were stored in forced conditions (room temperature). In sensory terms, chestnuts coated with paraffin or beeswax were similar to chestnuts before from storage. The use of volatile additives with antimicrobial capacity can be a solution to reduce the loss of chestnuts by microbial growth (rot). 4) Packaging- MAP, VAC and PM bags may be a promising solution in preventing weight loss and microbial growth. MAP and VAC packages are the most suitable for periods less than 3 months, while PM bags are the most promising for a long-term storage (6 months). These packages caused losses of fruit weight lower than 2% and did not lead to an increase in the microbial load. On the other hand, chestnuts not packaged or packed in bags macroperforated (PH) showed to be less effective, causing weight loss greater than 9% and mold development during storage. 5) Chestnut flour - presents itself as an ingredient promising for the development of fresh and dried pasta formulations. It imparts softness and lightness to recipes usually made only with wheat flour, but it also darkens the final product and alters other characteristics. The percentage most suitable in terms of incorporation of chestnut flour was 50%. 6) New products- the chestnut sample with Tawny Port Wine and almonds was the best accepted on both sensory test sheets, both on the hedonic scale for the global appreciation parameters, color, aroma, texture and flavor as in the tests of purchase intention and preference ordering.
Lessons learned (1200 characters max.)	The cost reduction provided by mechanized harvesting is considerable, when compared to manual harvesting. With studied mechanical harvesting systems it is possible to get considerable advantages like: the shortage of manpower for this operation; the significant cost reduction and the improvement of the health status of chestnut. Soil management is a relevant aspect for this operation. For an efficient harvest, the soil must have good vegetation cover and be free of aggregates and residues resulting from past farming practices. Mechanical harvesting is not compatible with mobilized groves. In relation to packaging, due to the high cost associated with packaging, plastic bags weighing 0.5 kg each and the hand of respective work, it is not competitive from an economic point of view to pack the chestnut in bag track weight loss. As an alternative, is advised an experience with a strong reduction in the costs of packaging, larger plastic bags and respective filling eventually automated. For chestnut processing, there were some interesting results (powder, fruit mix, patisserie, etc.) but more experiments are needed, as well as costs evaluation.
Contact information	jlaranjo@utad.pt
Links to website/report/video (if applicable)	ValorCast – Valorização da castanha e otimização da sua produção Suporte: impresso e digital ISBN: 978-989-53782-2-7 (Suporte: Papel) ISSN: 978-989-53782-6-5 (Suporte: Eletrónico)

Pictures (if applicable)	   

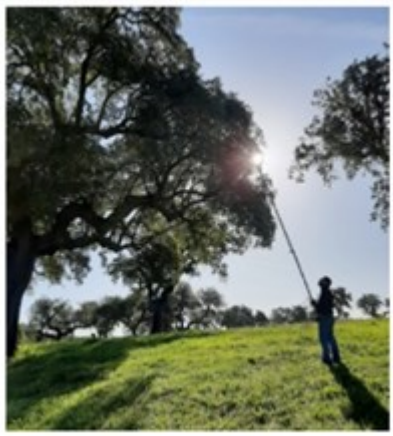
ITHub 4 - 6

Title of innovation	**The Burgundy truffle, a quality product with high added value**
ITHub	4
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	BIJOU
Operational Group (name)	BIJOU : The Burgundy truffle, a quality product with high added value
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest owners, researchers, advisors
Link from OGs database	
Country, region, city	France, Burgundy
Type of innovation	Product
Keywords	Forestry, Non-wood forest product, mushroom, Truffle, sylviculture, gastronomy
Approach and main results (4000 characters max.)	The Burgundy truffle (Tuber uncinatum) is an important player in the regional economic market and is illustrated by the exponential planting of new truffle orchards. To promote an excellent quality product, markets have been set up over the past ten years to offer quality-controlled truffles. If the quality of the Burgundy truffle depends on its maturity, other factors can have an influence on the development of its aromas: local climatic variations, nature of the soil, microbiota of the truffle (bacteria, yeasts, viruses, etc.), its specific genetic characteristics or its method of conservation after harvest. The sector must also anticipate climate change and adapt truffle farming to more difficult and water-poor environments. The challenge is to increase and regularize quality agricultural and forestry production. STUDY TUBER UNCINATUM TO BETTER VALUE IT In order to develop competitive and sustainable truffle farming, the project was structured around three objectives: • Develop quality control tools for Burgundy truffles. Develop molecular tools for identifying the provenance of Burgundy truffles as well as sensory and physicochemical analyzes to better understand the origin and diversity of Burgundy truffle aromas. • Acquire references to cultivation techniques that anticipate climate change to optimize production in truffle orchards (temporarily floodable valley or on dry limestone plateau). • Develop sustainable silvicultural management to produce both wood and truffles. Develop a tool for predicting the distribution of truffles in forest environments;

	characterize the stations favorable to Burgundy truffles; evaluate the effects of silviculture (thinning experiments) on truffle production. Researchers from INRAE in Dijon (Center for Taste and Food Sciences and UMR Agroecology) carried out analyzes to characterize the aromatic complexity of Burgundy truffles. Sensory analysis sessions were also carried out by researchers from the ChemoSens platform. The results highlighted three "typical profiles" of Burgundy truffles: truffles characterized by more intense forest odors (button mushroom, undergrowth), more spicy odors (vanilla, smoked, pepper) and truffles presenting more negative odors (animal, earth, etc.). At the same time, researchers have developed methods and tools for the analysis of the chemical compounds responsible for the odor of Tuber uncinatum, as well as molecular tools making it possible to determine the geographical origin of the truffles. Two pilot truffle farms have been set up. The first in Leuglay, in a flood zone, and the second in La Cras, in a dry environment. On the La Cras site, analyzes of the roots of truffle trees and estimates of the mycorrhization rate were carried out. The results show good maintenance of the mycorrhization of 3 out of 4 species in conditions of major water deficit. Finally, a prediction model for areas favorable to Burgundy truffles based on LIDAR data was established. Its extension to the scale of a forest massif will be possible based on adequate digging data. Different methods of thinning coppices under high forests have been implemented. Their monitoring over time will make it possible to study the effects of forestry on truffle harvests.
Lessons learned (1200 characters max.)	The project made it possible to develop a partnership approach rich in exchanges between the different stakeholders interested in recognizing the value of the Burgundy truffle among institutions and the general public. The IGP (controlled geographical indication) approach was not successful because research is still necessary to successfully differentiate the aetivum truffle from the autumnal uncinatum variety. The project made it possible to improve the recognition of the Burgundy truffle with the French Federation of Trufficulteurs. BIJOU has also encouraged better consideration of this truffle in management plans in private and public forests in order to promote forest heritage and produce added value to wood. The partners also recommend integrating the Burgundy Truffle into agroforestry projects. It is necessary to adapt regulations and require traceability of truffles to avoid the parallel market. Likewise, technical routes should also be shared to guarantee the development of the production of national truffles while the French market is flooded by Burgundy truffles from Eastern countries.
Contact information	christine.dupaty@gmail.com
Links to website/report/video (if applicable)	http://www.artbfc.fr/

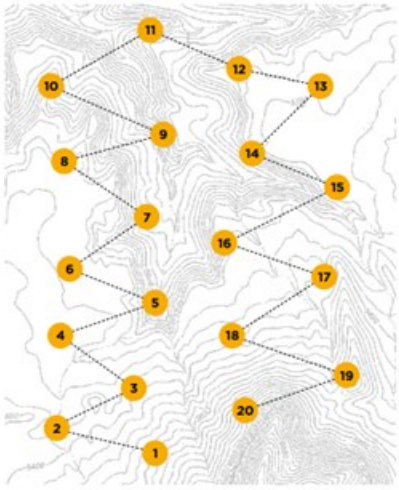
ITHub 4 - 7

Title of innovation	**Fertilization recommendations for cork oak**
ITHub	4
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	OG NUTRISUBER
Operational Group (name)	Nutrition and Fertilization of the cork oak forest - NUTRISUBER
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	1 Forest Federation, 4 forest companies, 2 research institutions,
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/nutri%C3%A7%C3%A3o-e-fertiliza%C3%A7%C3%A3o-do-montado-de-sobro.html
Country, region, city	Portugal
Type of innovation	Service
Keywords	Fertilisation and nutrients management; Adaptation to climate change; Non-wood forest product
Approach and main results (4000 characters max.)	Although the cork oak is one of the main forest species and the national tree of Portugal, there was not much information about fertilization recommendations for the development of this species. The practice was to carry out soil analyzes only for the installation of under-cover pastures, forgetting the arboreal component of the system. GO NUTRISUBER carried out the characterization of the soils of 30 cork oak forests and the monitoring of their fertility in the areas where the species occurs in greater density and where it is most economically exploited: Alentejo and Ribatejo. The soil, in addition to the water and air it contains, is made up of mineral and organic particles of various sizes that give it different characteristics, depending on whether one or the other dominates and, within these, whether the finest or the coarsest. In Portugal, most soils are mineral, that is, mineral matter is dominant, with very few organic soils (with contents greater than 15% of organic matter). From the point of view of plant nutrition, only the finest particles, with dimensions smaller than 2 mm – the so-called fine earth – are considered, and this is the fraction that is analyzed to assess the state of soil fertility. Some of the characteristics of the soil can be observed in the field, just by looking closely at its profile. Others, such as texture, organic matter and mineral nutrient content, reaction (pH) and cation exchange capacity, can only be evaluated through laboratory analysis.

	In addition to soil analyses, this work demonstrates the importance of leaf analysis of nutrients for understanding the true state of nutrition of cork oaks to allow giving recommendations for fertilization. Methodologies for collecting soil and leaf samples were defined in order to obtain more efficient results, and dissemination videos were made for technicians and forestry producers.
Lessons learned (1200 characters max.)	The main result of this project was the creation of fertilization tables for different states of development of the cork oak forest stands: Stand installation phase; Young phase until the first stripping; Adulthood. All the information was compiled in a manual on cork oak fertilization, which describes the physical, chemical and biological characteristics of the soils in the cork oak forests. In addition, it makes a simple description of the forms and availability of soil nutrients for plants, creating a table that classifies the forest stand in fertility class (very low, low, medium, high and very high) according to chemical parameters such as phosphorus (P2O5), potassium (K2O) and magnesium (Mg). At the end, it presents the mentioned fertilization tables with the recommended amounts of fertilizer to apply for a correct fertilization of the Montado. These tables are based on the previously mentioned fertility classes that resulted from the analysis of soil samples and foliar samples, defining the amounts of nutrients to be applied per hectare.
Contact information	cristina.sempiterno@iniav.pt
Links to website/report/video (if applicable)	https://www.iniav.pt/images/publicacoes/livros-manuais/MANUAL-DE-FERTILIZACAO-DO-SOBREIRO.pdf
Pictures (if applicable)	  

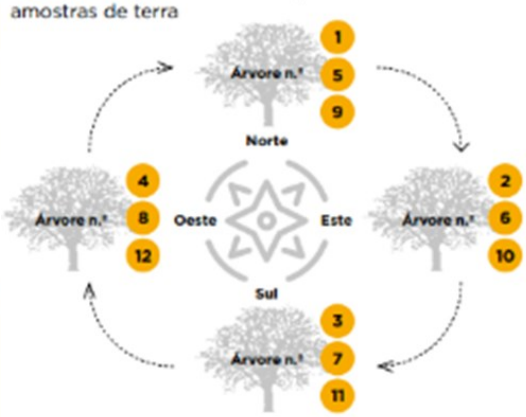
ITHub 4 - 8

Title of innovation	**Brochure for the collection of soil samples in cork oak forests**
ITHub	4
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	OG NUTRISUBER
Operational Group (name)	Nutrition and Fertilization of the cork oak forest - NUTRISUBER
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	1 Forest Federation, 4 forest companies, 2 research institutions,
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/nutri%C3%A7%C3%A3o-e-fertiliza%C3%A7%C3%A3o-do-montado-de-sobro.html
Country, region, city	Portugal
Type of innovation	Service
Keywords	Fertilisation and nutrients management; Adaptation to climate change; Non-wood forest product
Approach and main results (4000 characters max.)	The analysis of soil samples collected in cork oak forests allows knowing the physical and chemical characteristics of the soil, constituting, together with foliar analysis, support for the most appropriate fertilization recommendation. However, although this practice is not new, it is not a practice followed by the majority of forestry producers, who, although viewing cork production as a lucrative economic activity, do not understand the need to analyze the nutritional status of forest stands and carry out necessary fertilization and soil amendments. The collection of soil samples must be carried out well in advance of the application of fertilizers, being advisable the period in which the soil has a moisture content that allows this operation to be carried out, which generally happens in autumn – winter. If the land is not uniform, it should be divided into relatively homogeneous plots with regard to color, slope, drainage and type of forest management. Samples must not be taken in wet areas, near paths, houses, stables or in places that have been occupied with manure, sludge, fertilizers, ashes or other products.

Lessons learned (1200 characters max.)	Thus, to sensitize forestry producers, a publicity leaflet was prepared, which is available in paper and online, in accessible and easy-to-understand language. The leaflet defines when the analysis should be carried out, how it should be carried out depending on the type of existing forest stand: before the stand, in a young stand, in an adult stand or even in modern irrigated cork oak plantations. It also defines what equipment is necessary for the correct collection of samples and how to pack and send them to the laboratory to obtain the results.
Contact information	cristina.sempiterno@iniav.pt
Links to website/report/video (if applicable)	n_f_Colheita_amostras_terra_em_montados_de_sobro_e_povoamentos_de_pinheiro_m.pdf (unac.pt)
Pictures (if applicable)	**Figura 1.** Material necessário à colheita das amostras de terra  • No caso de se utilizar uma sonda, é necessário possuir também um punho e uma marreta **Fig. 1 e Fig. 2.** **Figura 2.** Pormenor do punho e da sonda de meia cana  **Figura 3.** Pontos de recolha de subamostras de terra 

ITHub 4 - 9

Title of innovation	**Brochure for the collection of soil samples in stone pine**
ITHub	4
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	OG FERTIPINEA
Operational Group (name)	Nutrition and fertilization of stone pine in rainfed and irrigated systems - FERTIPINEA
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Forest company, research institutions, forest narsery company, National Forest Autority
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/nutri%C3%A7%C3%A3o-e-fertiliza%C3%A7%C3%A3o-do-pinheiro-manso-em.html
Country, region, city	Portugal
Type of innovation	Service
Keywords	Fertilisation and nutrients management; Adaptation to climate change; Non-wood forest product
Approach and main results (4000 characters max.)	The analysis of soil samples collected in stone pine forests allows knowing the physical and chemical characteristics of the soil, constituting, together with foliar analysis, support for the most appropriate fertilization recommendation. However, although this practice is not new, it is not a practice followed by the majority of forestry producers, who, although viewing pine nuts production as a lucrative economic activity, do not understand the need to analyze the nutritional status of forest stands and carry out necessary fertilization and soil amendments. The collection of soil samples must be carried out well in advance of the application of fertilizers, being advisable the period in which the soil has a moisture content that allows this operation to be carried out, which generally happens in autumn – winter. If the land is not uniform, it should be divided into relatively homogeneous plots with regard to color, slope, drainage and type of forest management. Samples must not be taken in wet areas, near paths, houses, stables or in places that have been occupied with manure, sludge, fertilizers, ashes or other products.
Lessons learned (1200 characters max.)	Thus, to sensitize forestry producers, a publicity leaflet was prepared, which is available in paper and online, in accessible and easy-to-understand language. The leaflet defines when the analysis should be carried out, how it should be carried out depending on the type of existing forest stand: before the stand, in a young stand, in an adult stand. It also defines

	what equipment is necessary for the correct collection of samples and how to pack and send them to the laboratory to obtain the results.
Contact information	Maria da Encarnação Marcelo <encarnacao.marcelo@iniav.pt>
Links to website/report/video (if applicable)	https://www.unac.pt/index.php/id-i/grupos-operacionais-accao-1-1-pdr2020/fertipinea
Pictures (if applicable)	**Figura 1.** Material necessário à colheita das amostras de terra  • No caso de se utilizar uma sonda, é necessário possuir também um punho e uma marreta **Fig. 1 e Fig. 2**. **Figura 2.** Pormenor do punho e da sonda de meia cana  **Figura 4.** Esquema da orientação da colheita das amostras de terra 

ITHub 4 - 10

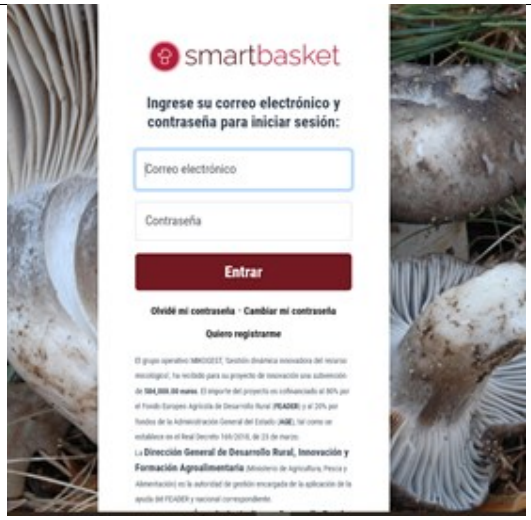
Title of innovation	**Pinea ClimaDAT. A tool for pine harvest prediction**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO PINEA
Operational Group (name)	Improvements and innovation in the production of national pine nut
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	2 organizations representing private forest owners, two technology centres and a research institute, a pine nut producers' cooperative and a private forestry company.
Link from OGs database	Mejoras e innovación en la producción de piñón nacional. | EIP-AGRI (europa.eu)
Country, region, city	Spain, Castilla y leon y Cataluña
Type of innovation	Service
Keywords	Non-wood forest product; digital tool; Pest/disease control; smart-application; plant production and horticulture; food industries
Approach and main results (4000 characters max.)	One of the main objectives of the OG Pinea has been to establish a system for predicting pine cone harvests. The estimation of harvests on a real scale in Castilla y León is still done visually carried out by environmental agents. There is an increasing disparity between what is estimated and what is harvested. For this reason, as opposed to direct measurement, the aim is to develop a predictive model that allows a reliable estimate of harvests. Pinea ClimaDAT is an application for simulating pine cone harvests at the forest scale several months (or even years) in advance, which is a fundamental tool for predicting harvests, and facilitates the management and organization of forest management. This app has been developed in two phases: In the first phase, during 2017, the application was developed by research centers, private enterprise and local administration in areas where this activity has economical relevance. The purpose of Pinea ClimaDAT in this first version was to calculate - both for historical series and for the current year - the annual pine cone production and biomass stocks for *Pinus pinea* public utility forests. It was developed for a specific province of the Spanish territory in which there was an extensive database for the development of the model underlying the application. In addition, it allowed simulations to be carried out on user-defined climate data or on climate scenario projections. In a second phase, during the years 2022 and 2023, within the framework of the PINEA OG, an improvement of the application has been carried out, which can be summarized as follows: (i) The geographical validity of the App has been extended to two more provenance regions. (ii) Pine cone harvest data available until 2021 are included. (iii)

	The App is made compatible with public GIS data. (iv) The natural units used by the tool to relocate the study area are redefined. (v) The effect of *Leptoglossus occidentalis* on pine cones production is incorporated. (vi) The use of new climatic variables is evaluated. The simulations of this tool are performed by applying different pine cone production models, including the model of Calama et al. 2016. These models use data from available forest management inventories. In the case of the usability of the application referring to how to carry out a simulation with user-defined data, the following are requested: A) Location data B) Forestry characterization (surface area, number of trees for stone pine and the rest of the species) C) Select the season for which the simulation is to be carried out. With these three simple steps you can simulate pine cone production in tn and kg/ha. It also allows you to compare production with previous seasons. This application is available for free on the project's website
Lessons learned (1200 characters max.)	Building predictive models requires a significant amount of quality data to produce accurate and reliable results; the quality of the record has a bearing on the quality of the model. Maintaining continuity in data collection can become complicated in periods of crisis with budget constraints. The data recorded are from a limited number of experimental plots, although the prediction system has been able to extrapolate to neighbouring areas within the same source area, it has not been able to reach other more distant territories. The arrival of Leptoglossus occidentalis in Europe had a disruptive impact on the historical data series that previously reflected the strong influence of climate on pine cone production, in addition to the difficulty of detecting the presence of the insect - due to its elusive nature and the lack of an effective monitoring system - and being able to predict the effect of its population on production in a given area. The forthcoming arrival of new exotic pests or diseases (such as the alert that already exists in France or Italy for Toumeyella parvicornis) may change the dynamics of ecosystems in an unpredictable way and alter the data series used to feed the prediction models, so that all the calculations and formulas used will have to be readjusted once again.
Contact information	montse.ganado@cesefor.com
Links to website/report/video (if applicable)	https://gopinea.org/climadat/

Pictures (if applicable)	 

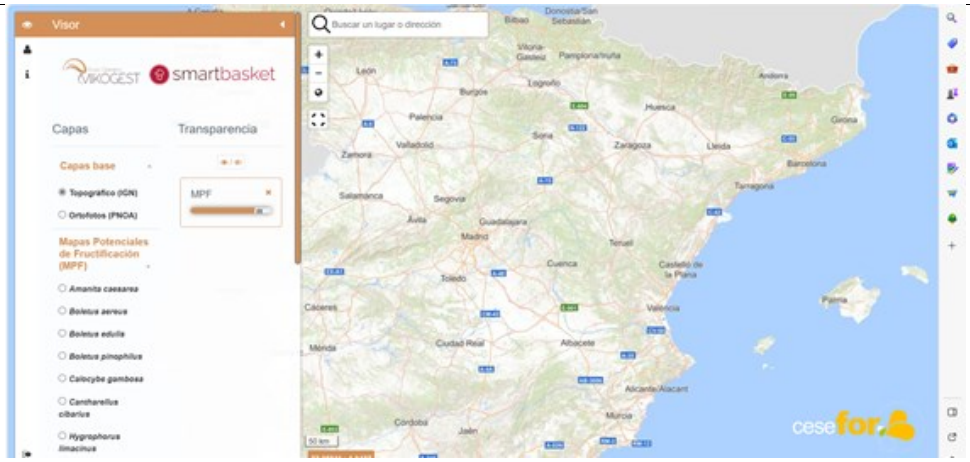
ITHub 4 - 11

Title of innovation	**Smartbasket. An app for mushroom collecters**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO MIKOGEST
Operational Group (name)	Operational Group MIKOGEST : 'Innovative dynamic management of the mycological resource'.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two organizations representing private forest owners, a public research institute, a tecnologival center and mushroom businessmen federation
Link from OGs database	Grupo Operativo GO MIKOGEST: 'Gestión dinámica innovadora del recurso micológico' | EIP-AGRI (europa.eu)
Country, region, city	Spain
Type of innovation	Technological innovation
Keywords	Non-wood forest product; digital tool;Supply chain, market and consumption; smart-application
Approach and main results (4000 characters max.)	The increasing activity of collecting and trading wild mushrooms has led many public administrations to regulate the use of mycological resources. Shortcomings have been detected in terms of legal regulation and the professionalization of collectors. As a result, this project (OG Pinea) seeks to manage the regulation of the mycological resource and proposes the use of technological tools. Priority is given to guaranteeing sustainability in harvesting, traceability in the value chain and generating useful information for both, the collector and the business sector. Among the different proposals developed by the OG, the Smartbasket application has been selected as an innovation. This tool is a data collection device. It is a pedagogical tool based on learning through gamification techniques, being a mobile technology and accessible to all users (GPS, camera, audio...). These techniques are based on learning that transfers the mechanics of games to the educational-professional field to achieve better results. In this case, the more collecting areas you register in your application, the higher your ranking will be compared to other users. In addition, you will be able to access a greater number of species identification queries. Smartbasket aims to involve society through Citizen Science tools. The aim is to stimulate active collaboration in the collection of field data from collectors and lovers of nature and the mycological resource, as well as to open a channel of information with society and raise awareness about the need to respect, care for and protect our mycological resource. Within the application we find the following features: USER ROLES:

	The possible user roles are: collector, identifier, collaborating professional and administrator. Each of them has access to various features of the app that facilitate their work. SETALS (collection areas): The app user can manage his collection areas through smartbasket, identifying species, location, date of sighting, etc. WARNINGS: The smartbasket warning functionality allows the user to report bad practices detected in the forest. It also allows the user to collaborate with the system by sending data related to the mushroom market, which become part of a BigData aimed at facilitating the sustainable management of the mycological resource. RANKING: As a recreational component, smartbasket recognizes the participation of the expert identifiers and that of the users, collected in ordered lists where the identification is only by the user's alias. Each user has also an account of credits that increases with his participation and use of smartbasket: each time a user participates in smartbasket, the number of credits increases. Each user also has a credit account that increases with his participation and use of smartbasket: each collected area, itinerary or notice adds credits to the user's account, which can be invested in requesting identifications. REQUEST RESOLUTION BY THE IDENTIFICATION EXPERT The request for identification of a species must be accompanied by one or more photographs taken at the collection site. The expert identifier has the capacity to identify species through the photographs sent by the user collector in the identification requests.
Lessons learned (1200 characters max.)	The digital skills of the user collector are highly variable, as the activity is performed by a wide demographic profile. The data collection App has to have a design that is very simple and easily understandable by less digitally skilled users. Functionalities have to be developed that connect collectors to each other, for mutual transfer of knowledge and information. One initial difficulty is the reluctance of collectors to share information about their mushroom collecting areas, so prior work must be done to build trust and provide assurance that the data collected through this application are confidential, are not shared with other users and are for their exclusive use for analysis and research.
Contact information	montse.ganado@cesefor.com
Links to website/report/video (if applicable)	https://www.youtube.com/watch?v=dLQ732Zp_J8&ab_channel=FundacionCesefor
Pictures (if applicable)	

ITHub 4 - 12

Title of innovation	**Visor Mikogest**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	MIKOGEST
Operational Group (name)	Operational Group MIKOGEST : 'Innovative dynamic management of the mycological resource'.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two organizations representing private forest owners, a public research institute, a tecnological center and mushroom businessmen federation
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/grupo-operativo-go-mikogest-%E2%80%98gesti%C3%B3n-din%C3%A1mica.html
Country, region, city	Spain
Type of innovation	Service
Keywords	Non-wood forest product; digital tool; Supply chain, market and consumption; Decisional Support System: Sustainible Forest Management
Approach and main results (4000 characters max.)	One of the objectives of the operative group is to learn about and manage the regulation of the mycological resource using technological tools. Priority is given to guaranteeing sustainability in harvesting, traceability in the value chain and generating useful information for both the collector and the business sector. To this end, a Big Data collection and analysis system has been generated to provide the necessary information to guarantee the sustainability of both the activity and the habitats, offering precise knowledge of the production capacity of these habitats in real time (through estimates of the production in each place and time), and also processing precise parameters of the demand, commercialization and exploitation of the resource. Queries made on the Mycological Big Data database can be visualized through the mikogest viewer. This viewer is based on the collection and integration of all existing data from the mycological sector for Big Data analysis, designed to allow us to address, in an effective and useful way, the large volume of existing data in the natural environment and also those collected through the apps generated within the project. Its purpose is to improve the management of our mushroom producing forests. This viewer displays the Potential Fruiting Maps (PPM) of the selected mushroom specie. This potential fruiting area is classified according to the legend in Optimum, Adequate and Marginal according to the main and secondary forest species, its age, climatological criteria, edaphology and fraction of covered area. Information can be obtained, among others, on: POTENTIAL FRUCTIFICATION AREA (ha),

	ANNUAL PRODUCTIVE CAPACITY, AVERAGE MARKET PRICES. Information can also be obtained on: POTENTIAL AND OBSERVED MYCOLOGICAL DIVERSITY OF EDIBLE SPECIES. For the 11 species for which the potential fruiting map has been obtained, the Optimum, Adequate and Marginal surface is shown. In addition, it also shows the potential annual production capacity in kg, estimated from adjusted production models based on habitat-dependent variables and stand characteristics. Observed diversity refers to the number of times that species is known to be present in the administrative unit of work. OBSERVED PRODUCTION OF EDIBLE SPECIES: for the target species of socioeconomic interest for which a fruiting potential map is available, the number of observations recorded in the database is shown, as well as the average production calculated in kg per hectare and the average yield in kg per hour. PRODUCTIVE CAPACITY OF EDIBLE SPECIES: in this case we can see the annual amount harvested during the previous season and the estimated productive capacity. An indicator of the sustainability of the resource is also included so that it will appear green when the species is harvested without compromising the resource and orange when the species may be harvested with the risk of compromising its survival. FRUCTIFICATION PREDICTION: you can also see a prediction of fruiting production for the next few days for the target species. Thus, you can see whether an area has a very likely, likely, unlikely or improbable fruiting prediction for each of the 11 target species.
Lessons learned (1200 characters max.)	The prediction models developed by the viewer require long series of data well distributed in time and territory. The development of the viewer itself is feasible for any computer expert. However, its implementation requires crossing several data layers, which are sometimes not available. The real complexity lies in the collection of this information needed to generate the viewer's outputs, such as fruiting potential maps or fruiting predictions.
Contact information	montse.ganado@cesefor.com
Links to website/report/video (if applicable)	https://visor.mikogest.net/
Pictures (if applicable)	

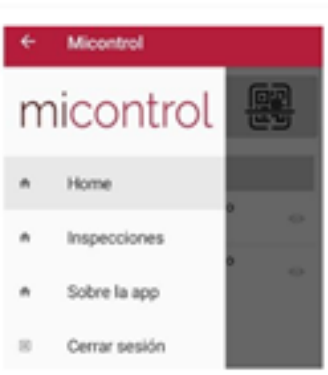
ITHub 4 - 13

Title of innovation	**Inter-territorial Association of Wild Mushroom Harvesting Professionals**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	MIKOGEST
Operational Group (name)	Operational Group MIKOGEST : 'Innovative dynamic management of the mycological resource'.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two organizations representing private forest owners, a public research institute, a tecnological center and mushroom businessmen federation
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/grupo-operativo-go-mikogest-%E2%80%98gesti%C3%B3n-din%C3%A1mica.html
Country, region, city	Spain
Type of innovation	Organisational innovation
Keywords	organisational innovation; Cooperation; business model; Supply chain, market and consumption
Approach and main results (4000 characters max.)	Go Mikogest states that it is crucial to use the sectorial associationism as a tool to professionalize the primary sector of the mycological activity. With the growing activity of collecting and marketing mushrooms, most regional administrations have independently regulated their mycological exploitation. This lack of legislative homogeneity in the territory causes difficulties in the management of the mycological resource, among which the following have been detected: (i) Lack of coordination between the different sectors concerned. (ii) Lack of knowledge of mycological production in the territory, as well as its local economic impact. It is precisely the local collectors who obtain a large part of the mycological resource for subsequent sale. However, the lack of professionalism in this sector, most of them being sporadic collectors, forces a dispersion of the resource to other sales channels, making it very difficult to quantify collection data in producing areas. GO Mikogest's proposal to face this problem has been the creation and promotion of the Inter-territorial Association of Wild Mushroom Harvesting Professionals. The association's statutes have been drafted for their subsequent registration and constitution, accompanying these actions with the development of a training plan aimed at the professional collector. Thus, with the creation of this national professional association, it is intended to: (i) Achieve the professionalization of the group of collectors. (ii) To provide the necessary training for the unequivocal identification of edible species. (iii) To ensure the conservation of all mycological species. (iv) To prevent indiscriminate collection by

	people outside the municipality or locality. (v) To avoid the loss of the usual local collector. The association develops its activities throughout the Spanish territory, represents the wild mushroom collecting sector, and arises to defend and promote the economic and social interests that are proper to this activity, both in its individual and collective development. Membership is open to all individuals who hold the status of professional wild mushroom picker.
Lessons learned (1200 characters max.)	To ensure the success of a partnership, in addition to encouraging its establishment, it is essential to have a period of accompaniment, which can last one or two years. This will allow the initiative to move beyond the initial start-up phase and give it a better chance of success
Contact information	montse.ganado@cesefor.com
Links to website/report/video (if applicable)	https://seteros.es/
Pictures (if applicable)	

ITHub 4 - 14

Title of innovation	**App Micontrol**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	MIKOGEST
Operational Group (name)	Operational Group MIKOGEST : 'Innovative dynamic management of the mycological resource'.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two organizations representing private forest owners, a public research institute, a tecnological center and mushroom businessmen federation
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/grupo-operativo-go-mikogest-%E2%80%98gesti%C3%B3n-din%C3%A1mica.html
Country, region, city	Spain
Type of innovation	Service
Keywords	Non-wood forest product; digital tool; Supply chain, market and consumption; Sustainible Forest Management
Approach and main results (4000 characters max.)	This operational group pursues to manage the regulation of the mycological resource through tools based on Information and Communication Technologies (ICT), guaranteeing sustainability in the use of the mycological resource, traceability in the value chain and offering useful information to both the collector and the business sector. One of the problems identified in the mycological sector is related to the difficulty of harvesting control tasks. As an innovative solution, GO Mikogest has developed the Micontrol app, designed to facilitate the work of harvest control of the guards in the mycological areas. In addition, it captures data on the development of the harvesting activity through the quantities collected and yields by species with socioeconomic interest. This application has two objectives: - Facilitate the management of the environmental agent in the control of harvesting in his task of verifying that the activity is carried out according to the conditions of collection established in the enclosure. - Capture data of the harvesting activity. The app has been designed to be used by multiple users through any model of mobile device. A web space has also been developed for each user, from which they can manage the data of all their inspections, visualize them through GIS technology, access their images and verify the data of each inspection. The application has two different functionalities: 1- Control of harvesting activity: With the harvesting control, it is verified that the activity is carried out according to the harvesting conditions established in the enclosure. The environmental agents carry out the inspection activity to the collectors, verifying that they

	have authorization (license) and that they respect harvestable species, sizes and quantities, being able to carry out the pertinent proceedings for the processing of complaints if the situation requires it. 2- Inspection Manager: Micontrol is a manager of inspections carried out, which facilitates and organizes the work done in the field by the agents. The capture of the collector's personal data can be done manually, or through the capture of this data by means of a QR reader, which speeds up and prevents the data entered from being erroneous. This QR reader is only valid for enclosures that include this code in their harvesting permit. In addition, through the micontrol app, the rural guard, private field guard or civil guard-seprona, verifies in real time (with mobile coverage) fraud by falsification of harvesting permits. This functionality is only available for certain reserves, integrated in the Micocyl mycological exploitation system. The application sends a query to the database receiving a valid or unmatched permit message. The activity of harvesting control generates a very important volume of data about the harvesting that is being carried out in the territory. Micontrol enables a simple system for the capture and management of this data, contemplating the different scenarios faced by the agent in his control activity.
Lessons learned (1200 characters max.)	The digital skills of the people who carry out the collection control are highly variable, so it is advisable that the data capture app has a very simple design that is easily understood by less digitally skilled users. It is important that any control that is performed on a collector takes as little time as possible, so that the use of this application is both attractive and convenient. If the monitoring process involves lengthy data collection over time, it may reduce interest in using the application.
Contact information	montse.ganado@cesefor.com
Links to website/report/video (if applicable)	https://www.mikogest.net/pagina/micontrol
Pictures (if applicable)	 

ITHub 4 - 15

Title of innovation	**Exchange between chestnut growers**
ITHub	4
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	GO INGECA
Operational Group (name)	Strategie INnovative a basso impatto per la GEstione delle avversità dei CAstagneti da frutto
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Universities, chestnut farmers consortium, public operators, research institutions, chestnut transformation companies, biochar companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/strategie-innovative-basso-impatto-la-gestione-delle
Country, region, city	Tuscany, Italy
Type of innovation	Social innovation
Keywords	Cooperation, Forest Sustainable Management, chestnuts
Approach and main results (4000 characters max.)	During INGECA project, a lot of effort was put into dissemination activities, with 8 thematic meetings, 2 seminars and 2 field visits. These activities permitted to chestnut growers to share experiences about the innovations tested (endotherapic treatments with Trichoderma spp., use of BITE technology, mobile charcoal kiln prototype for local biochar production), to share approaches in chestnut grove management and production as well as to explore specific aspects like grafting, pruning, variety, disease control, in different regions (Tuscany, Lazio and Calabria).
Lessons learned (1200 characters max.)	Dissemination activities were very useful to engage chestnut growers and to demonstrate the effectiveness of a chestnut grove management that's also economically and environmentally sustainable. The project started in 2020 exactly at the beginning of the Covid19 pandemic crisis. In order to enhance real knowledge exchange between partners, it was chosen not to do remote dissemination activities but rather to wait until the end of pandemic restrictions. This has favored personal contacts, allowed participants to know important chestnut growing realities on a regional and extra-regional scale and practical demonstrations in the field. The chestnut production sector is facing many difficulties due to environmental, social and economic aspects. These sharing-knowledge activities are fundamental to establishing durable relationships between the multiple actors of the production chain and to build stable networks, capable to operate also after the end of the project.

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Links to website/report/video (if applicable)	https://www.psingeca.it/it
Pictures (if applicable)	

Title of innovation	**Integrated management of resources (water and soil) in nuts production**
ITHub	4
FOREST4EU partner (short name)	SOLUTOPUS
Operational Group (short name)	EGIS
Operational Group (name)	Stategies for an integrated management of water and soil related to nuts production (chestnut, almond, hazel and walnut)
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	farmers, NGO's, researchers, advisors; business
Link from OGs database	https://egis.cncfs.pt/projeto
Country, region, city	Portugal/ Trás-os-Montes
Type of innovation	Process
Keywords	NWFP, resources use
Approach and main results (4000 characters max.)	The initiative focused on soil and water management in four species that produce nuts: chestnut, almond, hazel and walnut. The OG aimed to evaluate the effect of different natural and sown plant covers on chestnut crops in order to select the type of cover best suited to each crop. Also, to evaluate different soil fertilization strategies, via foliar and/or fertirrigation in the four species studied with a view to knowing the response of these species to the main nutrients and recomend some corrections. The **Objectives were assumed as diferentiated,** according to the specimen to be analysed, and aligned with the most evident problems that arise in the production practice. As a previous point, the OG stated the importance of knowing the characteristics of the place where the plantation will be located, and act accordingly: **a)** drainage: in soil with poor drainage it is not possible to establish an orchard- then, establish some practices to increase the draining capacity; **b)** pH: is probably the soil property that can impose the most constraints to the development of plants- then, to correct it is important; **c)** organic matter: it is important to contribute to the correction of its availability, for the plants; **d)** correction of phosphorus content, accordingly with the results of correction in the ph. The OG worked several field stations, with extended experiences for the distinct specimens here considered. **The results, by specimen, may be referentiated like this: 1- the walnuts,** even not being a particularly demanding crop in nutrients, need good soil structure and aggregation conditions provided by a good organic matter content, from deep soils with good storage capacity for water, and must also be ventilated and well drained. **2- the chestnut tree** must receive nitrogen annually and boron as fertilizers. Potassium also should be applied regularly. The phosphorus should be required in smaller quantities than nitrogen and potassium and is less important the annual regularity of its application. The

	foliar analysis helps in the quantification of these aplications. **3-** for t**he hazelnut ,d**ue to the growing impact caused by climate change, ways are being studied to reduce the amount of water to be applied through irrigation, mainly through regulated deficit irrigation (RDI). The adoption of drip or micro-sprinkler irrigation, combined with irrigation strategies deficit, are the most viable solution to the current scenario of decreasing water reserves available for irrigation. **4- Almonds:** The use of indicators water and thermal stress of the plant is essential for adequate irrigation management deficit. It is essential to monitor the water status of the crop in the initial stages and evaluate the need to start watering earlier, considering the importance of satisfying water needs of the crop in the first phases of its cycle. The irregularity of Mediterranean climate reinforces the need of this control. **Other considerations and conclusions for the orchards:** install biodiverse pastures; make legumes profitable for orchards, improve soil structure, use alternative fertilizers such as e.g. ex. algae, establish technically supported fertilization plans and install adapted irrigation systems, for each case.
Lessons learned (1200 characters max.)	It is a need to go deeper in practical experiences regarding nuts systems. Traditionally, they are produced in dry conditions, without special care in soil management, fertiliation, irrigation and varieties. The uncertainity in climate and the need to be more profitable appeals to more applied research, field experiments and farmers'engagement. Alternative nutrients sources, more frequent analysis (foliar and soil), technological advanced solutions for irrigation and biodiverse pastures are among the most suitable practices to improve nuts productions.
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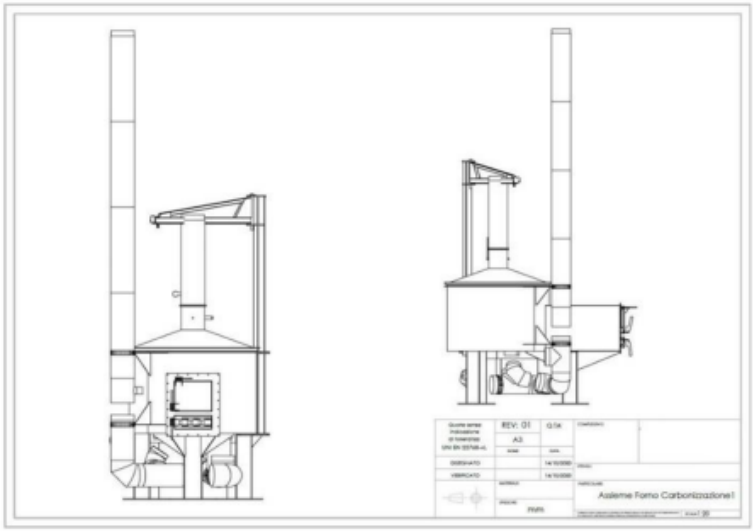
Links to website/report/video (if applicable)	https://egis.cncfs.pt/projeto
Pictures (if applicable)	

Title of innovation	**Biological Treatment of cancer chestmenut (Cryphonectria parasitica) in Portugal**
ITHub	4
FOREST4EU partner (short name)	SOLUTOPUS
Operational Group (short name)	BioChest nut- IBM
Operational Group (name)	BioChest nut- IBM- Biological treatment for chestnut cancer
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	research institutions; farmers; cooperatives (business) and associations (NGO)
Link from OGs database	https://biochestnut.cncfs.pt/
Country, region, city	Portugal/ Trás-os-Montes e Beira Interior
Type of innovation	Technological innovation
Keywords	Cancer of chestnut; biological techniques
Approach and main results (4000 characters max.)	The OG focused on the chestnut cancer, with the aim of finding biological tools and mangement to decrease the effects of the parasit; the conventional treatment until now hasn't been efficient in fighting this disease. Chestnut cancer is associated with the fungus Cryphonectria parasitica (Murril) Barr, a species of Asian origin, invasive and very aggressive on chestnut trees, causing death of the branches and progressively of the entire tree. A European and Mediterranean Plant Protection Organization (EPPO) categorizes the fungus C. parasitica as an organism of quarantine on the A2 list, i.e. a quarantine organism but already present in many of the European countries (EPPO, 2022). OG BioChestnut- IBM had 4 **Phases:** **1**-Characterization of the virulent C.parasitica population; - **2-** Know the presence of natural hypovirulence in the C.parasitica population in Portugal; **3-** Monitor the effectiveness of treatments and **4-** Develop formulations of the DICTIS bioproduct for use in different disease situations in chestnut trees. Following a strict experimental design, essays were made with the biological products, supported by laboratory analysis and field observations. Considering that the biological control using hypovirulent strains of C. parasitica (hypovirulence) is a very effective means of control that promotes the healing of cancers and the full recovery of diseased chestnut trees and considered by EFSA (2016) as the most adequate and more effective to mitigate and control the high risks that the diseascker with CHV1 Strains is necessary to complete the following: **stage 1** - Scientific and technical studies (Pre-Application). Population Study of the Parasitic Fungus Present in Soutos, Production and Formulation of the Bioproduct, Experimental Development; **Stage 2** - Treatment of Cancers, by puncturing or brushing with CHV1 Strains Compatible; **Stage 3** - Monitoring and Evaluating the Efficacy of Treatments and **Stage 4** – Compliance

	with IPB Regulatory Commitments, Chestnut Producers, Producer Associations, Other Authorized Entities.
Lessons learned (1200 characters max.)	Find the best practices and develop action and interaction tools between different participants was one of the objectives of the GO - Biochestnut -IPM- project to implement measures effective fight against chestnut and almond trees. The participation of researchers, technicians and chestnut producers as well as the different entities involved in the organization of production, management of the territory and official entities allowed the transfer to take place of technology and the adoption of the new biological control method in the treatment of breast cancer chestnut. The success achieved translates into the treatment of 4028 (plots) chestnut trees and 59452 chestnut trees recovered, thus guaranteeing productivity for producers, but also the sustainability and resilience of the chestnut ecosystem of high environmental value in the mountain regions of Portugal. The "Experimental Program for the Biological Treatment of Chestnut Canker Based in Hypovirulent Strains of Cryphonectria parasitica - CHV1 Strains" effectively resolves and will continue to ensure the long-term resilience of the chestnut ecosystem. The new parasites and mutations need similar approach, in continuous.
Contact information	ana.santos@cncfs.pt
Links to website/report/video (if applicable)	https://biochestnut.cncfs.pt/
Pictures (if applicable)	   

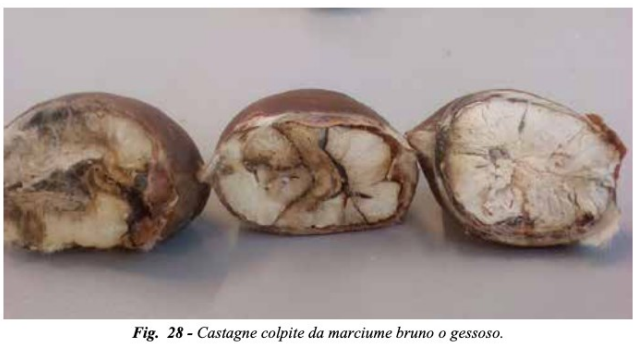
ITHub 4 - 18

Title of innovation	**Mobile charcoal pile prototype for biochar production in situ**
ITHub	4
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	INGECA
Operational Group (name)	Strategie INnovative a basso impatto per la GEstione delle avversità dei CAstagneti da frutto
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Universities, chestnut farmers consortium, public operators, research institutions, chestnut transformation companies, biochar companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/strategie-innovative-basso-impatto-la-gestione-delle
Country, region, city	Tuscany, Italy
Type of innovation	Technological innovation
Keywords	Carbon stock, circular bioeconomy, Multifunctional forest management
Approach and main results (4000 characters max.)	A prototype of vertical mobile charcoal kiln has been developed on a farm scale, with quite small dimensions, whose work for the charcoal-making operations is such that only one worker's day is sufficient. The transformation of chestnut cultivation residues into biochar and charcoal is a good practice from a phytosanitary point of view, and furthermore, this activity allows for increased profitability on a small company scale, mainly focused on forest owners. These products can be further valorised on the farm or sold to third parties, thus becoming an additional source of income from materials that would otherwise have to be disposed of. Other promising products are condensate liquids derived from the pyrolysis process. The prototype is structured with a vertical development, outlining a type of mobile kiln called 'vertical kilns with discontinuous operation', capable of operating in direct and indirect carbonization process. The input material can be in the form of wood with varying diameters and length reduced to approximately one metre, (direct or indirect system), but also chopped wood or other residues (indirect system), coming from the cultivation of the chestnut grove, but also supplied by other sources within the owner forest production, such as pruning residues of other fruit trees or residues of silvicultural operations. The product obtained therefore has

	characteristics, even if only dimensional ones, that are peculiar and therefore destined to be used in the production of chestnuts. The carbonisation that can be carried out in this prototype is a slow process that takes place at a low to medium temperature (below 500 °C), and is the system that yields a higher yield in solid product (charcoal), compared to rapid and/or high temperature pyrolysis systems (Bridgwater, 2007), an element that should not be underestimated at farm level.
Lessons learned (1200 characters max.)	Considering the excellent results and the current need of chestnut growers to diversify and increase income, the mobile charcoal kiln has proved to be a machine capable of responding to the needs of chestnut farms, and the versatility of the direct and indirect system process also makes it suitable for all those farms that have agro-forestry waste, such as prunings from olive groves and vineyards, making the project multi-purpose in creating economic and employment induced from elements previously considered waste and above all not exclusively linked to chestnut growing.
Contact information	Solaria Anzilotti, Salvatore Moricca, Rodolfo Picchio
Links to website/report/video (if applicable)	https://www.psingeca.it/it
Pictures (if applicable)	 *Fig. 53 - Il prototipo in vista frontale e laterale.*

ITHub 4 - 19

Title of innovation	**Endotherapic treatments with Trichoderma spp. in chestnut groves**
ITHub	4
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	INGECA
Operational Group (name)	Strategie INnovative a basso impatto per la GEstione delle avversità dei CAstagneti da frutto
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Universities, chestnut farmers consortium, public operators, research institutions, chestnut transformation companies, biochar companies
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/strategie-innovative-basso-impatto-la-gestione-delle
Country, region, city	Tuscany, Italy
Type of innovation	Technological innovation
Keywords	Pest/disease control, Multifunctional forest management, wood transformation
Approach and main results (4000 characters max.)	Tuscan chestnut cultivation is still carried out using traditional methods. Climatic, economic and social factors led in recent decades to the ageing and physiological decline of chestnut groves. Moreover, the arrival of new pathogens and pests as well as the resurgence of already known parasites severely curtail chestnut production. Phytosanitary control in chestnut groves has always been carried out by traditional treatments, that caused a high product dispersion in the environment and a low efficacy. For the above reasons the introduction of new, economically viable tree cultivation and protection techniques may provide a valuable solution. The objective was to transfer to chestnut groves biocontrol protocols that have already been tested and validated in others crop systems. This was the first case of application of biocontrol agents (BCAs) in chestnut groves. BCAs are beneficial microorganisms that live naturally in soil and/or within plants tissues (endopythes). Trichoderma spp., in particular, has been widely used in agricultural crops as “biopesticides” proving to be highly effective in enhancing plants growth and increasing parasite resistance. Endotherapic treatments were carried out with various local strains of Trichoderma spp. These were directly injected into the tree sapwood by using the new, minimally invasive BITE® (Blade for Infusion in TrEes) injection tool, at 1,30 m of height. The best period for treatments is during the growing season when the tree canopy is fully developed, with transpiration and water transport within trees very high, so that the Trichoderma suspension

	can be quickly adsorbed and moved to the upper part of the crown. The same microorganisms were also inoculated into the soil where they can protect tree roots in the rhizosphere. The results showed that Trichoderma empowers natural plant defenses, so that the tree is also more resistant to pathogens. In particular, this methodology has shown very significative results in limiting the nut rot disease caused by Gnomognopsis castaneae, which strongly impacts chestnut fruit production. Disease incidence reduction was by 30-35% in the first year and 60% in the second year. The same BCAs were also used to protect pruning wounds (both ordinary and phytosanitary cuts) because some pathogens (e.g. the agent of chestnut blight Chryphonectria parasitica) cause wound infections. Moreover, biocontrol treatments proved also effective in increasing the density of Torymus sinensis larvae.
Lessons learned (1200 characters max.)	Biological control, when coupled with good management practices, leads to a reduction in the incidence and severity of pest attacks on the fruit and, as a consequence, a remarkable increase in chestnut production. Tree endotherapy with local Trichoderma is functional to safeguarding ecological integrity and biodiversity of chestnut groves as well as to maintaining the ecosystem services these stands provide.
Contact information	Salvatore Moricca, Solaria Anzilotti (solaria.anzilotti@unifi.it)
Links to website/report/video (if applicable)	https://www.psingeca.it/it/trattamenti-endoterapici-con-trichoderma-spp
Pictures (if applicable)	  *Fig. 28 - Castagne colpite da marciume bruno o gessoso.*

ITHub 4 - 20

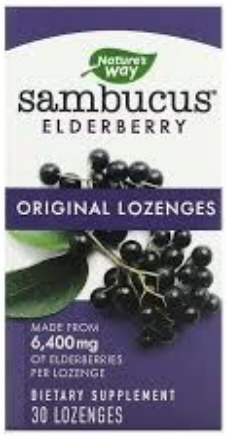
Title of innovation	**Methodology for plantations**
ITHub	4
FOREST4EU partner (short name)	SOLUTOPUS
Operational Group (short name)	ClimCast
Operational Group (name)	The new challenges for the chestnut grove in the context of climate change
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	NGOs; business; researchers
Link from OGs database	https://www.citab.utad.pt/projects
Country, region, city	Portugal / Trás-os-Montes and Beiras
Type of innovation	Process
Keywords	Plantation; chestnut; varieties; climate adaptation
Approach and main results (4000 characters max.)	ClimCast installed a **network of 7 demonstration groves in different soil and climatic contexts** of the "chestnut" country. These chestnut trees were made up of specimens of 11 chestnut cultivars and are equipped with meteorological stations. It was thought to be an embryonic basis of a knowledge network to serve the sector, according to the needs. Chestnut production is strongly conditioned by weather conditions averages and extremes observed during its annual cycle. Diseases and pests that affect and decimate chestnut trees are also associated with specific environmental conditions. Like this, the economic potential and development strategy of the vlue chain, in Portugal, face difficulties resulting from climate variability and climate change. The chestnut tree presents weaknesses resulting from poor tolerance to the combination of water and thermal stresses that result in loss of vigor and productivity as well as a abnormal increase in tree mortality rate. **As objectives,** it had: (i) characterize the evolution of soil and climate conditions in the main producing regions in terms of potential for chestnut production; (ii) identify the best adapted varieties future climate conditions; (iii) develop tools to estimate future production; (iv) develop a manual of good chestnut cultivation practices to be adopted by producers (v) create a warning network for chestnuts. **The results** are mainly related to the large number of meteorological variables that were identified, detection indices remote control and other parameters with influence on the chestnut tree and predictive potential of chestnut productivity in Portugal. The climatic characterization of the main chestnut regions and chestnut producing regions, under current climate conditions and future. These results allow selecting the best cultivar for each situation edafoclimatics and

	understand the impacts of climate change in oil-producing regions brunette. Based on this knowledge, climate models were developed for simulation and forecasting nut productivity and mapping climatic suitability for chestnut production. The methodology developed allowed identifying the regions producers and potential producers of chestnuts depending on their characteristics climate and also provides a gradation of the risk situation of the crop.
Lessons learned (1200 characters max.)	This OG arose with the aim of taking advantage of the opportunity of the development of the sector and, in the context of climate change. Monitoring soil evolution will make it possible to assess the impact of climate change in the soil and make the necessary adjustments to the fertilization plans. A climate productivity model and potential production chart will be developed of chestnuts in Portugal. This model will allow us to better systematize knowledge about the climatic conditions of production and with some advance help to predict the annual chestnut production, an aspect of the greatest importance for the industry. Last but not least, is the grove network complemented with stations weather forecasts that are set up, allowing the creation of a warning network that will work from RefCast (producers association). Future financial support is expected to continue the work. The available data and the methodology for the field experiments was an example to be followed.
Contact information	gpereira@utad.pt
Links to website/report/video (if applicable)	https://www.citab.utad.pt/
Pictures (if applicable)	

ITHub 4 - 21

Title of innovation	**Valorization of a neglected plant**
ITHub	4
FOREST4EU partner (short name)	SOLUTOPUS
Operational Group (short name)	SambucusValor
Operational Group (name)	Integrated valorization of elderberries according to healthy consumption patterns: from the plant to the creation of new value-added food products.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farmers and forest owners; business; researchers
Link from OGs database	https://sambucusvalor.pt/
Country, region, city	Portugal (north inland)
Type of innovation	Product
Keywords	Elderberries; valorization; packaging; virtualities
Approach and main results (4000 characters max.)	OG SambucusValor aimed to develop value-added food products from elderberries, with a view to increasing their market penetration. It was assumed that the management and valorization of elderberry cultivation based on the creation of quality indicators and sustainable production and transformation strategies, namely through the integration of skills and resources installed in partner entities, which should lead to the creation of a pilot center to enhance this development . **The Objectives** were: **1-**Definition of flower and berry quality indicators, which relate growing conditions to flower and berry composition; **2-**Implementation of flower and berry stabilization and storage processes with a view to preserving their bioactive components for a period longer than the normal harvesting of materials, thus ensuring the continuous supply of raw materials with strict food quality standards; **3-** Design and development of new food products, based on elderberry flowers and berries; **4-**Nutritional assessment of products to be developed; **5-**Creation of a website, information dissemination networks and a partnership network with consumer associations, food companies and elderberry producers as a means of disseminating, communicating and valuing elderberry, at national and international level and **6-** Creation of a pilot elderberry center that should represent a nucleus of innovation across the entire elderberry value chain: from the plant to the creation of new value-added food products. T**he results** are made available through diverse technical (p.ex : Publicação Uaonline: Investigação do Departamento de Química: Centro-piloto do sabugueiro nasce para desenvolver produtos alimentares mais saudáveis – notícia no site da UA on-line - http://uaonline.ua.pt/pub/detail.asp?lg=pt&c=54222) and scientific publications. An

	inpressive number of presentations and workshops and other events were organized. A PhD thesis was supported by the OG activities.
Lessons learned (1200 characters max.)	Promotion of elderberry products in baskets: In January 2021, Inovterra, in partnership with some farmers and with the partner entities of the Operational Group, launched a distribution of baskets of vegetables and regional products at national level. This launch of product baskets made making it possible to include elderberry products in sales to the public in a different way, and made it possible to publicize elderberry-based products, which were presented every week in the baskets. Also, beginning of cooperation with Galiza (Spain) due to common interests. Involvement between producers and commerce, for renewed products and presentations, as well as in marketing activities. Involvement of the agroindustry.
Contact information	https://sambucusvalor.pt/; inovterra@gmail.com
Links to website/report/video (if applicable)	https://youtu.be/SdJiiO15zKs; https://youtu.be/ZZAOQxeEazs; https://youtu.be/17Ep-wlLw3o
Pictures (if applicable)	

	  Nature's Way sambucus ELDERBERRY ORIGINAL LOZENGES MADE FROM 6,400mg OF ELDERBERRIES PER LOZENGE DIETARY SUPPLEMENT 30 LOZENGES

ITHub 4 - 22

Title of innovation	**Valorization of dried nuts with hard skin**
ITHub	4
FOREST4EU partner (short name)	SOLUTOPUS
Operational Group (short name)	ValNuts
Operational Group (name)	Valorization of dried nuts
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	NGOs; researchers; business
Link from OGs database	https://inovacao.rederural.gov.pt/grupos-operacionais/13-projectos-groupos-operacionais/82-valnuts-valorizacaodos-frutos-secos-de-casca-rija-fscr
Country, region, city	Portugal/ Trás-os-Montes and Beiras
Type of innovation	Product
Keywords	Almond, hazelnut, walnut, valorization, conservation
Approach and main results (4000 characters max.)	The OG had as **Objective the valorization of dried nuts, diversifying their use.** For the almonds and hazelnuts, to contribute to their long lasting, presentation, and conservation, making possible to attain distant markets. **Almonds**: to explore the potential of ground, flour, granulated and laminated. Also explore its processed value: fried, in jams, toasted, with meat or in liqueurs or other drinks. ground, flour, granulated and laminated. also explore its processed value: fried, in jams, toasted, with meat or in liqueurs. For the by-products such as the bark, explore their use as fertilizer, use in animal feed, as a source of bioactive compounds or as gum. For each of these objectives, tests and essays were made, according to the variability of the fruit, the time consuming, the cost and the real transport conditions. The humidity, microbial content, storage temperature in the different stages of product preparation were particularly sensitive aspects. **Hazelnuts**: The intention was to potentiate this crop in Portugal by diversifying its use and presentation (indirectly the price) and achieving export. The physical-chemical characterization of the different varieties was carried out and good practices were established. For post-harvest, attention was paid to peeling, packaging and transportation, with special relevance for tropical countries. **Connection with the Project Valor+** (https://valormais.cncfs.pt/): The 'ValorMais' project aimed to promote the valorization of by-products from agricultural, agri-food and forestry sector through its characterization and quantification. In this sense, the OG co-promote the use and valorization of the so called "waste" (by-products) in a view of circular economy.

	The forest waste of other varieties such as eucalypthos, pine and quercus are also considered here in Valor+, building a platform to inform about the stock, use and commercial operators in this field.
Lessons learned (1200 characters max.)	Several scientific articles were published, as a way to promote the results and the international discussion on these subjects. The cooperation between research institutions was productive, as in other OG. The essays are expected to go further, as well the efforts to achieve the efective advantages for producers. The foreign competition is an aspect to be studied, yet. The elargissement of the cooperation with other partners, beyond the promotors of this OG, was an addded value to better disseminate and promote the use of the all the products valences.
Contact information	gruposoperacionais@gmail.com; CNCFS
Links to website/report/video (if applicable)	https://valnuts.cncfs.pt/projeto
Pictures (if applicable)	 

ITHub 4 - 23

Title of innovation	**Mechanised cork extraction method**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO SUBER
Operational Group (name)	Global modernization of the cork harvesting sector: mechanization, improvement of work environment, optimization of organization and commercialization
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two Forestry management private companies, one robotic technologies and innovation private company, two universities cork specialized centers, three oak cork forest owners representatives, four national and regional public cork researcher centers.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/grupo-operativo-resinlab-para-la-creaci%C3%B3n-de.html
Country, region, city	Spain, Extremadura-Andalucia-Madrid-Cataluña
Type of innovation	Process
Keywords	Non-wood forest product; cork, harvesting, wine stopper, Multifunctional forest management, cicrular bioeconomy
Approach and main results (4000 characters max.)	Gosuber project, developed from 2018 to 2020, has been oriented to improve cork harvesting efficiency. The absence of mechanization in cork extraction work, or cork removal, is one of the main problems that affects subericulture, that is, forestry applied to cork oak forests. Cork harvesting continues to be carried out in the 21st century as it did more than two hundred years ago, manually, with the help of the axe and a leverage, which points towards a necessary modernization. The conditions in which cork harvesting is carried out make this profession unattractive for new generations, due to the temporary nature of the work, the difficulty involved in handling the axe (it requires strength and skill), and the danger of the work (sometimes involves climbing the trees). As a consequence, specialized labor is scarce and aging, and in addition, they work with serious security deficiencies. New procedures have been sought by changing the way that it is usually done, bringing new machinery on, and upgrading security and health practices, as well as introducing new complete logistic process through last technologies and adapted procedures. Main results have been materialized in a mechanical cork harvesting guide.

Lessons learned (1200 characters max.)	One of the most important parts of the project, the mechanization of cork harvesting, has a long development path ahead. The introduction of electrical machinery in cork harvesting still requires a deep awareness effort regarding the occupational safety and health of the cork remover's work. Only with the professionalization of the sector, and at the hands of the administrations, would technological advances be possible that would make us forget about the axe. The technological evolution of the electric saw and the battery is already causing this change.
Contact information	m.bejarano@trevincaingenieria.com
Links to website/report/video (if applicable)	https://gosuber.es/
Pictures (if applicable)	

ITHub 4 - 24

Title of innovation	**Quality cork guide**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO SUBER
Operational Group (name)	Global modernization of the cork harvesting sector: mechanization, improvement of work environment, optimization of organization and commercialization
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two Forestry management private companies, one robotic technologies and innovation private company, two universities cork specialized centers, three oak cork forest owners representatives, four national and regional public cork researcher centers.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/go-suber-modernizaci%C3%B3n-global-del-sector-de-la.html
Country, region, city	Spain, Extremadura-Andalucia-Madrid-Cataluña
Type of innovation	Product
Keywords	Non-wood forest product; cork, vertical, gardens, isolation
Approach and main results (4000 characters max.)	Gosuber project, developed from 2018 to 2020, has been oriented to improve cork harvesting efficiency. Furthermore, at GOSUBER other uses of cork have been studied, apart from wine corking, the aeronautical industry, construction, and other minor uses, to improve the marketing and valuation of cork. Currently, much of the economic value of cork lies in its capacity to manufacture wine stoppers but, given its exceptional physical-chemical properties, there are multiple possibilities for use in areas as diverse as the aeronautical industry or cosmetics. ; The resulting products provide a very high added value compared to traditional uses and represent a very significant economic potential for rural areas (creation of qualified work, stopping rural depopulation, industrialization of the economy, etc.) as well as the maintenance of the ecosystems of the cork oak forests. Main results have been materialized in a guide to new uses of cork whit the studies carried out and their applications.
Lessons learned (1200 characters max.)	The valorization of cork, on the rise due to the general decline of cork oak forests and the advance in the technology of manufacturing technological wine stoppers (where almost all cork quality classifications are valid), complicates its use for applications outside of the wine market.

Contact information	m.bejarano@trevincaingenieria.com
Links to website/report/video (if applicable)	https://gosuber.es/
Pictures (if applicable)	

ITHub 4 - 25

Title of innovation	**Mechanised resin extraction method**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO ACREMA
Operational Group (name)	ADAPTATION OF THE RESIN ACTIVITY TO PINEWOODS FOR WOOD PRODUCING PURPOSES.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Resin processing industries, resin producers' cooperative, forest asociation and enterprise and forestry technology centres.
Link from OGs database	ADAPTACIÓN DE LA ACTIVIDAD RESINERA A MASAS DE PINO CON FINES PRODUCTORES MADEREROS. | EIP-AGRI (europa.eu)
Country, region, city	Spain, Galicia, Castillay León, Asturias
Type of innovation	Process
Keywords	Non-wood forest product, Multifunctional forest management, circular bioeconomy
Approach and main results (4000 characters max.)	Although the practices used in resin extraction have been improving in yield and quality, the extractive method remains the same: collecting the resin that emanates from a bare wood surface as a result of incisions, called picks, made repeatedly over time on the surface of the tree. With the development of mechanised extraction methods, the aim is to obtain a raw material with greater purity, less physical effort and skill in execution, and good yields. The method tested in this OG is the so-called borehole at height. This method, which has existed for decades but has not yet been applied in Spain, has been tested and improved in this project. The methodology consists of drilling 3 simultaneous holes of 1.6 cm in diameter and 12 cm deep, with an inclination of 10 gr with tangential orientation (not radial), leaving a horizontal space between holes of 10 cm and a vertical space of 2 cm. For the borehole method, three extraction bags were used simultaneously, which were raised in height each time the picks were refreshed in an upward direction, with a periodicity of 14 days between picks. The results show that the borehole method produced 8.5 % more P. pinaster and 15 % more P. radiata than the other methods tested (traditional method and surface drilling method). The Borehole method is suitable for stands destined for chipping wood, and the yields obtained are very interesting, even without the application of stimulants. Stimulants have increased resin production by 70 % for traditional pica and circular notching, but only by 40 % for borehole. The high borehole productions stand out, especially in the non-stimulated trees, reaching productions of 1,796 g for P. pinaster and 1,162 g for P. radiata. The increase in production in 2022

	compared to 2021 is very small for the borehole method, from which it can be deduced that the borehole wood penetration production system has a smaller cumulative effect per season and/or is less influenced by the different environmental conditions between seasons. For example, the production increases for Borehole, depending on the species and extraction technology, range between 8 and 10% in 2022, while for the traditional and circular notching system the increases are 34.5% and 30.22% respectively in 2022.
Lessons learned (1200 characters max.)	The generation of innovation in resin extraction processes requires long-term trials and a large number of individual specimens (trees) studied. Resin production is affected by numerous variables, including climatic, edaphic, dasometric and, of course, human factors. This means that in order to extrapolate an innovation in this field to different scenarios, it requires longer study periods than those currently provided by the OG. On the other hand, the complexity of scientific and technical cooperation has become manifest. Good communication of the real interests of the parties is essential for the success of these processes. On the scientific side, data collection in the field, which is carried out by the tapping workers, as well as the execution of the work, is essential to scientist work. Without reliable data, all research results will be useless. On the other hand, the researchers developing the experimental designs must know and communicate frequently and closely with the tapping workers or the designs cannot be realistically implemented
Contact information	erikamc@foresin.es
Links to website/report/video (if applicable)	https://acrema.es/r1-mejoras-en-la-extraccion-de-resina-en-base-al-desarrollo-de-metodos-de-extraccion-mecanizados-en-envase-cerrado-y-optimizacion-del-metodo-convencional-de-pica-sobre-corteza/
Pictures (if applicable)	 

ITHub 4 - 26

Title of innovation	**Wood-resin compatibility model. Mechanical wood characterization to assign a resistance class according to the UNE-EN 338 standard**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO ACREMA
Operational Group (name)	ADAPTATION OF THE RESIN ACTIVITY TO PINEWOODS FOR WOOD PRODUCING PURPOSES.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Resin processing industries, resin producers' cooperative, forest asociation and enterprise and forestry technology centres.
Link from OGs database	**ADAPTACIÓN DE LA ACTIVIDAD RESINERA A MASAS DE PINO CON FINES PRODUCTORES MADEREROS. | EIP-AGRI (europa.eu)**
Country, region, city	Spain, Galicia, Castillay León, Asturias
Type of innovation	Product
Keywords	Non-wood forest product, Multifunctional forest management, circular bioeconomy, Supply chain, market and consumption, forest industries
Approach and main results (4000 characters max.)	The incorporation of complementary activities to the exploitation of timber can represent an improvement in the management and conservation of forests, as well as allowing the generation of regular economic activities that create added social value for the populations benefiting from different products. One of the complementary activities listed for Galicia in Decree 73/2020 of 24 April is the use of resin in three pine species (Pinus pinaster Ait., Pinus radiata D. Don and Pinus nigra Arnold) before the clear-felling. In this context, there is an interest in including tapping activity as an ecosystem service added to the management of Galician mountains, initially planted for timber use only. As a material of natural origin, wood presents a great deal of variability. The characterization and classification processes are presented with the aim of complying with the basic requirements established by regulations for the appropriate use of wood as a structural element, which consists, fundamentally, in knowing the properties of the material. In this sense, one of the proposals of the ACREMA Operative Group was to **evaluate the influence of the resin activity on the quality of wood from a structural point of view. For this purpose, mechanical tests** (static bending) were carried out on a total of 238 pieces of Pinus pinaster with structural dimensions, separated into two subsamples (resin-treated and control logs). Prior to the breakage (bending) tests, all the boards were **visually graded** according to the criteria

	established in the Spanish visual grading regulations for coniferous wood. During the visual grading process, the presence of some singularities that may affect the structural strength of the wood were analysed: knots, resin pockets, cracks, deformations. However, the number of rejected tapped boards is quite similar to the number of rejected boards from control logs. **Structural strength values** for all the material were obtained from the mechanical tests and it was possible to compare the structural quality of the wood from previously tapped and untapped logs. In general, the values obtained for the two samples are in the same order. Regarding the **strength**, the sample of boards from the control logs had a slightly (6 %) higher average value than the sample of boards from the tapped trees. The average values of the strength properties: **modulus of elasticity, bending strength and density**, showed no numerically significant differences between the tapped and control material from the two plots. The study concluded that the resin does not cause any loss in the mechanical properties of the wood (strength and stiffness). With regard to the **density** parameter, however, an increase in the value is observed in the wood from tapped pieces, which could mean positive contributions from a structural point of view. The characteristic values of the strength properties of the tapped wood obtained are within the expected range for Spanish Pinus pinaster wood, which is nowadays accepted in the European standard that regulates the use of wood species for structural purposes (EN 1912).
Lessons learned (1200 characters max.)	The use of resin in the Galician community presents a series of weaknesses that hinder the development of the sector, from the scarce availability of workers in the trade to the rejection of forest owners due to the possible effects of the use of resin on the quality of the wood, to the lack of confidence on the part of the manufacturing industry due to possible problems in the technical handling of the material.
Contact information	erikamc@foresin.com
Links to website/report/video (if applicable)	https://acrema.es/r4-asignacion-de-una-clase-resistente-a-la-madera-de-p-pinaster-resinada-con-fines-estructurales-segun-la-norma-une-en-338/
Pictures (if applicable)	

ITHub 4 - 27

Title of innovation	**Analytical techniques based on NIR technology for the characterisation of resins and their derivatives**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO ACREMA
Operational Group (name)	ADAPTATION OF THE RESIN ACTIVITY TO PINEWOODS FOR WOOD PRODUCING PURPOSES.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Resin processing industries, resin producers' cooperative, forest asociation and enterprise and forestry technology centres.
Link from OGs database	ADAPTACIÓN DE LA ACTIVIDAD RESINERA A MASAS DE PINO CON FINES PRODUCTORES MADEREROS. | EIP-AGRI (europa.eu)
Country, region, city	Spain, Galicia, Castillay León, Asturias
Type of innovation	Technological innovation
Keywords	Non-wood forest product, Multifunctional forest management, circular bioeconomy, Supply chain, market and consumption, forest industries
Approach and main results (4000 characters max.)	The quality of the resin is a key factor in the competitiveness and viability of the resin sector, about which there is insufficient knowledge to date. Starting from the distillation of the resin by hydrodistillation or steam distillation to obtain its main components (rosin and turpentine), and through laboratory analytical techniques, we can determine important parameters that will vary depending on the resination method, the species or the climate, among others, and which will be decisive when classifying the resin according to its quality and, therefore, its final destination. A study has been carried out on the analysis of resins and rosins using NIRs technology (Near Infrared Spectroscopy), a non-destructive, simple and fast technique that would allow an initial classification of the resins based on their quality parameters, such as rosin and turpentine content, for example. This would allow a more detailed knowledge of the product for sale to the first transformation industry, directing the resin production to different sectors, depending on the needs demanded by the companies. The NIRs analysis has focused on the development of models to determine the % turpentine and % rosin of the starting resins and the acidity index of the rosins obtained. The first step of the working system in the development of a NIR prediction tool is calibration, which involves the analysis by classical (or laboratory) technologies of a set of samples that are representative of the parameter of interest (called the calibration population). At the same time, these samples will be analysed by

	NIR, optimising the process so that quality spectra are obtained. The spectra will be confronted with data obtained by classical methodologies, constituting the working databases with which, using multivariate analysis software, prediction models will be developed. The second step is validation, the application of these models on samples not included in the calibration population, also analysed by classical methods, thus knowing the reference value of the parameter to be determined (known as the validation population). The statistical study of these results will determine the framework of application of the prediction models, restricting it to a classification system by categories, or it can be applied in quantitative analysis. Model development was studied considering a global data set, and also classifying the calibration population by method, species and both factors simultaneously. As expected, correlation values improve when variability is restricted. As an overall result it can be concluded that, although correlation coefficients of 0.8 have been obtained for some models, it is necessary to extend the calibration populations to be able to continue working and developing robust models that allow, if not quantification, a quick and easy classification of the resin. All this, together with the great versatility of commercial accessories for NIR equipment (portable and non-portable) would provide companies with a tool that not only allows product control, but also its commercialisation with a guarantee of traceability and quality.
Lessons learned (1200 characters max.)	NIRs technology is a promising technique in the resin industry as a simple and fast way to classify resin. The models developed for the prediction of rosin % show better statistics than those developed for the prediction of turpentine content. This may be due to the method used to obtain principal components. It is necessary to extend the calibration populations in order to be able to continue working and developing robust models that allow, at least, a quick and simple classification of the resin.
Contact information	erikamc@foresin.com
Links to website/report/video (if applicable)	https://acrema.es/wp-content/uploads/2023/04/FV3.2_Modelos-de-calibracion-y-validacion-de-tecnologias-NIR-en-el-.pdf
Pictures (if applicable)	

ITHub 4 - 28

Title of innovation	**New cork uses guide**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO SUBER
Operational Group (name)	Global modernization of the cork harvesting sector: mechanization, improvement of work environment, optimization of organization and commercialization
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two Forestry management private companies, one robotic technologies and innovation private company, two universities cork specialized centers, three oak cork forest owners representatives, four national and regional public cork researcher centers.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/go-suber-modernizaci%C3%B3n-global-del-sector-de-la.html
Country, region, city	Spain, Extremadura-Andalucia-Madrid-Cataluña
Type of innovation	Process
Keywords	Non-wood forest product; cork, harvesting, wine stopper, axe, safety and health
Approach and main results (4000 characters max.)	Gosuber project, developed from 2018 to 2020, has been oriented to improve cork harvesting efficiency. An attempt has been made to establish a cork quality classification procedure. Main results have been materialized in a guide, that collect detailed information about the studies carried out and their applications in cork quality classification.
Lessons learned (1200 characters max.)	Information technologies applied to subericulture are the immediate future of forest management of cork oak forests. The possibility of establishing the different qualities of cork in the field through innovative technologies will lead to a democratization of cork sales standards.
Contact information	m.bejarano@trevincaingenieria.com
Links to website/report/video (if applicable)	https://gosuber.es/
Pictures (if applicable)	

ITHub 4 - 29

Title of innovation	**Establishing new business models with NWFP**
ITHub	4
FOREST4EU partner (short name)	StMELF-LWF
Operational Group (short name)	OG Bienwald (Bee forest)
Operational Group (name)	OG Zukunftsfähiger Bienenwald
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	The members of the “sustainable bee forest” OG are: Forest owner “Ruhlengut”, Bee institute Kirchhain in Hesse, Beekeeper “Auenblick”, Beekeeper “Beerow”, Farm community “Niederholzhausen”, and Comunis Projektbüro acting as coordinator for the OG Associated partners are: Justus-Liebig University of Gießen, Association for organic farming, German association for beekeepers, Hesse state enterprise for farming (LLH) technical information unit biological raw material use, Institute for animal ecology (ITN), Forest service Hesse in Kirchhain, Forest owner cooperative Morsch.-Spangenberg, Georg-August University of Göttingen The main target group are farmers who own small forest lands. Through the cooperation with the regional forestry association, in which numerous predominantly small forest owners are organized, and forestry offices of the state of Hesse, information transfer up to urban forest owners is possible. "Urban forest owners" mostly live in cities. They have inherited forest but have little connection to this property and therefore often take insufficient care of it. The innovative bee forest concept offers the possibility to reach out to the variety of forest owners and encourage them to actively manage their forest.
Link from OGs database	Link-netwerk-laendlicher-raum
Country, region, city	Germany, Hesse
Type of innovation	Product
Keywords	Climate and climate change, Biodiversity and nature management, Non-wood forest product, New planting system, Multifunctional forest management

Approach and main results (4000 characters max.)	Together with the state of Rhineland-Palatinate, Hesse is the most densely forested state in Germany. The forest area in Hesse is about 894.180 ha. Hesse has a total of around 60.000 forest owners, the majority of whom are small private forest owners. A quarter of the total forest area in Hesse is privately owned, and one third of this is small-scale private forest is owned by farmers. Because many of them are challenged with forest dieback in the face of climate change, the smallholder farmers are the main target group of the "sustainable bee forest" OG. Large tracts of forest underwent major disturbances over the last years (pests, storms, fire). The German ministry of agriculture and food (BMEL) estimates that over the next years almost 500.000 ha of forest land will need to be afforested (status: Oct 2023). The project "sustainable bee forest" develops and implements a new forest management concept that improves the habitat of flower-pollinating insects during re- and afforestation from the very beginning while generating new sources of income from non-wood forest products. The "sustainable bee forest" OG aims at building better linkages between profitability and conservation aspects for forest owners by diversifying sources of income from forest management. In addition to wood production, emphasis is placed on the production of honey and other non-wood forest products incl. berries and nuts in bee-friendly forest habitats. The OG conducts monitoring and evaluation studies, and collaborates with the University of Göttingen to analyze the economic potential of honey as a non-wood forest product. Such research is lacking while a solid knowledge base is needed for knowledge transfer and persuasion of interested forest owners, managers, and administrations. The product innovation – honey, berries, and nuts from managed forests with bee-friendly species – is based on a solid research base. OG participants and associated partners conduct various studies to model its economic potential in two different setting: 1. Since the project duration is only a fraction of the time horizons usually considered in forestry, the early succession phase in the first years of stand establishment is investigated. This is of particular ecological interest for the bee species group. Therefore, data on pollinator diversity, use as foraging and nesting habitat by wild bees, and nectar and pollen supply by honey bees are collected during three experimental years. 2. In addition, comparable areas in standing forests with corresponding succession as well as old-growth stands are investigated to enable a comparison of the use concepts. Since some of the main tree species envisaged in the planting concept offer abundant flowering in older stands (esp. sweet chestnut and black locust), the nectar availability to be expected from the cooperating beekeeping enterprises when migrating to corresponding sites in the federal territory are recorded. The real honey harvested per colony also serves as a measure of potential additional income from an exemplary non-wood forest product. 3. Analysis of economic potential of NWFP, incl. honey, berries, and nuts: income per hectare in different succession phases 4. Analysis of economic potential in combined forest use model, incl. wood, honey, nuts. Results will be made available via the OG website and communicated by various means and activities, incl. outreach to private small-scale forest owners.
Lessons learned (1200 characters max.)	The marketing of monofloral or type honey is economically interesting for professional beekeepers because it can be marketed nationwide at a high price. However, in order to produce such type honeys, large tracts of one flowering resource or tree species

	(monoculture) are required. This is in contradiction to the desired mixed forest of bee forest tree species. One solution could be to market a "bee forest honey" as an additional product alongside classic type honeys.
Contact information	Comunis Projektbüro, Judith Treis, info@comunis-projektbuero.de
Links to website/report/video (if applicable)	www.bienenwald-hessen.de
Pictures (if applicable)	 

ITHub 4 - 30

Title of innovation	**Interactive Pinus pinaster resin production simulator**
ITHub	4
FOREST4EU partner (short name)	CESEFOR
Operational Group (short name)	GO ACREMA
Operational Group (name)	ADAPTATION OF THE RESIN ACTIVITY TO PINEWOODS FOR WOOD PRODUCING PURPOSES.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Resin processing industries, resin producers' cooperative, forest asociation and enterprise and forestry technology centres.
Link from OGs database	ADAPTACIÓN DE LA ACTIVIDAD RESINERA A MASAS DE PINO CON FINES PRODUCTORES MADEREROS. | EIP-AGRI (europa.eu)
Country, region, city	Spain, Galicia, Castillay León, Asturias
Type of innovation	Service
Keywords	Non-wood forest product, Multifunctional forest management, circular bioeconomy, Supply chain, market and consumption, forest industries, Decisional Support System; Cooperation digital platform
Approach and main results (4000 characters max.)	In southern Europe, especially in Spain and Portugal, maritime pine resin is one of the main non-timber forest products. After suffering a crisis at the end of the 20th century, it is currently a growing sector. In Spain, depending on the area, the management of pine forests is one of the pillars of the national bioeconomy. In addition to timber production, these forests may be oriented towards resin production only, or resin production as a complementary activity to timber production. In both cases, as in any sector, it is essential to have tools to manage and anticipate production, especially in the new context of the bioeconomy. For this reason, the aim of this study is to develop a dynamic model to estimate the accumulated resin yield during the resin production season. Within the ACREMA GO, a decision support system has been developed which consists of two parts, one which is an interactive simulator with the production models and the other which is a web sig with the auxiliary variables and resin production maps. The data used were obtained from the macroresination tests of the project itself, which were subsequently processed through machine learning algorithms assembled to develop the predictive models of resin production, specific for the different areas, methods and pastes. These

	models were implemented in a web tool accessible to all users that allows them to locate their plot, choose the methods and pastes they wish to use, enter the number of trees and the dasometric variables of their stand and obtain an estimate of the resin production of their plot. In addition, the production maps elaborated in the interactive application and based on the IFN IV P. pinaster stands, as well as the auxiliary climatic variables used in the adjustment of the models, can be consulted in the web sig. For this purpose, the maximum resin potential was defined as the estimated maximum production that a territory could produce according to the legal restrictions in force if all the Pinus pinaster stands were resined. We used the estimates of the largest stands and dasometric attributes of P. pinaster from the IV National Forest Inventory (IFN). For the Autonomous Regions of Galicia and Asturias, trees with a normal diameter equal to or greater than 25 cm were filtered out; in the case of the provinces of Castilla y León, the normal diameter was 20 cm. As normal diameter the value of the diameter class was used and as total height the value of the estimate of the mean height weighted according to the diameter class was used. With the data analysed, maps were drawn up for each area of action and, depending on the extraction method and the stimulating pulp used, the maximum yields obtained were indicated. The yields were classified according to a stratified scale in four groups, in which darker colours indicate a higher maximum resin potential than those with lighter tones.
Lessons learned (1200 characters max.)	The results of this study make it possible to add the cumulative annual resin yield of maritime pine to the processes that the Bertalanffy-Richards equation is capable of modelling. Furthermore, the great versatility of these models will be of great use to the forest manager in optimising the annual harvesting season as well as for the scientific community.
Contact information	erikamc@foresin.com
Links to website/report/video (if applicable)	https://resim.proepla.com/
Pictures (if applicable)	

ITHub 4 - 31

Title of innovation	**Methods for managing cork oak forests with platype attacks from the Sor region (Process; technique)**
ITHub	4
FOREST4EU partner (short name)	SOLUTOPUS
Operational Group (short name)	PLATISOR
Operational Group (name)	Methods for managing cork oak forests with platype attacks from the Sor region
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Business; researchers; forest owners
Link from OGs database	https://inovacao.rederural.gov.pt/grupos-operacionais/13-projectos-groupos-operacionais/135-platisor-metodos-para-a-gestao-do-montado-de-sobro-com-ataques-de-platipo-da-regiao-do-sor;?cookie_4edc832c64da52717aa377e8ae55a36b=accepted
Country, region, city	Portugal/ Alentejo and Ribatejo
Type of innovation	Technological innovation
Keywords	cork oak; essays; platype
Approach and main results (4000 characters max.)	Cork oak forests (*Quercus suber*) are very complex and delicate ecosystems, characteristic of the Mediterranean Basin, with great economic, social and ecological value. The worsening of its health status and its relationship with biotic factors was verified: it is closely associated with complex patterns in which pests (e.g. *Platypus cylindrus, Coroebus undatus*) and diseases (e.g.: *Phytophtora spp, Biscogniauxia mediterranea, Botriosphaeria stevensii and Ophiostoma spp*) are determining factors for the death of cork oaks. In particular, a population increase of the insect *Platypus cylindrus* (platype) was observed and, consequently, its damage to the cork oak. It is an endemic species that mainly attacked dead or very weakened trees and currently contributes to the mortality of thousands of green trees. The most likely hypothesis suggests the fact that started attacking healthy trees as a result of current more aggressive behavior for having established new symbiosis relationships with fungi or bacteria, some of them do not endemic. **The project objectives were: 1)** Know the factors related to the spatial/temporal distribution of attacks platypus; **2)** Know the bioecology of the platypus in the region; **3**) Look for alternatives to existing

	means of control (biological and chemical); **4)** Seek to increase the effectiveness of the technique for capturing adult insects using traps with chemical attractants currently sold. The **Tasks performed were:** Identification of properties and characterization of plots with Platypus attacks; Evaluate the relationships between the occurrence of the platype and the different characteristics of the trees that allow a successful attack from the platypus; learn about the bioecology of the platypus in the region; field essays and technical experiments with several products nd techniques, analysis of the results. **The plots were defined** according to the presence of the pests, dideses and insects, contextualized within the regional picture. The fact that historical records reveal the strong presence of the plague throughout the region allowed the simplification of the choice of properties that were eligible for enforceability of the proposed work. With this precondition, 3 properties were immediately identified with cork oak stands and with characteristics apparently suitable for testing accomplishement. 6 experimental plots were installed in the field with the aim of carry out a detailed study of its health evolution, with the evaluation of 16 variables during the entire duration of the project, as well as carrying out the tests foreseen in the remaining phases. **Partial results** were obtained for the various tasks, related to the attack strategy of the platype: antecipating, plots determination, yeld records, cork extraction, observation of leafs and dry branches, presence of other biotic and abiotic agents, etc..
Lessons learned (1200 characters max.)	The dynamics between P. cylindrus and cork oak forests are relatively little known, despite there being a good research base. This topic is highly complex and requires further studies on the factors that influence the choice of new hosts by the platype and its importance in space and over time. Therefore, little is known about the evolution of attacks between years and whether the proximity of trees healthy trees with previously colonized and spreading trees increases the probability of occurrence of new attacks. To answer these key questions, all variables intrinsic to the location and settlement need to be properly analyzed with the aim of understand this individual and specific influence of each factor over time in the activity of the platype. More studies and long term fiels work are needed (without temporal empty breaks), to better approach the dynamic of the factors that affect the health and productivity of cork oak. This will have a direct and significance impact in the producers income and enthusiasm to continue with this production.
Contact information	AFLOSOR- https://www.aflosor.com/
Links to website/report/video (if applicable)	https://www.rederural.gov.pt/centro-de-recursos

Pictures (if applicable)	   

ITHub 4 - 32

Title of innovation	**Diversification of edible wild mushroom cultivation with new native species**
ITHub	4
FOREST4EU partner (short name)	Boscat
Operational Group (short name)	TEb Verd / BoletBenFet
Operational Group (name)	Diversification of edible wild mushroom cultivation with new native species
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	mushroom business, research center, CATALAN MYCOLOGY SOCIETY, : WOOD AND FURNITURE GUILD
Link from OGs database	
Country, region, city	Spain, Catalunya, Geographical area(s) of application PROVINCE(S): Barcelona, Tarragona, Lleida and Girona
Type of innovation	Product
Keywords	non-wood forest product, circula bioeconomy, new product, market and consumption, wood mobilisation and transformation, Competitiveness and agricultural and forestry diversification
Approach and main results (4000 characters max.)	The project was led by Bolet Ben Fet (TEB Verd SCCL). The operational group consists of: Bolets de Soca (Tresseras Multimèdia SL), the Catalan Mycology Society, the Wood and Furniture Guild and the Institute of Agrifood Research and Technology (IRTA). IRTA acted as a technology and research centre, and two lecturers from the University of Barcelona (UB) joined the team of researchers. A total of 120 strains belonging to 14 fungal species were isolated from the specimens collected in the field. A mixture of wheat, rye and sorghum grain in equal parts was designed with a water content adjusted to 50-60% and sterilised in the autoclave. It was tested successfully with 87 different strains of 11 fungal species for the production of the inoculum (seed). The small-scale trials were carried out using a substrate based on hardwood sawdust adapted to 60-65% humidity levels. An incubation temperature of 20-25°C was suitable for all the species. The project has made it possible to develop methods and protocols for the cultivation of eight edible fungal species from native strains. The cultivation protocols can be considered developed for: Agrocybe aegerita, Fistulina hepatica, Lypphyllum decastes, Meripilus giganteus, Pleurotus eryngii and Polyporus squamosus. They were also developed for better known species including: Ganoderma lucidum and Grifola frondosa, but using native strains. Catalonia is a country with a strong mycological presence and tradition, but the cultivation of wild forest mushrooms focuses on a few species that are mostly of Asian origin; this is

	a pioneering initiative in this type of cultivation. Diversification into other species with closer links to local tradition would increase the diversity and current range of edible fungi. These new products would give local producers a competitive advantage and open up new opportunities for export. The main objective of this project was to incorporate new species of fungi which are mostly lignicolous and native to Catalonia in the cultivation of edible mushrooms in order to diversify production and improve the commercial range of our country's producers.
Lessons learned (1200 characters max.)	1. A crop bank of 120 strains belonging to 14 edible fungal species native to Catalonia has been established. This collection of pure strains is available for future research and development work. 2. A viable seed production method has been established for 11 of the fungal species mentioned above. 3. The project has made it possible to develop methods and protocols for the cultivation of eight edible fungal species from native strains: Agrocybe aegerita, Fistulina hepatica, Ganoderma lucidum, Grifola frondosa, Lyophyllum decastes, Meripilus giganteus, Pleurotus eryngii and Polyporus squamosus. Some of these species, such as: F. hepatica, L. decastes and P. squamosus have never been cultivated before. 4. Nutrient and cytotoxicity analyses for all the newly cultivated species are being developed. 5. The complete cultivation cycle has not yet been reached for Laetiporus sulphureus. No mushrooms have been obtained. Interest in the species has led to the start of a bachelor's degree final project at the University of Barcelona to continue the research. Eight species of fungi were added to mushroom cultivation. Some of them, such as Fistulina hepatica,Lyophyllum decastes, Meripilus giganteus and Polyporus squamosus have never been cultivated before. Other more well-known strains, including: Agrocybe aegerita, Ganoderma lucidum, Grifola frondosa and Pleurotus eryngii, cultivated from native strains.The diversification of edible mushroom cultivation should continue in the long term in order to incorporate new products into the market. Cooperation between companies in the sector and research centres with support from government institutions proved to be an effective way of achieving these results.
Contact information	tebverd@teb.org
Links to website/report/video (if applicable)	El cultiu dels bolets de soca autòctons, camí de ser una realitat (irta.cat)

Pictures (if applicable)	 

ITHub 4 - 33

Title of innovation	**Improving productivity and sustainability of black truffle plantations by microbiological handling of the rhizosphere**
ITHub	4
FOREST4EU partner (short name)	Boscat
Operational Group (short name)	not found (project of 2015)
Operational Group (name)	Improving productivity and sustainability of black truffle plantations by microbiological handling of the rhizosphere
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	forest and agriculture companies, research center
Link from OGs database	-
Country, region, city	Spain, Catalunya
Type of innovation	Product
Keywords	non -wood forest poduct, circular bioeconomy, market and consumption, Farming / forestry competitiveness and Landscape / land management
Approach and main results (4000 characters max.)	Black truffle production is an expanding crop in Catalonia with high economical potential, especially in agricultural areas with low productivity. In this sense, black truffle cultivation is often developed on poor soils, with low production yields and where trees present nutritional deficiencies and serious phytosanitary problems. Another problem to be solved in trucficulture is crop irregularity, possibly due to suboptimal production conditions, both in the nursery and in the field. As a major difference from the cultivation of trees for biomass or for the cultivation of fruits, in this case we work with a much more complex interaction between the tree and the rhizosphere or interface zone between the root of the plant and the soil. However, the increase of monospecific plantations (generally holm oaks) can cause an increase in certain diseases and pests that decrease the production of truffles. Management of the rhizosphere can contribute to the general improvement of plant vigor and its tolerance to biotic factors without the need to use phytosanitary products. In this project we evaluated the capacity of different organic substances and rhizobacteria, some isolated from wild truffieres described by Vilanova et al (2013) with the intention of improving the biotic and abiotic conditions of the rhizosphere, considering the presence and availability of nutrients, Development of the vegetative phase of truffle mycelium,

	vigorousness of the tree (nutritional status) and control of pathogens. The follow-up of the fungus response will be carried out in collaboration with IRTA, using the technology and results of the innovative pilot project, financed by the Department of Agriculture of the Generalitat de Catalunya in 2013 (File No. 56700362013). These techniques are based on quantitative PCR and allow us to determine the mycelium biomass of a fungal species, in this case Tuber melanosporum, in a soil sample (Parladé et al. 2013). The monitoring of the vigorousness of the tree will be carried out through foliar nutrient analysis. In order to correlate the bacterial activity generated in the rhizospheric soil by the introduction of bacterial strains and the effects on the plant and the fungus, initial and final counts of viable aerial mesophiles will be carried out by means of isolating in the appropriate selective media.
Lessons learned (1200 characters max.)	The application of the different rizobacteria, organic compounds, and combinations of treatments in the first and second year of experimentation did not present effects on the concentration of Tuber melanosporum mycelium in the substrate of the plants produced in nursery. The treatments used, in isolation or combined, have no effect on a young plant growing in the nursery. The conditions of the nursery (substrate, irrigation, fertilization) and the fact of incorporating a can concentration of spores of the mycorrhizal fungus to obtain the mycorrhization of the plants are sufficiently developed, and the application of this compounds in the phase of Nursery does not represent any detectable improvement. In the plot of Granollers we find comparable results. None of the applied treatments, separately or in combination, have increased the concentration of truffle mycelium in the soil surrounding the treated plants. In a plot already established for years and that is already producing truffles, the incorporation of rizobacterial and organic compounds has no stimulating effect on the development of mycelium fungus. A plot established more than 12 years ago, the fungal composition of the rhizosphere of plants is sufficiently stabilized to be able to significantly modify the equilibrium established with contributions such as those proposed. In the case of Batea's newly established plot in which the treated plants had an age of 3 years, the effects of the incorporation of rizobacteria such as Bacillus liqueniformis or Pseudomonas fluorescens, as well as the incorporation of organic compounds of different origins, had a stimulating effect on the development of Tuber melanosporum mycelium. In young plants, in the phase of settling in their place of definitive plantation, with strong biotic and abiotic competition of the environment, the application of these products if it confers a positive effect on the development of the mycelium of truffle. In conclusion, the application of these products in young plantations in the phase of establishment would be recommended, and it would not be necessary in the phase of production of mycorrhizal plant in nursery or in plantations already adult in phase of production. In view of the results obtained, it can also be concluded that combinations of rizobacteria and organic compounds did not present the expected summation effect in a principle. The hypothesis that the combination of treatments with stimulating effects on the development of truffle mycelium would have a better behavior than the components separately has not been confirmed. More studies would be needed to design, with more data, these possible combinations. On the other hand, combinations of treatments, especially those that contained organic compounds, have had an effect on the bacterial populations of the soils of both plantations. And also the fungus in the case of the Granollers plantation, consisting of adult plants in production. It is described in the literature that these bacteria can have a positive effect on the development of the plant, and indirectly on the production of truffles. The future

	monitoring of these parcels would allow to verify it. At the time, to continue collecting data from these experiments, would allow it to determine if the effects of the treatment persist in time or the need to repeat them periodically during the first phases of planting establishments should be considered. With regard to the improvement of the collection and accumulation of nutrients in plants, in all cases the detected effects were not consistent and did not allow to detect a treatment that was efficient in improving the content of nutrients in the plants. There are not enough data to extract solid conclusions.
Contact information	marcosmorcillo@micofora.com
Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 4 - 34

Title of innovation	**Geolocation and monitoring of animals to identify possible incidents and improve the management of animals and pastures**
ITHub	4
FOREST4EU partner (short name)	Boscat
Operational Group (short name)	CLIM'AGIL
Operational Group (name)	Improvement of the technical-economic management of extensive livestock farms in the Catalan Pyrenees using geolocation and animal monitoring systems
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farmers' Union of Catalonia, research center, farmer companies
Link from OGs database	-
Country, region, city	Spain, Catalunya
Type of innovation	Technological innovation
Keywords	Biodiversity and environmental management, Competitiveness and agricultural and forestry diversification, non-wood forest product, ecosystem services, food industries
Approach and main results (4000 characters max.)	The project aims to provide the extensive livestock farming sector (cattle, horses and sheep) with new technological tools to obtain and manage as much data as possible from a herd with minimum involvement by the farmer. Geolocation and monitoring of animals uses various algorithms to analyse the information collected in order to identify possible incidents and improve the management of animals and pastures. This Operational Group, consisting of the Unió de Pagesos (Farmers' Union of Catalonia), the Institute of Agrifood Research and Technology (IRTA), Digitanimal, SL and the cooperatives Pirenaica Societat Cooperativa C. LTDA and Agrària Ramadera del Pallars de Sort, SCCL, focuses on exploring the full potential that these technologies can provide to help overcome the main challenges facing the sector: 1 – Improving the economic viability of farms. · Adjustment of the devices to herd activity patterns to improve technical-health-financial management. · Provision of the location and monitoring of the movements and condition of animals and herds. · The task requiring the most labour is supervising the herd and monitoring the animals' health (behaviour, diseases, births, etc.). Reducing working hours is a key factor in lowering costs and increasing the financial viability of farms. 2 – Efficient and sustainable use of natural resources and the maintenance of biodiversity. · Analysis of the grouped data related to the animals' location to determine grazing pressure, preserve the pasture's quality and ensure the sustainability of the silvopastoral system. 3 – Proximity of herds to wildlife. · A third challenge is the fact that herds live in proximity to other wildlife.

	The technology for detecting wildlife attacks will be assessed, and patterns of behaviour to detect and document them will be established Facilitate control of herds, management of technical-health and pasture data to improve the productivity and viability of extensive livestock farms by using geolocation systems and by monitoring animals using collars. Characteristics of the technological tools: -A position sensor that shows the location. -A triaxial accelerometer, which shows the level of activity. -A surface temperature sensor. - A low-consumption long-range communications module. -A cloud server, and various databases and algorithms for extracting patterns and creating notifications. -A long-life battery.
Lessons learned (1200 characters max.)	In conclusion, it has been proved that this technology is an opportunity for extensive livestock farming, even though the following is necessary: Ensuring proper network to achieve the greatest emissivity of collars. Shepherds should know what type of network they got when purchasing collars (mobile network, Sigfox network, Lora network…). Antenna installers are recommended. They should be technicians (which may belong to the own public administration, if it already exists, or to the private sector) and would be in charge of the antenna maintenance and testing before animals reach the mountain and during the season.
Contact information	uniopagesos@uniopagesos.cat
Links to website/report/video (if applicable)	15 de diciembre de 2020 Collares de Geolocalización #POCTEFA proyecto CLIM'AGIL - YouTube
Pictures (if applicable)	

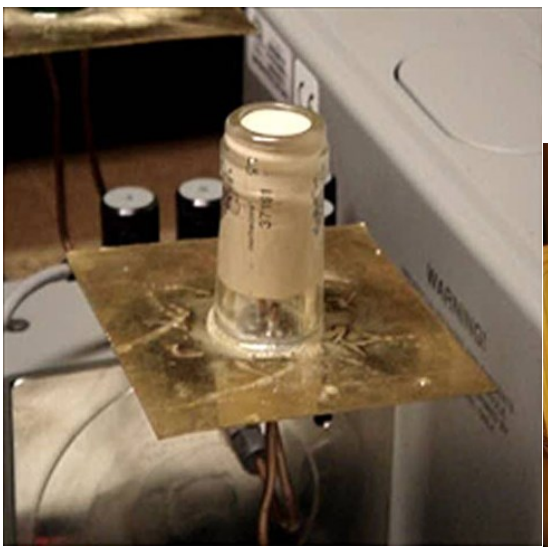
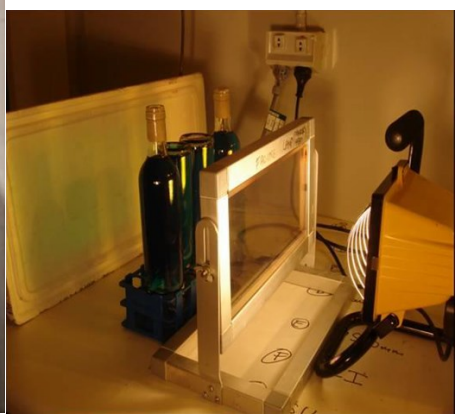
ITHub 4 - 35

Title of innovation	**Development of a system to remove TCA from cork stoppers using adsorbents and biosorbents**
ITHub	4
FOREST4EU partner (short name)	Boscat
Operational Group (short name)	OG TCA
Operational Group (name)	Development an innovative system to remove aromas from cork stoppers based on a combination of various adsorbent and biosorbent materials
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	CATALAN CORK INSTITUTE (ICSURO), companies of the cork industry
Link from OGs database	-
Country, region, city	Spain, Catalunya
Type of innovation	product
Keywords	Waste and by-product management, Food quality/processing and nutrition, Supply chain, marketing and consumption, non-wood forest product
Approach and main results (4000 characters max.)	The manufacture of stoppers is currently the application with the highest added value for cork as a raw material with 98% of the Catalan cork sector's revenue coming from the manufacture of corks for still wines and sparkling wines. The industry has a turnover of almost €230 million, has an export level of around 50% and employs more than 1200 people. Given that it is a high-quality product, the challenge is to remove sensory deviations in order to comply with requirements of the wineries and stave off the threat of alternative stoppers. These alternative stoppers have consolidated their position in the market, mainly due to the controversy generated around the presence of haloanisoles (like TCA) and other volatile compounds which may be present in the cork and affect the bouquet of the wine. This has forced the cork sector to implement technologies for the detection and/or removal of these aromatic compounds. There are currently systems to remove aromas in the market, but they are mainly aimed at cork granules, not bottle corks, given that they are 'aggressive' elimination systems that may affect the cellular structure of the material. The proposed system is based on the use of adsorbents and biosorbents with the aim of retaining the aromas extracted in the various cork production stages. The innovation developed in the project has an impact on productivity and sustainability levels both territorially and in the winemaking and cork industries in general. The objective of the project was to develop an innovative system to remove aromas from cork stoppers based on a combination of various adsorbent and biosorbent materials.

	Achieving this objective helps to improve the competitiveness of cork companies, foster the use of natural and renewable products such as cork stoppers and address the competition from alternative stoppers by reducing the problem of aromas associated with corks
Lessons learned (1200 characters max.)	The end result of the project is two aroma removal systems, one for the natural cork stopper manufacturing process and the other for the agglomerated cork stopper manufacturing process with two discs for sparkling wine in liquid and steam conditions. A mixture of natural biosorbents was obtained that captures 50-95% of haloanisoles under laboratory conditions. This capture system is based on adsorbent compounds with a greater affinity for aromas than cork, enabling an increase in their removal without supposing major changes to the systems currently used by the companies. The following practical recommendations may be drawn from the project: - Recovered activated carbons are a good option for the removal of defective aromatic compounds present in corks. - The selected materials can be applied in both aqueous and dry environments. - The materials have a shelf life of more than six months. - Application of these compounds in company extraction systems improves their efficiency The following conclusions may be drawn from the project: ● There is significant potential for removing unwanted aromas in corks by using biosorbents at different points in the production process, adapted to the needs of each company. ● It is worth exploring the design of biosorbent containment prototypes to solve the challenge of biosorbent containment without limiting their adsorption properties
Contact information	jpuig@ollerfco.com
Links to website/report/video (if applicable)	The project has been disseminated mainly through the coordinating body (Catalan Cork Institute Foundation) and the following actions have been carried out, among others: 1. Web portal of the participating companies and the research centre: https://www.icsuro.com/projectes/sistema-deliminacio-dhaloanisols-tca-i-altres-aromesdefectuosos/ 2. Dissemination on @ICSuro social media (Twitter, Linkedin and Facebook) 3. ICSuro article and newsletter: https://www.icsuro.com/la-bioabsorcio-daromes-suro
Pictures (if applicable)	

ITHub 4 – 36

Title of innovation	**Evolution of oxygen transfer in the various cork stopper manufacturing conditions. Effect of this parameter on still and sparkling wine**
ITHub	4
FOREST4EU partner (short name)	Boscat
Operational Group (short name)	GO OTR
Operational Group (name)	Evolution of oxygen transfer in the various cork stopper manufacturing conditions. Effect of this parameter on still and sparkling wine
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Companies of wine sector, foundation for the promotion of the cork sector
Link from OGs database	-
Country, region, city	Spain, Catalunya, Province Girona
Type of innovation	Product
Keywords	Waste and by-product management, Food quality/processing and nutrition, Supply chain, marketing and consumption, non-wood forest product, Competitiveness and agricultural and forestry diversification
Approach and main results (4000 characters max.)	One of the most significant variables that affect the evolution of wine in the bottle is the supply of oxygen through its stopper: the oxygen transfer rate). Cork stoppers are known to have an advantage over their synthetic alternatives in this respect due to their vegetal matrix. Corks enable the progressive ingress of oxygen into the bottle over time, preventing the oxidation and reduction processes that are characteristic of certain alternative stoppers. The project consisted in determining the variables in the cork stopper production process that affect oxygen transfer and obtaining information to modify the production procedure to adjust the oxygen transfer rate of the corks in accordance with the consensus values for each type of wine. Objectives 1. Assessment of oxygen transfer throughout the production process. 2. Application of control measures based on the values obtained in point 1. 3. Assessment of the effect of the oxygen transfer rate on the wine. 4. Preparation of a catalogue of cork stoppers with different transfer rates and their effects on the evolution of the wine. 5. Foster relations between the cork sector and the winemaking industry.

Lessons learned (1200 characters max.)	• The oxygen permeability of the stopper in still and sparkling wines affects their chemical and sensory development. • Different types of cork stoppers (natural one-piece, granular and cork discs) have different oxygen permeability characteristics. • For each type of cork, there are factors in the production process that have key impact on the oxygen transfer ratio of different batches of corks. • Use of stoppers with higher or lower oxygen permeability depends on the oxidative capacity of each wine, which in turn depends mainly on the grape variety. • Determining the type of cork to be used is a key factor for wineries that want to control how their wines age and the oxygen transfer values of the corks should be known so as to favour the desired ageing
Contact information	teresa@jvigas.com
Links to website/report/video (if applicable)	Determinació de l'evolució de la permeabilitat a l'oxigen - Institut Català del Suro (icsuro.com)
Pictures (if applicable)	  

ITHub 5 – Agroforestry (33 extended summaries)

Table 12. Overview of the extended summaries of ITHub5.

	Title of innovation	Operational Groups (short name)	Type of innovation	Country
1	Increase and transfer knowledge to producers about the natural regeneration processes of cork oaks and holm oaks in agro-forestry systems in Alentejo region, Portugal.	Oak Regeneration	Service	Portugal
2	Expeditious method for mapping soil's organic matter	OG Solo	Process	Portugal
3	Identification and Monitoring of Pastures in Agroforestry using Multispectral Unmanned Aerial Vehicle Products	OG Fósforo	Technological	Portugal
4	Use of Keyline for planting cork oaks and holm oaks in agro-forestry systems	EcoMontadoXXI	Process	Portugal
5	Test and develop a method for the implementation of silvopastoral mosaics, using remote sensing approaches, that supports agricultural and forestry activity in areas of Pyrenean oak, which typically have low agricultural value	SILVPAST	Process	Portugal
6	Use of Keyline to increase soil's moisture retention capacity in summer months	EcoMontadoXXI	Process	Portugal
7	Use of Keyline to increase soil chimicals conditions for plant assimilation	EcoMontadoXXI	Process	Portugal
8	Characterization of portuguese sown rainfed grasslands using remote sensing and machine learning	OG Fósforo	Technological	Portugal
9	Spatiotemporal Patterns of Pasture Quality Based on NDVI Time-Series in Mediterranean Montado Ecosystem	OG Fósforo	Technological	Portugal
10	Review assesses the state of the art regarding the use of livestock for ecosystem management in Mediterranean landscapes	SILVPAST	Technological	Portugal
11	Development of an autonomous and digitalized feeding system for pigs of the Celtic trunk in Atlantic deciduous forests	FORESTCELTA	Technological	Spain
12	"Agroforestry in Austria" Network	Agroforst in Österreich	Organisational	Austria

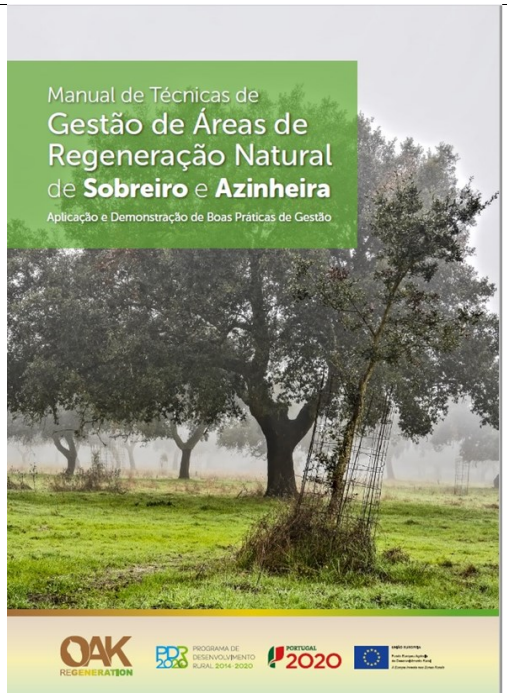
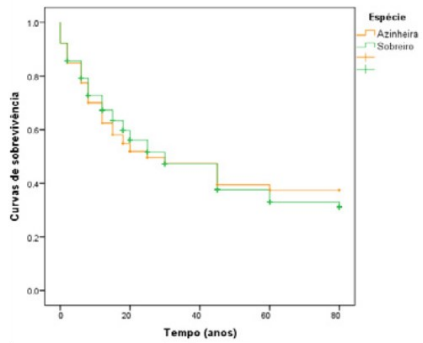
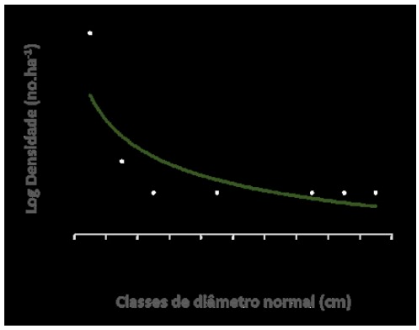
13	Practitioner-oriented consulting for agroforestry systems in Austria	Agroforst in Österreich	Service	Austria
14	Agroforestry "Farminar" as new mode of knowledge transfer	Agroforst in Österreich	Service	Austria
15	Technology for the mobilization and use of forest biomass in agroindustry	GOTECFOR	Technological	Portugal
16	New and innovative cultivation methods of highly productive apples adapted to northern climates	Commercial productive apple growing in a northern climate	Process	Sweden
17	Local densified log industry	BUCHDENS	Organisational	France
18	Transposing knowledge and tools on the adaptation of trees to climate change from the forest environment to the bocage environment	ARBRE	Service	France
19	Raising awareness and setting up tests on assisted natural hedge regeneration	ARBRE	Process	France
20	Trees and forests on mountain farms: measuring performance and innovating to support the evolution of Pyrenean grassland systems	AGROSYL	Process	France
21	Biological control of Chestnut blight (Cryphonectria parasitica) by virus infection (hypovirulence)	CASTANEA	Process	Spain
22	Manual of recommendations for an efficient use of water in chestnut groves	CASTANEA	Service	Spain
23	School of Agroforestry	NEWTON	Organisational	Italy
24	Criteria and indicators for the certification of the sustainable management of an agroforestry system PEFC	NEWTON	Process	Italy
25	Model of a productive agroforestry system in Extremadura (Southwest Spain)	CASTANEA	Process	SPAIN
26	LCA application on semi-extensive agrosilvopastoral systems	NEWTON	Process	Italy

27	Evaluation of the impact of different grazing intensities of Maremma cattle on the components of the agroecosystem: soil, tree vegetation (structure, natural regeneration and biodiversity)	NEWTON	Process	Italy
28	Chestnut varieties recommended for cultivation in Extremadura (Southwest Spain)	CASTANEA	Technological	SPAIN
29	Comparing pastoral and silvopastoral management on a local beef cattle breed: productivity, animal welfare and pasture depletion in a Mediterranean extensive farm	NEWTON	Process	Italy
30	Development of a platform through sensors for pasture management in the dehesa	GRASSEN	Technological	Spain
31	Are short rotation coppice a solution in future regional biorafineries ?	OG TCR	Technological	France
32	A feasible step-by-step plan with practical guidelines and concrete designs to enable the application of agroforestry on farms	Experiment Agroforestry Noord-Holland	Service	Netherl.
33	New management practices in rainfed olive groves	GO Olival	Process	Portugal

ITHub 5 - 1

Title of innovation	**Increase and transfer knowledge to producers about the natural regeneration processes of cork oaks and holm oaks in agro-forestry systems in Alentejo region, Portugal**
ITHub	5
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	Oak Regeneration
Operational Group (name)	Oak Regeneration
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	One investigation Institute, 4 forestland owners associations and 8 forestland owners
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/oak%C2%AEegeneration.html
Country, region, city	Portugal, Alentejo
Type of innovation	Service
Keywords	Agroforestry; forest degradation ; forest restouration;
Approach and main results (4000 characters max.)	Cork oak (Quercus suber) and holm oak (Quercus rotundifolia) forests are Mediterranean ecosystems characterized by an open, irregular forest that regenerates naturally and is associated with agricultural and livestock activities, in a traditional and multifunctional system, agro-silvo-pastoral land use. One of the greatest threats to economic and ecological sustainability of these systems is the lack of natural regeneration, which tends to be aggravated by climate change. This threat is embodied in the current context of management of cork oak and holm oak forests which, on the one hand, resort almost exclusively to artificial regeneration (mainly by plantation), with high costs, aggravated when the young plants fail and promotes the intensification of grazing or which, on the other hand, resorts to the extensification of management forestry and the abandonment of the cork oak forests. OG OakRegeneration was set out to better understand the natural regeneration process; occurrence patterns, growth dynamics and survival rates of natural regeneration in cork oak and holm oak forests. The objective is to make better use, protect and promote the natural regeneration of cork oaks and holm oaks in very restricted areas of the cork oak forests, typically areas where productive, agricultural and/or grazing activity was temporarily excluded, and where the

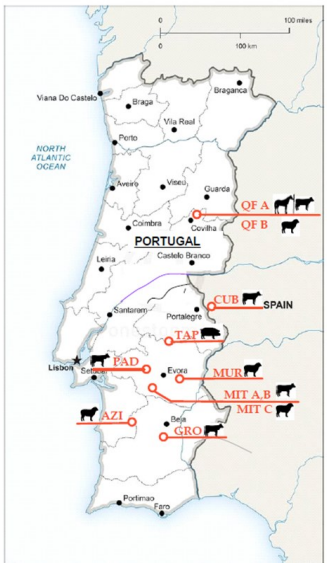
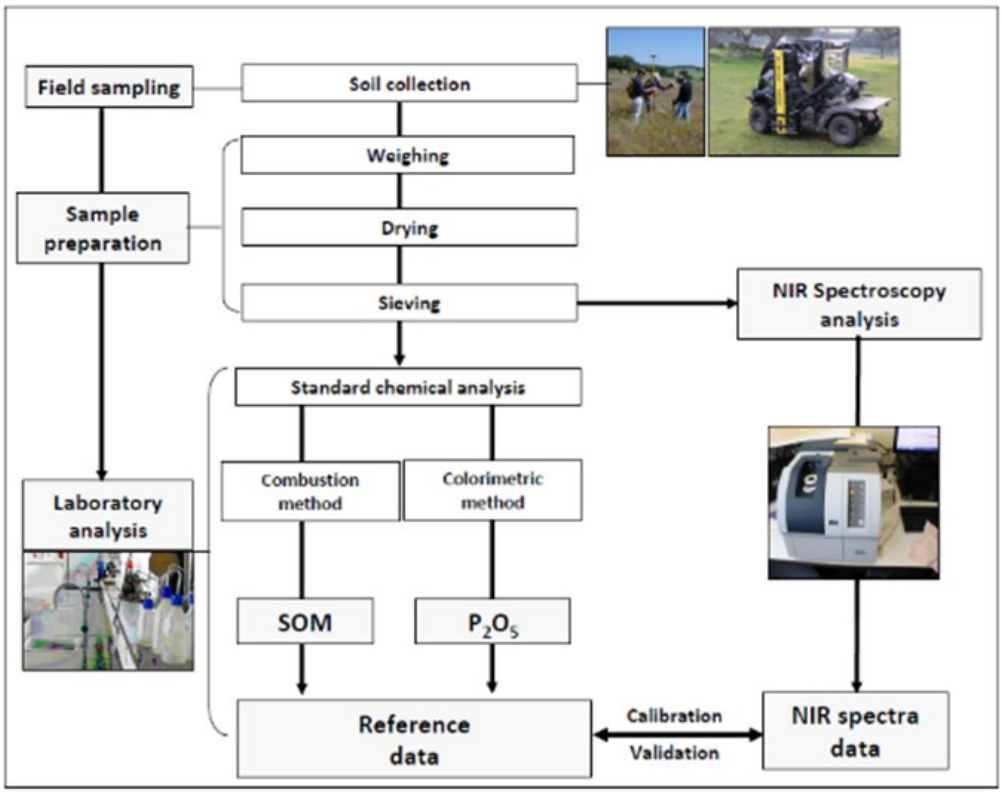
	local, biophysical and soil-climatic conditions were fortuitously favorable to the success of the natural regeneration process. For this purpose, a partnership was created with 8 entities, including producers and agro-forestry producers' associations, having installed 14 demonstration areas subject to forest inventory and continuous monitoring to assess the dynamics of density, structure and growth of juvenile trees. In this work, the process of natural regeneration by seed was described, paying special attention to the fruiting phase, the germination phase and the recruitment phase of juvenile trees in function of soil types, competition with spontaneous shrub vegetation, whether in density, or in type of species. In this last item, this effect on soil fertility, solar irradiance, water stress, nitrogen fixation and biodiversity of the system was also analysed. It was also described the process of natural regeneration by bursting stumps and the most appropriate techniques to increase the success rate of this practice. The advantages and disadvantages of these forest regeneration processes were analysed too. As the main result of this project, a Manual of Management Techniques for Natural Regeneration Areas of Cork Oaks and Holm Oaks – Application and Demonstration of Good Management Practices was drawn up, on paper and available online to be distributed by interested agro-forestry producers.
Lessons learned (1200 characters max.)	In cork oak forests, there seem to be no problems with regeneration density in the fruiting and germination phases, nor with the survival of young trees that matured in the seedling phase. The bottleneck of the process occurs in the temporal transition between regeneration of the year (without normal diameter) for the regeneration of seedlings (normal diameter up to 5 cm). In the natural regeneration process, the density of recruitment of juvenile trees (normal diameter greater than 20 cm) represents 50% of the regeneration density of seedlings (with normal diameter and less than 5 cm). Between cork and holm oaks, the survival curves, despite being very similar, present some differences. The survival curves in relation to the type of grazing are very similar and are distinguished only in the initial stages of the regeneration process. Although grazing with cattle is pointed out as one of the most serious factors responsible for the failure of the regeneration process. Plant density curve in grazed areas with cows and sheep is very similar. Technics like grazing management or individual protection of natural regeneration can improve survival curves.
Contact information	augusta.costa@iniav.pt
Links to website/report/video (if applicable)	https://www.oakregeneration.pt/en/

Pictures (if applicable)	  

ITHub 5 - 2

Title of innovation	**Expeditious method for mapping soil's organic matter**
ITHub	5
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	OG Solo
Operational Group (name)	Promoting soil conservation agricultural practices by demonstrating, expeditiously and at low cost, their impact on organic matter
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	An University, an Investigation center, an adviser, one farmers confederation and 6 farmers and forestland owners
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/go-solo-promo%C3%A7%C3%A3o-de-pr%C3%A1ticas-agr%C3%ADcolas.html
Country, region, city	Portugal, Alentejo
Type of innovation	Process
Keywords	Soil management/functionality; Agroforestry; Remote Sensing data
Approach and main results (4000 characters max.)	Soil organic matter is a key variable in soil analyses, used by farmers in pasture management and in the assessment of soil carbon sequestration. This assessment requires a rapid survey of soil samples in large quantities, capable of cost-effectively, covering large areas and assessing spatial heterogeneity for the application of differentiated management recommendations. The aim of the project was to develop an expeditious and low-cost method for mapping soil organic matter and for analyzing carbon sequestration in biodiverse sown pastures in agricultural and agro-forestry areas. The method used visible and near-infrared (VNIR) spectroscopy, using field sensors and satellite images. Experimental data collection was carried out on 7 agricultural properties, between 2018 and 2021. Soil samples were collected in 25 ha plots and the choice of sampling points was based on measurements of soil electrical conductivity. Sampling was carried out using mechanical and automatic collection equipment. The measurement of organic matter was carried out conventionally, in the laboratory, and also using near-infrared spectroscopy, using a spectrometer. The results obtained were correlated with satellite data and pasture management practices, measured during field visits.

Lessons learned (1200 characters max.)	Soil organic matter (SOM) in an indicator of the evolution of soil fertility in the Montado Mediterranean ecosystem. There are significant correlations between NIRS calibration models and reference methods to quantify this soil parameters (R2, 0.85 and RPD, 2.7), which can mean an important simplification of the time and costs involved, better suited to the needs of the current agricultural production management. To go further, in a perspective of PA, two research topics require further attention: (i) improvement of portable spectrometers in order to achieve a more accurate response in direct field measurements and (ii) further exploration of soil spectral information obtained through satellites (remote sensing). Future research along any of these lines will involve more advanced technologies, such as the use of methods drawn from the field of artificial intelligence.
Contact information	nuno.rodrigues@terraprima.pt
Links to website/report/video (if applicable)	https://www.terraprima.pt/pt/projecto/24

Pictures (if applicable)	 

ITHub 5 - 3

Title of innovation	**Identification and Monitoring of Pastures in Agroforestry using Multispectral Unmanned Aerial Vehicle Products**
ITHub	5
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	OG Fósforo
Operational Group (name)	GO Fósforo - Increasing the viability of sown biodiverse pastures through optimization of phosphate fertilization.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two Universities, an advisor, an agricultors Association and 7 farmers
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/viabiliza%C3%A7%C3%A3o-de-pastagens-semeadas-biodiversas.html
Country, region, city	Portugal, Alentejo
Type of innovation	Technological innovation
Keywords	Soil management/functionality; Agroforestry; Remote Sensing data
Approach and main results (4000 characters max.)	Sown Biodiverse Pastures (SBP) are the basis of a high-yield grazing system tailored for Mediterranean ecosystems and widely implemented in Southern Portugal. The application of precision farming methods in SBP requires cost-effective monitoring using remote sensing (RS). The main hurdle for the remote monitoring of SBP is the fact that the bulk of the pastures are installed in open Montado agroforestry systems. Sparsely distributed trees cast shadows that hinder the identification of the underlaying pasture using Unmanned Aerial Vehicles (UAV) imagery. Image acquisition in the Spring is made difficult by the presence of flowers that mislead the classification algorithms. The project tested multiple procedures for the geographical, object-based image classification (GEOBIA) of SBP, aiming to reduce the effects of tree shadows and flowers in open Montado systems. It was used remotely sensed data acquired between November 2017 and May 2018 in three Portuguese farms. It was used three machine learning supervised classification algorithms: Random Forests (RF), Support Vector Machine (SVM) and Artificial Neural Networks (ANN). It was classified SBP based on: (1) a single-period image for the maximum Normalized Difference Vegetation Index (NDVI) epoch in each of the three farms, and

	(2) multi-temporal image stacking. RF, SVM and ANN were trained using some visible (red, green and blue bands) and near-infrared (NIR) reflectance bands, plus NDVI and a Digital Surface Model (DSM). It was obtained high overall accuracy and kappa index (higher than 79% and 0.60, respectively). The RF algorithm had the highest overall accuracy (more than 92%) for all farms. Multitemporal image classification increased the accuracy of the algorithms, as it helped to correctly identify as SBP the areas covered by tree shadows and flower patches, which would be misclassified using single image classification. This study thus established the first workflow for SBP monitoring based on remotely sensed data, suggesting an operational approach for SBP identification. The workflow can be applied to other types of pastures in agroforestry regions to reduce the effects of shadows and flowering in classification problems.
Lessons learned (1200 characters max.)	This study was performed to address an increasingly pressing need for RS-based classification of pastures in agroforestry regions, through the development of an accurate workflow capable of correctly identifying pasture areas, even in the presence of trees shadows and flowers. Both effects confuse algorithms and lead to the underestimation of pasture areas using data collected on one singular date. We showed here that a multitemporal approach is crucial in order to deal with the effects of tree shadows and flower patches. This approach works mostly due to the radiometric variability of SBP, compared to the trees and other objects in the ecosystem. To our knowledge, this was the first application of multitemporal classification that successfully decreased misclassifications due to shadows and flowers without requiring additional corrections. Prior approaches resorted to physical- or image-based correction methods to identify shadows or the application of multisource data fusion to fill shadowed areas. This study also applied for the first time GEOBIA classification and ML algorithms to identify SBP in Portugal. Although the type of ML algorithm made some difference, with RF being the most accurate, the most important methodological choice for obtaining accurate results was the use of multitemporal classification. The workflow presented here enables the identification of SBP area with an overall accuracy that is always higher than 79%, regardless of the approach.
Contact information	nuno.rodrigues@terraprima.pt
Links to website/report/video (if applicable)	https://www.terraprima.pt/en/projecto/22

Pictures (if applicable)	

ITHub 5 - 4

Title of innovation	**Use of Keyline for planting cork oaks and holm oaks in agro-forestry systems**
ITHub	5
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	EcoMontadoXXI
Operational Group (name)	ECOMONTADO XXI - Agroecology applied to the design of the new cork-oak forest ("Montado")
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	One Investigation Centre and a farmer
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/ecomontado-xxi-agroecologia-aplicada-ao-design-do.html
Country, region, city	Portugal, Alentejo
Type of innovation	Process
Keywords	landscape/land management; Agroforestry; forest restouration; new planting system; Farming equipment and machinery
Approach and main results (4000 characters max.)	The implementation of the Keyline system consists in the design of curves, slightly uneven (about 1%), in relation to the level curves, towards the ridge. In this way, the water is forced out of the valley area and distributed to areas where it normally does not accumulate. The Keyline system also includes the use of a Yeomans plow, which opens furrows in the soil without any mobilization, so as not to disturb soil life and reduce the rate of mineralization of organic matter to a minimum. The furrows can have depths of 10 to 40 centimeters and are made with passages successive, each year in areas close to the previous furrow, in order to create soil and open space for the roots of plants to develop. The purpose of this system is to improve water distribution at ground level both horizontally and in depth, reducing areas of waterlogging and low infiltration. With more humidity, the functions of the soil improve, the amount of soil life, the levels of organic matter and consequently the capacity to support vegetation, like vegetables, aromatic hedges, fruit trees or cork oaks and holm oaks. The first step towards the implementation of the project was the carrying out, in 2017, of the topographical survey of the land, for the design of the Keyline project to be implemented. This project was executed in AutoCad and later marked on the ground. On the other hand, native species were planted according to the agroecology model,

	taking advantage of the Keyline lines, where there is a greater infiltration of water, to install the trees. This operation had, in the first year, a low success rate, so in the following years it was repeated again, reviving the Keyline lines. As a result of the activities of these campaigns, a good survival rate of the installed plants was observed, which was around 80% in these test plantations. There was also a better germination rate of the sown acorns and an improvement in productivity between the rows, with higher levels of organic matter.
Lessons learned (1200 characters max.)	Tree plantations are very dependent on the characteristics of the land and weather conditions. To help the plants survive, a hole of about 20 cm was made next to each plant, which was filled with a mixture of soil and well-cured organic compost. The plant was installed and small boilers were made, for better water retention. The boiler was covered with ground plant material ("mulch") in order to prevent evaporation, maintain soil moisture and beneficial microorganisms. Once the plant material has been crushed, it is incorporated into the soil, enriching it with nutrients. These techniques led to a higher survival rate of the planted trees. What was observed, after several years of intervention, was the preferential survival of the trees planted and germinated in the mid-slope areas facing north and east. In the top and bottom areas there was high mortality, both because conditions of strong exposure to the sun and wind were maintained in the top areas, and because of the high levels of waterlogging in the bottom areas. Given the high clay content of the soils in this plot, the poor drainage of the low areas was not properly solved by Keyline, leading to the waterlogging of the roots of some of the installed plants. In locations with greater waterlogging, the recovery of the old water line, already destroyed several years ago, should prove to be a more effective solution for this type of soil.
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Pictures (if applicable)	

	

ITHub 5 - 5

Title of innovation	Test and develop a method for the implementation of silvopastoral mosaics, using remote sensing approaches, that supports agricultural and forestry activity in areas of Pyrenean oak, which typically have low agricultural value
ITHub	5
FOREST4EU partner (short name)	FC.ID
Operational Group (short name)	SILVPAST
Operational Group (name)	Cost-efficient implementation of silvo-pastoral mosaics of Quercus pyrenaica
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	4 farmers/forest owners, 1 research centre, 1 association, 1 NGO (note: the NGO and 1 forest owner left the project before its conclusion, due to difficulties in complying with reporting requirements; another forest owner accompanied the project was not approved for funding)
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/go-silvpast-implementa%C3%A7%C3%A3o-custo-eficiente-de.html
Country, region, city	Portugal
Type of innovation	Process
Keywords	forest restoration, Multifunctional forest management, remote sensing data
Approach and main results (4000 characters max.)	The OG SILVPAST evaluated the use of livestock grazing in two pilot areas to assess the contribution for assisting in forest regeneration (by aiding in processes like thinning and biomass regulation for preventing fires), employed genetic analyses to evaluate forest diversity and provide insights for restoration initiatives, and experimented remote sensing techniques for monitoring purposes. MAIN RESULTS/CONCLUSIONS: The existence of parcels with different uses and management objectives in a silvopastoral mosaic is advantageous for landscape sustainability by promoting synergies among the different parcels, diversifying the uses, and mitigating potential impacts. These synergies have been identified in the pilot areas of SILVPAST. • At Quinta da França (pilot area 1), the pastoral use of the regenerating forest was supported by the neighbouring pastures, which provided the necessary food for the animals and allowed for maintaining a sufficiently high stocking rate to achieve effects on the regulation of vegetation structure and on the growth of understory shrubs in the oak forest. On the other hand, no significant effects were identified on the understory plant species richness (i.e., no promotion or impoverishment of biodiversity was observed). However, this result requires further future evaluation as it pertains to short-term effects.

	Moderate impacts on the recruitment of young oaks were also identified, highlighting the need to maintain exclusion areas that provide the necessary conditions for natural regeneration to occur. Furthermore, genetic studies identified a good proportion of seed regeneration and suggested the existence of large-scale genetic exchanges, which favour the genetic diversity of the forest. Finally, satellite image analysis suggests that the pastoral use of the forest provides benefits to the natural pastures in the clearings, with an anticipation of the growing season and increased productivity (compared to the control parcel). Possibly, this effect was promoted by the lower amount of senescent herbaceous biomass accumulated in the autumn (due to previous grazing), which improved conditions for seed germination and seedling emergence in early autumn, including more sunlight and space. • In the Médio Côa (pilot area 2), a complementarity in species composition was identified among different land uses (i.e., with species communities associated to each use), which enhances landscape-scale biodiversity. Grazing by semi-wild horses with low stocking rates did not result in significant differences in vegetation structure and shrub cover volume compared to the non-grazed area. However, differences were found in the coverage of tall herbs, which was lower in the parcel with horses. These results suggest the potential of this grazing regime, but also the need for additional management measures, such as shrub clearing to create open areas (which will then be maintained through grazing), in order to improve performance in terms of biomass regulation and fire prevention. Lastly, the recruitment level of young oaks was lower in the pasture parcel with cattle, which reinforces the need to maintain exclusion areas or areas with lower stocking rates, and if necessary, implement local measures for the protection of regeneration.
Lessons learned (1200 characters max.)	Livestock grazing at moderate densities helped to regulate shrub biomass and tall grasses and to create vertical discontinuities; however, these densities required the combined use of pastures, adjacent to the forest, to ensure adequate food resources and water points (if not available in the forest). Despite the use of GPS collars, there were signal failures, and animal injuries not attended in the due time. Hence, improved approaches are needed to effectively monitor livestock in a free-ranging regime in complex forest environments. Initial monitoring data indicates that the impact on biodiversity is neutral when compared to non-grazed areas. Grazing reduced levels of senescent herbs, which accumulated between growing seasons, and facilitated more vigorous grow in the autumn. Tree recruitment was moderately impacted, which is of low concern given the abundant recruitment at the pilot sites, but highlights the need for protective measures in areas with limited recruitment. Genetic studies identified a good proportion of seed regeneration and suggested the existence of large-scale genetic exchanges, which favour the genetic diversity.
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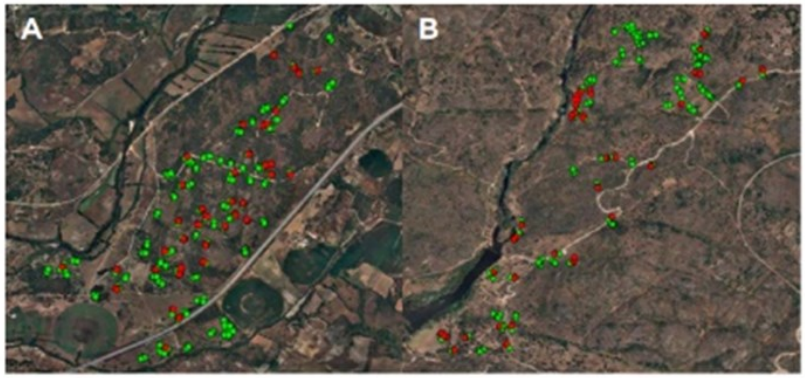
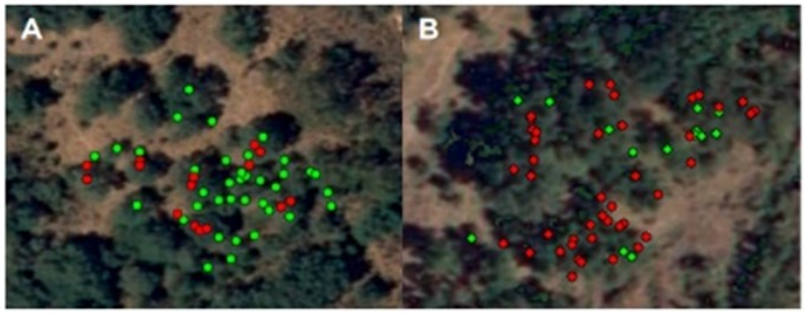
Links to website/report/video (if applicable)	https://www.terraprima.pt/pt/projecto/23 https://www.unac.pt/index.php/id-i/grupos-operacionais-accao-1-1-pdr2020/silvpast-implementacao-custo-eficiente-de-mosaicos-silvo-pastoris-de-carvalho-negral
Pictures (if applicable)	**Figure 6.** Distribution of sampled Pyrenean oaks in Quinta da França (A) and Médio Côa (B). The trees with a clone in the vicinity are marked in red.  **Figure 7.** Distribution of Pyrenean oaks in the sub-population (30mx30m) in Quinta da França (A) and Médio Côa (B). The trees with a clone in the vicinity are marked in red.  8 COST-EFFICIENT IMPLEMENTATION OF SILVO-PASTORAL MOSAICS OF QUERCUS PYRENAICA

ITHub 5 - 6

Title of innovation	**Use of Keyline to increase soil's moisture retention capacity in summer months**
ITHub	5
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	EcoMontadoXXI
Operational Group (name)	ECOMONTADO XXI - Agroecology applied to the design of the new cork-oak forest ("Montado")
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	One Investigation Centre and a farmer
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/ecomontado-xxi-agroecologia-aplicada-ao-design-do.html
Country, region, city	Portugal, Alentejo
Type of innovation	Process
Keywords	Soil management/functionality; Water management; Agroforestry; mitigation to climate change; Farming equipment and machinery
Approach and main results (4000 characters max.)	Keyline is an agricultural system developed by Percival Alfred Yeomans (PA), in Australia, in the late 1940s and 1950s, after combining experiments carried out on his farm, with his readings on ecological agriculture and the knowledge of some academics. Keyline is a topographic line traced using a point on the ground as reference where the water, when descending, abruptly slows down, resulting in an area of accumulation of water. Using this line as a reference, slightly uneven lines (about 1% in relation to the Key Line) are drawn for surface water redistribution and/or water storage. This way, water is distributed in the soil and progressively transported from the valley for the peak zones. Thus, the infiltration rate is increased at the same time as the surface runoff and the evaporation rate are reduced, allowing a significant improvement in soil fertility and structure. By improving the distribution of moisture in the soil, it increase the total content of organic matter, as well as the biological activity. This system is designed to promote the retention and redistribution of water in the soil, as well as the active construction of the soil in clean areas or with a low degree of forest cover to improve installation conditions of new vegetation cover, including improved pastures, aromatic, or trees in different agroforestry systems. Assuming that the impact of Keyline is mainly felt at the level of soil moisture, 30 humidity measurement probes were installed on 2 properties in south Portugal. we can see that Keyline effects indicate that soil's moisture content vary according to

	weather and the altitude zone. In the upper zone, the results indicate greater moisture retention at depths from 10 to 40 centimeters, from March to July, when the reduction of precipitation starts to affect soil moisture values. In the intermediate zone, there was a greater retention of soil moisture at depths from 0 to 20 centimeters. On the other hand, in the lower zone, there was a reduction in moisture retention at depths from 0 to 10 centimeters, since the first marking of the Keyline, in February 2019, with reinforcement of this effect after the second Keyline marking, in June 2020. Thus, a reduction in waterlogging is observed in the most superficial layer of the soil. However, for depths from 10 to 50 centimeters, a greater retention of moisture in the soil is already observed again in the months of May and June, when it starts to dry. In another property, an increase in the humidity values in the deepest layer of the soil, from 40 to 50 centimeters, is observed in the high zone, with a simultaneous decrease in the values of soil humidity in the most superficial layer, from 0 to 10 centimeters, for the months from March to May. In this situation, which coincided with a period of higher precipitation, there seems to have been a drainage of water from the most superficial levels to the deepest levels of the soil, due to the Keyline effect. From May to July, there is a reduction in soil moisture levels similar both in the share of control as in instalment with Keyline. In this situation, corresponding to the higher altitude topographical location, Keyline had no effect on soil moisture retention.
Lessons learned (1200 characters max.)	Keyline has an impact on soil moisture but it varies according to weather and the altitude zone. Therefore, the implementation of this Keyline system is not recommended in sandy loam or sandy soils, with the exception of areas that are prone to saturation, where the Keyline could reduce this tendency. In places where the textural composition of the soil frequently leads to situations of waterlogging or reduced infiltration into the deeper layers, the implementation of Keyline brings advantages by enabling an increase in the soil moisture retention capacity in the months summer, mitigating the effects of the lack of water during this season and facilitating the drainage of water in the lower areas, when there is more precipitation.
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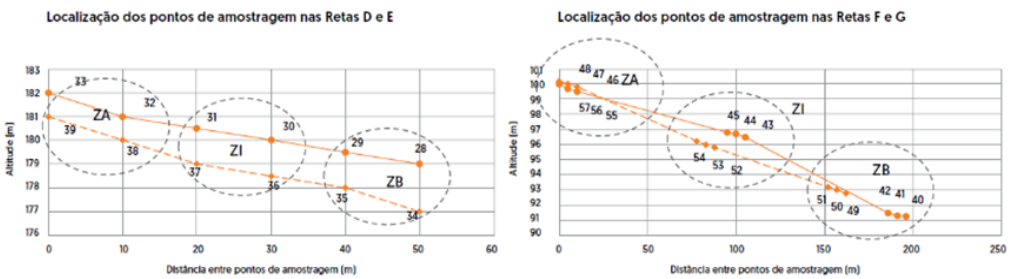
Pictures (if applicable)	

ITHub 5 - 7

Title of innovation	**Use of Keyline to increase soil chemicals conditions for plant assimilation**
ITHub	5
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	EcoMontadoXXI
Operational Group (name)	ECOMONTADO XXI - Agroecology applied to the design of the new cork-oak forest ("Montado")
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	One Investigation Centre and a farmer
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/ecomontado-xxi-agroecologia-aplicada-ao-design-do.html
Country, region, city	Portugal, Alentejo
Type of innovation	Process
Keywords	Farming equipment and machinery; Fertilisation and nutrients management; Soil management/functionality; Agroforestry
Approach and main results (4000 characters max.)	The Montado is a multifunctional silvo-pastoral system with high conservation value, but which is currently subject to some pressure factors, namely the abandonment and intensification due to inadequate management of the animal herd in farms, among other factors. Climate change is causing more frequent droughts and higher temperatures that result in the loss of soil organic matter, making soils more prone to erosion. This leads to loss of fertility, making the system more vulnerable to drought and less able to support the establishment of new trees. In response to these observations, the Operational Group ECOMONTADO XXI has tried to develop a new forest management practice to restore the vitality and productivity of Montado soils, based on the Keyline system and Agroecology. The implementation of the Keyline system consists in the design of curves, slightly uneven (about 1%), in relation to the level curves, towards the ridge. In this way, the water is forced out of the valley area and distributed to areas where it normally does not accumulate. The Keyline system also includes the use of a Yeomans plow, which opens furrows in the soil without any mobilization, so as not to disturb soil life and reduce the rate of mineralization of organic matter to a minimum. 57 sampling points were defined for various measurements (soil quality, soil moisture monitoring, evaluation of pasture biomass growth and determination of species of pasture

	present). These points were grouped into straight lines with their beginning in a higher altitude topographical area and their end in a topographical area down. Soil analyzes were carried out twice during the project, with the first soil collection taking place between March and May, 2019, and the second soil collection taking place between March and April, 2021. Soil samples were collected from 19 sampling sites, at the following depths (0-20 cm, 20-40 cm, 40-60 cm). Each sample from a location at a given depth is a composite sample of the samples collected at the two or three points (from the same location at that depth. Analyzes of soil samples collected were: Field texture (only at the beginning of the project); pH (H2O), pH (KCl), Conductivity, Organic Matter, Extractable Phosphorus (P2O5), Extractable Potassium (K2O), Extractable Calcium, Extractable Magnesium and Manganese.
Lessons learned (1200 characters max.)	There are a multitude of factors that influence the availability of different elements in the soil, namely pH values whose increase seems to have an impact on the highest phosphorus values observed. On the other hand, the growth of pasture biomass, quite significant in plot 1, but also observed in plots E and G where a Keyline passage, seems to influence the lower availability of potassium and calcium due to their absorption by the plants. These results are in line with what has already been observed in other studies. In fact, Keyline was designed to improve water infiltration and prevent soil erosion which should, in the long term, increase soil fertility, but this result will take years to be observed. The increase in soil organic matter content can be a natural consequence of a good implementation of the Keyline design, without turning over the soil, but this too must be a process that will take several years to observe. The short period of study of this Operational Group does not allow the observation of these results or the clarification of the factors that justify the different variations in the contents of the different nutrients in the soil.
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Pictures (if applicable)	Valores médios das primeiras análises de solos para as diferentes parcelas da exploração A (parcelas 1, 2 e 3) e da exploração B (parcelas 4 e 5) para as profundidades de 0 a 60 centímetros. * Profundidade de 0 a 10 centímetros.

Parcela	pH		Condutividade em H_2O	P Extraível		K Extraível	Macronutrientes Extraíveis		Mn Extraível (mg/Kg)	Textura			Classificação Textural	C_{org}	Mat. Org.	C_{org}	Mat. Org.
	H_2O	KCl 1M	(µS/cm)	Conc. Média	P_2O_5 (mg/Kg)	(mg/Kg)	Ca (mg/Kg)	Mg (mg/Kg)		% Areia	% Limo	% Argila		%	%	%*	%*
1	5,76	4,11	61,22	1,95	4,54	37,94	685,47	95,66	25,86	66,73	17,27	15,99	Franco-Arenoso	0,31	0,54	0,44	0,76
2	5,90	4,31	56,00	20,49	46,99	36,16	1232,37	450,79	24,72	60,74	13,86	25,40	Franco-Argiloso-Arenoso	0,20	0,34	0,28	0,48
3	5,82	4,11	112,00	13,30	30,58	33,77	2206,24	927,81	7,85	57,77	15,64	26,59	Franco-Argiloso-Arenoso	0,20	0,34	0,30	0,51
4	5,12	3,98	41,67	2,42	5,60	27,91	68,00	7,81	9,94	73,29	19,87	6,84	Franco-Arenoso	0,34	0,59	0,62	1,06
5	5,05	4,26	31,83	0,10	0,40	32,32	131,89	24,34	15,50	70,44	20,51	9,04	Franco-Arenoso	0,27	0,46	0,43	0,73
Valor médio em solos				51-100	51-100	430-860	71-124										

ITHub 5 - 8

Title of innovation	**Characterization of portuguese sown rainfed grasslands using remote sensing and machine learning**
ITHub	5
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	OG Fósforo
Operational Group (name)	GO Fósforo - Increasing the viability of sown biodiverse pastures through optimization of phosphate fertilization.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two Universities, an advisor, an agricultors Association and 7 farmers
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/viabiliza%C3%A7%C3%A3o-de-pastagens-semeadas-biodiversas.html
Country, region, city	Portugal, Alentejo
Type of innovation	Technological innovation
Keywords	Soil management/functionality; Agroforestry; Remote Sensing data
Approach and main results (4000 characters max.)	Grasslands are crucial ecosystems that support and provide a diverse number of ecosystem services. Sown biodiverse pastures rich in legumes (SBP) were developed with the main goal of increasing grassland production while minimizing fertilizers inputs. The main properties of SBP in Portugal were estimated using remote sensing and machine learning in six different farms and two production years (spring 2018 and 2019). Four pasture characteristics were considered: aboveground standing biomass, fraction of legumes, plant nitrogen (N) content and plant phosphorus (P) content. Remote sensing data were obtained from Sentinel-2. The spectral bands combined with 5 vegetation indices and 9 covariates were used. Multiple linear regression, LASSO, Ridge, random forests, XGBoost and LightGBM regression models were used. Two cross-validation approaches were used: (1) a random approach with random selection of the folds (RN-CV), and (2) a structured approach where each fold is a unique combination of farm and year, which is subsequently used to assess the performance of the model obtained with the 8 other folds (LLYO-CV).
Lessons learned (1200 characters max.)	Results showed that the random forest method had the best estimation accuracy for all pasture characteristics. Regarding cross-validation approaches, the algorithms with RN-CV have higher estimation accuracy for all pasture characteristics (on average about 10% lower RMSE and an R2 85% higher), as compared to the algorithms with LLYO-CV. The RMSE for all variables were significantly low, especially in RN-CV. Plant P is the variable

	where the choice of CV approach has the least influence (RMSE of test set with RN-CV: 0.71 g P kg− 1; LLYO-CV: 0.72 g P kg− 1). Standing biomass is the variable with the highest difference between CV approaches (RN-CV: 722 kg ha− 1; LLYO-CV: 825 kg ha− 1). The RMSE, of legumes and plant N were moderately affected by the CV approach (legume RN-CV: 0.11; LLYO-CV: 0.12 – plant N RN-CV: 3.96 g N kg− 1; LLYO-CV: 3.99 g N kg− 1). The algorithms developed here were applied for entire parcels in the two farms with the most different climate conditions as demonstration of their potential future use for precision farming.
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Links to website/report/video (if applicable)	https://www.terraprima.pt/en/projecto/22
Pictures (if applicable)	

ITHub 5 - 9

Title of innovation	**Spatiotemporal Patterns of Pasture Quality Based on NDVI Time-Series in Mediterranean Montado Ecosystem**
ITHub	5
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	OG Fósforo
Operational Group (name)	GO Fósforo - Increasing the viability of sown biodiverse pastures through optimization of phosphate fertilization.
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two Universities, an advisor, an agricultors Association and 7 farmers
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/viabiliza%C3%A7%C3%A3o-de-pastagens-semeadas-biodiversas.html
Country, region, city	Portugal, Alentejo
Type of innovation	Technological innovation
Keywords	Soil management/functionality; Agroforestry; Remote Sensing data
Approach and main results (4000 characters max.)	The evolution of dryland pasture quality is closely related to the seasonal and inter-annual variability characteristic of the Mediterranean climate. This variability introduces great unpredictability in the dynamic management of animal grazing. The aim of this study is to evaluate the potential of two complementary tools (satellite images, Sentinel-2 and proximal optical sensor, OptRx) for the calculation of the normalized difference vegetation index (NDVI), to monitor in a timely manner indicators of pasture quality (moisture content, crude protein, and neutral detergent fiber). In two consecutive years (2018/2019 and 2019/2020) these tools were evaluated in six fields representative of dryland pastures in the Alentejo region, in Portugal. Grasslands play a vital role in regulating the global carbon cycle, as well as supporting plant biodiversity and livestock production in Montado ecosystem. The real-time decision making that is made possible by the assessment of pasture quality ensures the resilience of these extensive systems, the estimation and adjustment of stocking rates, establishment of a sound scheduling of grazing or mowing, and the supplementary feeding or grassland improvements with legumes mixes, soil fertilization, or pH correction. Despite the complexity of grassland ecosystems, characterized by mixed species composition and strong spatial and temporal variability, this work opens perspectives to explore new solutions in the field of Precision Agriculture technologies based on spectral reflectance to

	respond to the challenges of economic and environmental sustainability of extensive livestock production systems.
Lessons learned (1200 characters max.)	The results show a significant correlation between pasture quality degradation index (PQDI) and NDVI measured by remote sensing (R2 = 0.82) and measured by proximal optical sensor (R2 = 0.83). These technological tools can potentially make an important contribution to decision making and to the management of livestock production. The complementarity of these two approaches makes it possible to overcome the limitations of satellite images that result (i) from the interference of clouds (which occurs frequently throughout the pasture vegetative cycle) and (ii) from the interference of tree canopy, an important layer of the Montado ecosystem. This work opens perspectives to explore new solutions in the field of Precision Agriculture technologies based on spectral reflectance to respond to the challenges of economic and environmental sustainability of extensive livestock production systems.
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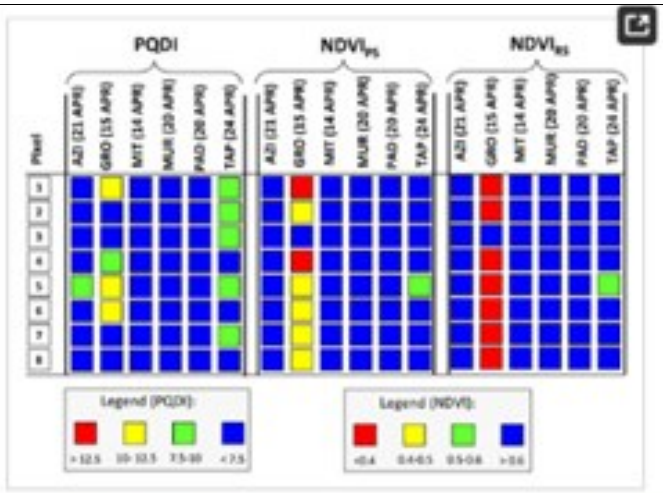
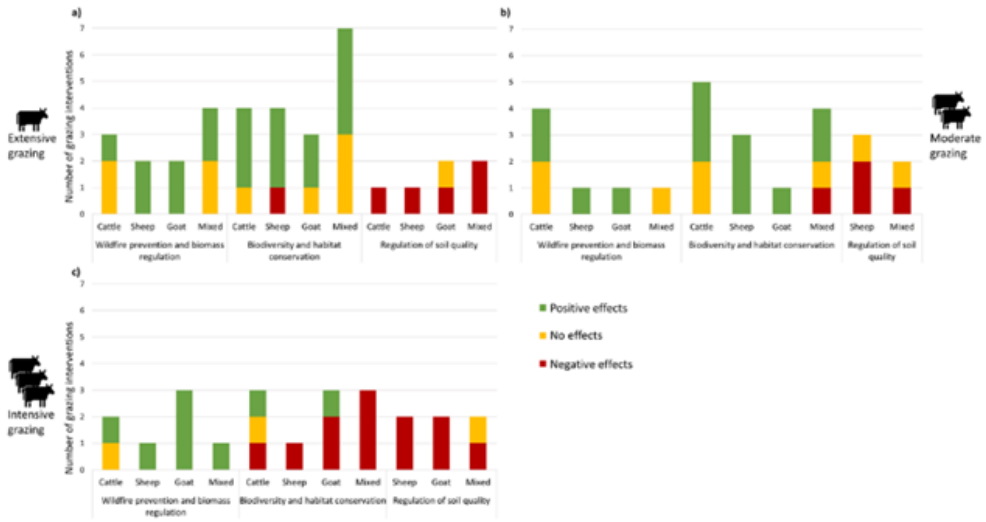
Links to website/report/video (if applicable)	https://www.terraprima.pt/en/projecto/22
Pictures (if applicable)	 **Figure 15.** Example of spatial variability of pasture quality degradation index (PQDI) and normalized difference vegetation index (NDVI) obtained by proximal and remote sensing (PS and RS, respectively) within each experimental field in April 2020.

ITHub 5 - 10

Title of innovation	**Review assesses the state of the art regarding the use of livestock for ecosystem management in Mediterranean landscapes**
ITHub	5
FOREST4EU partner (short name)	FC.ID
Operational Group (short name)	SILVPAST
Operational Group (name)	Cost-efficient implementation of silvo-pastoral mosaics of Quercus pyrenaica
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	4 farmers/forest owners, 1 research centre, 1 association, 1 NGO (note: the NGO and 1 forest owner left the project before its conclusion, due to difficulties in complying with reporting requirements; another forest owner accompanied the project was not approved for funding)
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/go-silvpast-implementa%C3%A7%C3%A3o-custo-eficiente-de.html
Country, region, city	Portugal
Type of innovation	Technological innovation
Keywords	Multifunctional forest management, landscape/land management; Agroforestry; Managing ecosystem services;
Approach and main results (4000 characters max.)	In the Mediterranean basin, the structure and species composition of traditional landscapes have historically been shaped and maintained by human-driven disturbances, such as extensive live- stock grazing. The cessation of these activities, which have partially replaced the role of natural disturbances, may lead to vegetation overgrowth and biomass accumulation, with potential adverse impacts on biodiversity, ecosystem functions and services. Recently, the use of livestock for ecosystem management, with the purpose of maintaining grazing disturbance and the associated ecosystem processes, has been gaining traction. Nevertheless, there is still limited evidence on the performance of such grazing interventions. This review assesses the state of the art regarding the use of livestock for ecosystem management in Mediterranean landscapes. It ex- amines the association between the regime and duration of grazing interventions and their re- ported effects on ecosystems. The list of reviewed interventions (68 interventions, retrieved from 47 studies) covered a diverse range of landcover systems (from grasslands to forests), of grazing regimes (characterized by different levels of grazing intensity and livestock species), and of duration of grazing (from short-term, < 5 years to long-term grazing, > 20 years). Wildfire prevention and biomass control, biodiversity and habitat conservation and the regulation of soil quality are the main reasons for the use of grazing interventions.

Lessons learned (1200 characters max.)	The results of this review suggest that the use of domestic herbivores in ecosystem management can contribute to wildfire prevention and biomass control, with these positive effects fading away in long-term grazing interventions. Goats seem to perform better than cattle for biomass control. Overall, the retrieved data revealed heterogenous findings on the use of domestic herbivores for ecosystem management in Mediterranean landscapes. The use of grazing for wildfire prevention and biomass regulation generally yielded positive outcomes, with lower performances observed in longer grazing interventions. On the other hand, using grazing for biodiversity and habitat conservation generated a diversity of outcomes, which were generally positive for extensive and moderate grazing regimes and significantly negative for intensive grazing regimes. Finally, outcomes for the regulation of soil quality were mainly negative, and a common trade-off with other ecosystem services, which calls for dedicated research that contributes to improved livestock management to avoid and mitigate these impacts.
Contact information	Vânia Proença (vania.proenca@tecnico.ulisboa.pt) Nuno Rodrigues (nuno.rodrigues@terraprima.pt)
Links to website/report/video (if applicable)	https://www.terraprima.pt/pt/projecto/23 https://www.unac.pt/index.php/id-i/grupos-operacionais-accao-1-1-pdr2020/silvpast-implementacao-custo-eficiente-de-mosaicos-silvo-pastoris-de-carvalho-negral
Pictures (if applicable)	 **Fig. 4.** Total number of grazing interventions and reported outcomes for each type of assessed livestock species and reported outcomes, for the three grazing intensities, per assessed ecosystem service (only the services with sufficient data were analysed). MiXed – grazing intervention assessing the effects of miXed species herds, including sheep and goat, sheep and cattle and cattle and goat.

THub 5 - 11

Title of innovation	**Development of an autonomous and digitalized feeding system for pigs of the Celtic trunk in Atlantic deciduous forests**
ITHub	5
FOREST4EU partner (short name)	USC
Operational Group (short name)	FORESTCELTA
Operational Group (name)	Precision livestock farming in extensive swine cattle of the Celtic trunk in Ibero-Atlantic deciduous forests
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Two forest owners, two research centers, two farmer associations, two advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/gesti%C3%B3n-de-precisi%C3%B3n-en-extensivo-de-ganado.html
Country, region, city	Spain, Galicia and Asturias
Type of innovation	Technological innovation
Keywords	Adaptation to climate change, Agroforestry, biomass, digital tools, Ecosystem services, Food security, forest degradation, mitigation to climate change
Approach and main results (4000 characters max.)	In the last years, the abandonment of rural areas in regions such as Galicia and Asturias (NW Spain) has increased the surface of deciduous forest lands occupied mainly by chestnuts and oaks without management. Silvopastoral systems with pig breeds of the Celtic trunk (Porco Celta, Gochu Asturcelta) could be established on these abandoned forest lands due to the demand for this type of meat by the consumers. Moreover, it is important to be aware of the rusticity of these pig breeds which allows a perfect adaptation to the conditions of the Galician and Asturian forests, making that animals can be kept in an extensive regime, providing a product of exceptional quality. The objective of the FORESTCELTA operation group was to implement and evaluate an automated mobile system for the feeding and control of pigs of the Celtic trunk established in an extensive regimen in Atlantic forests of chestnuts, oaks, and other deciduous tree species. For this purpose, a partnership was created with 8 entities, including forest owners, research centers, farmer associations and advisors, having installed two demonstration areas in Galicia and Asturias where herds of 55 pigs were introduced in each demonstration area, during two fattening cycles of 11 and 13 months. In the demonstration areas, an evaluation of the environmental and forest characteristics was carried out to evaluate the incidence of the feeding and control system implemented on the forest environment. Moreover, the pigs were monitored by analysing

	productive aspects and physical, nutritional and organoleptic characteristics. An economic study of the farms was also carried out. The results of FORESTCELTA showed that the use of the feeding and control system implemented and evaluated by FORESTCELTA: i) reduces the production costs, ii) facilitates the management, recovery and maintenance of pig breeds of the Celtic trunk, iii) improves the product obtained that will be of high sensory and food quality, iv) implies a sustainable use of the forest lands at the same time that the forest fire risk is reduced, v) favours the introduction of the obtained products in the distribution and consumption channels.
Lessons learned (1200 characters max.)	The development of this automated mobile system for the feeding and control of pigs in Atlantic forest lands showed that there are forest land owners interested in implementing the system on their farms mainly because this type of system allows diversification of their income. Moreover, it is possible to obtain real data on the economic profitability of the farm, which can increase the rural population fixation. The development of this type of system is also very attractive for the younger generations who can maintain or incorporate into agricultural work. Finally, it is important to highlight that the dissemination activities increase the adoption of FORESTCELTA results by the owners of the forest lands.
Contact information	María Rosa Mosquera-Losada (mrosa.mosquera.losada@usc.es) and Nuria Ferreiro-Domínguez (nuria.ferreiro@usc.es)
Links to website/report/video (if applicable)	https://forescelta.com/
Pictures (if applicable)	 

ITHub 5 - 12

Title of innovation	**"Agroforestry in Austria" Network**
ITHub	5
FOREST4EU partner (short name)	StMELF-LWF
Operational Group (short name)	Agroforst in Österreich
Operational Group (name)	Wissenstransfer und Umsetzung von Agroforst-Systemen in Österreich
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	farmers, researchers, advisors, training institutions, interest groups
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/wissenstransfer-und-umsetzung-von-agroforst.html
Country, region, city	Austria, Lower Austria
Type of innovation	Organisational innovation
Keywords	agroforestry, knowledge transfer, network
Approach and main results (4000 characters max.)	The progressing climatic change in the regions dominated by arable farming in East Austria cause agricultural holdings to test new growing methods, among them also agroforestry types of utilisation. In Austria there are, so far, only sporadic examples of implementation, and there exists neither a contact point for interested agricultural holdings, nor a network for the exchange of information and experience between practice and science. Within the project on six arable farms site- and farm-adapted agroforestry systems were established and insights from this pioneer work to other farms and multipliers was made available. Under certain conditions, contemporary agroforestry systems can be an economically and ecologically interesting way of optimizing land use for future (climate change-related) challenges, because they increase the productivity of an area without placing greater demands on natural resources. The OG created the multi-actor "Agroforestry in Austria" network, consisting of the 6 participating farms with an interest in developing agroforestry systems on their land. Moreover, farms with established agroforestry systems, the strategic partners of the OG (see above), and other interested groups were also involved. The network brings different types of knowledge together, incl. farming practice, scientific and advisory expertise on agroforestry systems, administrative and RDP-related knowledge, and knowledge transfer know how. It organizes field trips and learning from good practice examples (e.g. in Switzerland, supported by OG partner), provides knowledge and information on agroforestry systems, facilitates interaction and collaboration, and creates visibility for the

	topic in Austria. The network activities are mainly project-financed, thus lacking a solid basis. Communication activities are key to the network. The OG coordinator FiBL sustains the "Agroforestry in Austria" network through its website https://agroforst-oesterreich.at/ and follow-up projects. Moreover, the film "Agroforestry – Advantages for farms and environment" shows the participating farmers and informs about their agroforestry systems and motivations (see: https://www.youtube.com/watch?v=-NVTYmE4e7o) (in German). A publicly accessible journal article on the network's activities creates broader awareness for and discussion about agroforestry, farming and the environment (see https://www.derstandard.de/story/2000129711836/zu-wenig-baeume-auf-oesterreichs-aeckern-eine-vertane-chance-fuers) (in German).
Lessons learned (1200 characters max.)	Establishing the agroforestry network in Austria created multiple benefits: a contact point for questions and issues related to agroforestry, stronger interest and demand from practitioners, awareness among decisionmakers for agroforestry as a means for land management with climate and nature, and pulling relevant agroforestry knowledge for Austria together. The networking and opportunities to meet like-minded people reduce initial barriers, making it easier for practitioners to implement agroforestry systems. Foreign know-how is channeled to Austria and made available. What went well? - cooperation in the network - openness of involved parties - exchange of knowledge and experience with practitioners from Austria and other countries What would you do differently today? - better pay attention to farming seasons when planning for meetings and workshops (to enhance opportunities for participation of all stakeholders) - increase resources for networking - earlier involvement of decisionmakers
Contact information	Theresia Markut, theresia.markut@fibl.org
Links to website/report/video (if applicable)	https://www.youtube.com/watch?v=-NVTYmE4e7o (in German)

Pictures (if applicable)	 © Markut Theresia/FIBL

ITHub 5 - 13

Title of innovation	**Practitioner-oriented consulting for agroforestry systems in Austria**
ITHub	5
FOREST4EU partner (short name)	StMELF-LWF
Operational Group (short name)	Agroforst in Österreich
Operational Group (name)	Wissenstransfer und Umsetzung von Agroforst-Systemen in Österreich
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	farmers, researchers, advisors, training institutions, interest groups
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/wissenstransfer-und-umsetzung-von-agroforst.html
Country, region, city	Austria, Lower Austria
Type of innovation	Service
Keywords	agroforestry, knowledge transfer, practitioner, advise
Approach and main results (4000 characters max.)	Under certain conditions, contemporary agroforestry systems can be an economically and ecologically interesting way of optimizing land use for future (climate change-related) challenges, because they increase the productivity of an area without placing greater demands on natural resources. The OG seeks to promote agroforestry in Austrian agriculture by means of establishing demonstration sites and generating practical knowledge. The OG created a novel consulting service for agroforestry in Austrian agriculture. In Austria, the existing consulting services in agriculture did not meet the demand of farmers interested in agroforestry to provide them with guidance and support. When the OG started, there was no state-based consulting for identification of suitable agroforestry systems and their implementation. The OG met this demand and created learning opportunities for the multiple actors involved: six farmers in Upper- und Lower Austria, who were willing to implement site-adapted agroforestry systems, the Lower Austria's Chamber for Agriculture, and various experts in agroforestry. Lower Austria is one of eight Austrian provinces (plus Vienna). It is home to 1.7 Mio people and covers the largest territory (almost 20.000 km2) among Austrian provinces. The environmental pressure on the arable area is high. Establishing the demonstration sites benefited from practitioners' interest in and readiness for the topic. The OG foresaw support for the planning and implementation of site-adapted agroforestry systems. Practitioners' demands met with the support provided in the OG. With support of German and Swiss consultants, suitable

	systems were identified, plans for planting designed, means for browsing protection found and the farmers could plant and maintain the young trees. Participating farmers bought the tree seedlings with their own sources. EIP Agri does not provide for investment funding. A brochure for consulting on agroforestry in Austria pulls the existing knowledge together. It explains the notion of agroforestry, how farms and the environment benefit from it, provides planning tools and suggestions for implementation, the range of suitable tree species, possible problems that may occur and how to solve them. The brochure was published in Dec 2022 and is available via: https://agroforst-oesterreich.at/wp-content/uploads/2023/03/AF-Beraterbroschuere_END.pdf (in German).
Lessons learned (1200 characters max.)	The OG raised awareness for agroforestry among practitioners and in administrations, made concrete how different systems are implemented in practice, and the (potential) benefits which they delivered. The new Austrian GAP Strategic Planning for 2023-2027, however, does not include dedicated funding for agroforestry. Public support is yet available. The OG published an easy-to-read leaflet, which informs about alternative GAP funding (see: https://agroforst-oesterreich.at/wp-content/uploads/2023/01/Agroforst-im-Oesterreichischen-Foerdersystem_2023-01-05.pdf) (in German). What went well? - There was great diversity of agroforestry systems in the project, which allowed to generate a broad range of information material and support within the three-year project duration What would you do differently today? - involve more farms as participants for demonstration sites in the project to increase opportunities for experimentation and development.
Contact information	Theresia Markut, theresia.markut@fibl.org
Links to website/report/video (if applicable)	https://agroforst-oesterreich.at/wp-content/uploads/2023/01/Agroforst-im-Oesterreichischen-Foerdersystem_2023-01-05.pdf (in German)

Pictures (if applicable)	  © Markut Theresia/FIBL

ITHub 5 - 14

Title of innovation	**Agroforestry "Farminar" as new mode of knowledge transfer**
ITHub	5
FOREST4EU partner (short name)	StMELF-LWF
Operational Group (short name)	Agroforst in Österreich
Operational Group (name)	Wissenstransfer und Umsetzung von Agroforst-Systemen in Österreich
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	farmers, researchers, advisors, training institutions, interest groups
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/wissenstransfer-und-umsetzung-von-agroforst.html
Country, region, city	Austria, Lower Austria
Type of innovation	Service
Keywords	agroforestry, knowledge transfer, farminar, practitioners
Approach and main results (4000 characters max.)	Under certain conditions, contemporary agroforestry systems can be an economically and ecologically interesting way of optimizing land use for future (climate change-related) challenges, because they increase the productivity of an area without placing greater demands on natural resources. The Projekt Leader (FiBL) created an agroforestry farminar that ensures knowledge transfer on the topic for various groups, including practitioners and government agencies. In a farminar (a blend of the English "farm" and an "online seminar"), experts report directly from a farm, field or forest plot and present interesting work practices or equipment. People can participate on site as well online and ask questions via chat. Farminars thus stand for practical relevance and dynamism. Another plus point: they are recorded and posted online. The farminar format has been developed by an Austrian training institution for rural development. The agroforestry farminar, however, is the first of its kind. The agroforestry farminar is based on the knowledge and experience that was collected in the OG, yet funded by a different project. It was produced on one of the OG farms. People attended the farminar in person and online. The overall question of the farminar is: What does agroforestry bring to the farm and the environment?

Lessons learned (1200 characters max.)	What went well? - Preparation and on-site technical implementation; hybrid format increased scope What would you do differently today? - Possibly, greater share of practical knowledge (less theory) - alternative planning for bad weather event (there was a storm when the farminar event was held)
Contact information	Theresia Markut, theresia.markut@fibl.org
Links to website/report/video (if applicable)	https://www.youtube.com/watch?v=9HwseLy14vw (in German)
Pictures (if applicable)	 © Markut Theresia/FIBL

ITHub 5 - 15

Title of innovation	**Technology for the mobilization and use of forest biomass in agroindustry**
ITHub	5
FOREST4EU partner (short name)	SOLUTOPUS
Operational Group (short name)	GOTECFOR
Operational Group (name)	Technology for the mobilization and use of forest biomass in agroindustry
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	researchers; business
Link from OGs database	https://gotecfor.pt/
Country, region, city	Portugal (north). Porto
Type of innovation	Technological innovation
Keywords	wood mobilization; biomass; best use of machinery
Approach and main results (4000 characters max.)	TECFOR was a OG from the initiative of a foresters association, in collaboration with SMEs and research institutes. **The main objectives** were: *Promote the use of forest biomass (FB) for valorization of the forest and territory and increased productivity/interconnection among agroforestry activities; • Reduce costs associated with associated production activities to protected crops (heat needs); • Promote comprehensive management of forest resources and value products considered residual, in order to reduce imports of fossil fuels; • Promote the use of more efficient, safer and more suitable machines and equipment for the Portuguese reality; • Promote the development of new sustainable, low-carbon and more efficient value chains in terms of use of resources; • Stimulate innovation and technological development to provide response to the needs of the various agents related to the use of FB. More specifically, it intended to identify technological development solutions that contribute to overcoming existing barriers; to test existing technical solutions for collecting FB in a more efficient - Identify the main obstacles to along the value chain and test support tools within the scope logistics processes to optimize the supply chain; to propose integrated models of energy production solutions depending on the type of consumers; to disseminate appropriate techniques and technologies for the use from FB and apply results from the European FOCUS project to manage the biomass supply chain in Portugal. **The results** highlighted by the team are: **1)** a roadmap for floral biomass processing equipment that can be presented to forestry companies; **2)** Biomass mobilization

	models will be presented as best practices for forest owners; **3)** The application of biomass management software will give the percentage of efficiency that the forestry company "Floresta Jovem" obtained in terms of lower operational and logistical costs whose preliminary results are estimated at 9% efficiency in relation to previous biomass management; **4)** For the agroindustry, in the case of "Floralves", it is expected that the cost associated with the acquisition of forest biomass (chip) decreases by 82% relative to natural gas. The amortization of the investment of the Biomass boiler is not included in the calculations. Eventually, "Floralves"' productivity may decrease with the use of forest biomass as a source of fuel, in relation to the previous use of natural gas; **5)** To improve productivity, physical or mechanical reduction of CO2 emissions from the biomass boiler, using a cyclonic separation method that removes particulate matter. Ash from the biomass boiler is being used by "Floralves" as fertilizer for land near the greenhouse. They are not used in greenhouses, as flower production is hydroponic. The team considered very valuable the achieved beneficts (environmental, economic, social); a special enfhazis is put on the networking skills.
Lessons learned (1200 characters max.)	Transferability of the results and methodology is real, due to some similarities among regions and countries (e.g. among north Portugal and Galiza/Spain). The technological innovation through demonstrations is a vehicle to interact with other EU Projects were the problematic is similar. The valorization of forest biomass for heating greenhouses brings together forest owners, forestry companies and agribusinesses around the use of a natural resource, renewable energy and which is currently little used economically, in accordance with the principles of the circular economy. This approach, which values the forest and reduces energy costs of companies, calls the attention to: **a)** Lack of more efficient collection, planning and transport models forest biomass; **b**) Lack of more adapted and automated machines to reduce costs, increase safety and reduce operator effort forestry, during the collection and pre-processing of biomass and to **c)** Lack of resizing, adaptation or alteration of greenhouse heating equipment for the use of biomass forestry chip, increasing efficiency and reducing costs energy.
Contact information	info@forestis.pt
Links to website/report/video (if applicable)	https://gotecfor.pt/publications
Pictures (if applicable)	TECFOR TECNOLOGIA PARA A MOBILIZAÇÃO E APROVEITAMENTO DE BIOMASSA FLORESTAL NA AGROINDÚSTRIA

ITHub 5 - 16

Title of innovation	**New and innovative cultivation methods of highly productive apples adapted to northern climates**
ITHub	5
FOREST4EU partner (short name)	EFI
Operational Group (short name)	Commercial productive apple growing in a northern climate – innovation for new climate resilient agriculture in northern Europe
Operational Group (name)	Commercial productive apple growing in a northern climate – innovation for new climate resilient agriculture in northern Europe – om högproduktiv odling av äpple i nordliga klimat
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	All stakeholders have multiple expertise, especially in horticulture and plant production, beyond the expertise of the organisation they represent. 1 county administrative board of the region, 1 food company, 1 technology development company, 1 nursery, 1 wholesale company, 1 NGO, 1 gardener.
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/commercial-productive-apple-growing-northern.html
Country, region, city	Sweden; Norrbotten, Västerbotten and Västernorrland; Umeå
Type of innovation	Process
Keywords	Agroforestry, climate change, food production, rural development, plant production, apple production
Approach and main results (4000 characters max.)	Northern rural areas of Europe have been featured by challenges in making a living from traditional agriculture with historically limited number of commercially cultivated species, and generally harsh climate conditions. In this context, developing new and innovative cultivation methods for growing apples that are not only suitable for northern climates but also highly productive is aimed at to diversify farms economically and environmentally. The project has planted 10 ha of apple trees, in total about 12000 apple trees, in several different plots owned by different farmers – the beneficiaries of the project in Norrbotten, Västerbotten, Västernorrland and Harjedalen regions in Sweden. To make apple production profitable the focus of any commercial operation has to be on quality and value chain rather than tonnage. The profitability for the farmers in the project comes from the connection to a high value producer of ice cider operating in a global premium market. The project aims to develop new cultivation methods, new varieties, planting arrangements and management options to meet the demands of a new kind of buyer that in turn is ready to reward quality over quantity. It inspires farmers to go beyond business as usual and traditional agriculture in the area. Each farmer also finds their own way of managing their apple orchard – the whole idea is to learn new things for future and

	do observations to do things better in terms of growing apples with high sugar content suitable for ice cider production in the Northern Europe. The long-term goal of the project is to contribute to climate resilient sustainable agriculture and to create favourable partnerships between farmers and food processing companies in order to develop further products in local, regional and global markets. The project and its spinoffs continuously search for further collaboration with academia.
Lessons learned (1200 characters max.)	The project is yet to completed so the final lessons learned will be published by the project after it has ended in 2024. Overall, the project contributes to climate resilient food security, developing novel foods for consumers, economic and environmental resilience of farmers, region and local communities.
Contact information	Daniel Pacurar (danielpacurar@borealorchards.se)
Links to website/report/video (if applicable)	https://www.brannlandcider.se/om-oss/vara-odlingar/commercial-productive-apple-growing-in-a-northern-climate/
Pictures (if applicable)	https://www.brannlandcider.se/press/

ITHub 5 - 17

Title of innovation	**Local densified log industry**
ITHub	5
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	BUCHDENS
Operational Group (name)	New local value-added channel for hedges: densified logs
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	s, businesses
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/buchdens-nouvelle-fili%C3%A8re-locale-de-valorisation.html
Country, region, city	France, Normandie
Type of innovation	Organisational
Keywords	Territory and land management, Supply chain, marketing and consumption, Competitiveness and diversification of agriculture and forestry, Waste, by-products and residue management, Forestry, Energy management
Approach and main results (4000 characters max.)	Currently, hedgerows are used in two local sectors: wood energy (wood chips used for heating) and biomass (mulch). However, a significant proportion of this material is not compatible with the production of quality fuel. The Cooperative for the Use of Agricultural Equipment (CUMA) of western Normandia runs the local agricultural hedgerow valuation. In the Manche department, the project is being organised with the Ecovaloris CUMA (wood chipping), locals CUMA (storage platforms) and the Haiecobois association (commercialisation of chipped wood in local boiler rooms, colleges and local authorities). The project has both a technical component and a territorial development component involving local stakeholders. The basis shared by all the stakeholders in the project is based on a common vision of commitment to local development of natural resources, with a focus on the environment, social issues and business creation. The aim of this operational group is to set up a local densified wood supply chain (shredded wood and co-products of shredded wood screening) by making use of the hedgerow wood produced by farmers as part of a circular economy approach. The type of investment studied will be accessible to small production workshops and will be based on an agricultural and cooperative-type organisation. This sector would be complementary to wood chips and would strengthen

	the economic viability of the local wood energy sector by increasing opportunities. The end users are private individuals with a log-burning stove. The volumes of wood have been identified and are easy to mobilise, given the lack of outlets for hedgerow wood. Several non-agricultural supply sources are also being studied. These are difficult to identify but represent an economically interesting source for the project. They are mainly occasional resources that require large storage capacities. The source linked to private individuals has not yet been explored beyond occasional contacts. A test was carried out in 2019, validating the technical feasibility of the project using agricultural raw materials. The briquetting was carried out with the company Agriopal. It was found that there were no problems in applying the product and that the hydraulic press system met the requirements. Samples were also sent for analysis to check the quality of the product (physico-chemical measurements of the product and its thermal performance). The production site will have to be close to a dryer ("flat drying" type associated with a methaniser). The project is also based on complementary work with wood screening on Haiecobois' wood chip storage platforms in order to exploit the "fines" produced by screening.
Lessons learned (1200 characters max.)	It has been possible to confirm the feasibility of a local industry producing densified logs from local resources. One of the difficulties lies in mobilising the players and being able to free up time for project engineering and structuring the activity. The Cooperative for the Use of Agricultural Equipment of western Normandia supports local structures in their territorial projects and the work initiated with the BUCHDENS programme has been extended beyond densified logs. In fact, as part of the project to develop hedgerows, farmers have joined forces within the SECCOPA project to produce pellets from hedgerows as a complement to their project concerning the promotion of alfalfa.
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Links to website/report/video (if applicable)	www.normandie.cuma.fr
Pictures (if applicable)	

ITHub 5 - 18

Title of innovation	**Transposing knowledge and tools on the adaptation of trees to climate change from the forest environment to the bocage environment**
ITHub	5
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	ARBRE
Operational Group (name)	Transversal and systemic approach to trees in Perche
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	famers, advisors, forest owners
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/approche-transversale-et-systemique-de-larbre-dans.html
Country, region, city	France, Normandie
Type of innovation	Service
Keywords	Biodiversity, Agroecology, Cooperation, Research and Innovation
Approach and main results (4000 characters max.)	Bocage and woodland are major features of the Perche landscape, with almost 11,500 km of hedgerows in 2020. On the scale of the territory's forestry charter of the Perche, woodland represents 21.25% of the area. Adapting wooded areas to climate change is an issue that affects both hedgerows and forests. At present, little attention is paid to this issue in hedgerow management, whereas a number of research projects have been carried out on the subject in forestry. Deciduous species are present in both environments, which is why it is interesting to be able to pool knowledge by relying on existing tools such as the "guide to choosing tree species in Normandy" drawn up in 2018 by the Normandy delegation of the National Forest Property Centre. This decision-making tool is based on the relationship between forest station and species, which takes into account changes in climate to guide silvicultural management. The aim is to disseminate existing information and to work collectively with target audiences (bocage and agroforestry workers) to draw up a list of bocage species suited to tomorrow's climate. The partners met to discuss the feasibility of transposing the guide to the bocage context. A literature review on the adaptation of hardwood species to climate change was carried out. As a result, few studies have been carried out on non-productive species (for timber or fodder purposes). There is more flexibility in the choice of species for bocage, as the objective is not

	timber production. Farmland is generally richer, with a greater maximum water storage reserve. The tool developed by the CNPF, while interesting, is difficult to apply in the bocage context, due to the absence of herbaceous indicator flora or its misleading presence due to human fertilisation. The guide as it stands cannot be used to create an open field hedge, but would be more effective for replanting a hedge or rehabilitating a damaged hedge.
Lessons learned (1200 characters max.)	A transfer of knowledge from the forestry sector and an appropriation of decision-making tools has been carried out by those working in the bocage environment. Scientific studies and data on bocage species are scarce, and tools developed in forestry are not directly transferable. The various partners share the view that there is a need to examine the issue in further detail at the regional and/or departmental scale. There is a common interest and motivation among the players to take collective action on the subject. In particular, this work could be pursued by the regional natural park of the Perche as part of the "Normandie Hedges" call for expressions of interest. In addition, the Normandy delegation of the National Forest Property Center is conducting a parallel study on the application of the Guide to choosing tree species for farmland afforestation projects.
Contact information	Mrs Florence SBILE (florence.sbile@parc-naturel-perche.fr)
Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 5 - 19

Title of innovation	**Raising awareness and setting up tests on assisted natural hedge regeneration**
ITHub	5
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	ARBRE
Operational Group (name)	Transversal and systemic approach to trees in Perche
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	famers, advisors, forest owners
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/approche-transversale-et-systemique-de-larbre-dans.html
Country, region, city	France, Normandie
Type of innovation	Process
Keywords	Biodiversity, Agroecology, Cooperation, Research and Innovation
Approach and main results (4000 characters max.)	Bocage and woodland are major features of the Perche landscape, with almost 11,500 km of hedgerows in 2020. On the scale of the Charte forestière de territoire du Perche, the wooded area represents 21.25% of the area covered by the Charte forestière de territoire du Perche. The test was carried out on two linear routes with contrasting contexts, for a total length of 124 metres. The test was carried out over two days. The first day was used to identify the seed trees present and the quantity of fruiting bodies, as well as to prepare the site. The second day was used to install the plant material (fruiting shoots, seeds) and to plant the seedlings, in the form of a participatory worksite with farmers interested in the approach. In order to preserve the Perche bocage, it is necessary to maintain and create new linear hedgerows. The technique most commonly used is plantation by landscape companies. However, there are a number of limitations to this approach, such as the unsuitability of plants (linked to the question of origin) in the local context, the difficulty of obtaining materials, the increased cost of planting and the difficulty of obtaining fundings. It is to overcome these obstacles that assisted natural regeneration of the hedge (or semi-spontaneous hedge) may prove to be an alternative to planting operations. The Parc Naturel Régional du Perche has therefore set itself the objective of raising awareness and promoting this practice among farmers, in particular by organising meetings in the field. A technical itinerary for setting up a semi-spontaneous hedge was drawn up by an external consultant, Sylvaloir, and given to the participants. The test was carried out on two linear

	routes with contrasting contexts, for a total length of 124 metres. The test was carried out over two days. The first day was used to identify the seed trees present and the quantity of fruiting bodies, as well as to prepare the site. The second day was used to lay out the plant material (fruiting shoots, seeds) and to plant the seedlings, in the form of a participatory worksite with farmers interested in the approach.
Lessons learned (1200 characters max.)	This project has enabled the Park to build up its skills in this field, fulfilling its ambition to be an area of experimentation. This practice has an economic advantage, but despite the interest in the subject, participation in the participative worksite was low. The methodology used could also be improved, particularly in the context of the "Normandie hedgerow" call for expressions of interest. There are two threats to its development, however: firstly, the length of time it takes to install a hedge may dissuade project owners who want to have a "standard hedgerow" quickly, and secondly, the subsidy schemes do not include this alternative practice.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 5 - 20

Title of innovation	**Trees and forests on mountain farms: measuring performance and innovating to support the evolution of Pyrenean grassland systems**
ITHub	5
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	AGROSYL
Operational Group (name)	AGROSYL : Trees and forests on mountain farms: measuring performance and innovating to support the evolution of Pyrenean grassland systems
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farmers, forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/agrosyl.html
Country, region, city	France, Occitanie
Type of innovation	Process
Keywords	Farming/Forestry competitiveness and diversification, agroforestry
Approach and main results (4000 characters max.)	Over the years, agriculture and forestry have undergone a certain split which has led to spaces being specialized (mechanization, reduction in the workforce) in their uses. However, agroforestry is experiencing renewed interest among farmers, especially in large crops where it fulfills several objectives: thermal regulation, fight against erosion, preservation of biodiversity, production of timber, energy wood or fruits, heritage vision… Agroforestry and silvopastoralism have their place in livestock farming, particularly within an extensive mountain or foothill suckling cattle system. Their development is still little observed in the field while the forest can provide great services to livestock breeders: production of animal bedding, contribution to food and fodder autonomy (supplements with forest fruits and fodder on the ground), diversification of marketed production and sources of income (sale of wood). Without forgetting environmental benefits such as reduction of erosion, nitrogen absorption or animal welfare. AGROSYL aimed to promote innovative agricultural practices linked to forests and wood. The project was structured around four experiments: creation of a technical silvopastoral route; establishment of white mulberry trees as fodder trees; study of the impact of wood mulch as bedding on animal welfare and analysis of the productive potential of fruit trees (oaks, chestnuts, cherry trees, hazel trees) after selective thinning in the stands. Each experiment took place in three stages:• Construction of a system for experimenting with

	technical solutions: diagnostics with groups of farmers, state of the art on proven solutions and implementation of pilots. • Capitalization of results: monitoring-evaluation of pilots, marketing study (commercial development potential), comparison with similar projects, construction of a support offer (agrosylvopastoral advice). • Dissemination of results and implementation of innovations: coordination of OG, dissemination, awareness and training among farmers and advisors. The silvopastoralism experiment was carried out on three farms. The objective was for the owners of the settlements to reclaim their forests by grazing their animals there. 27 plots per farm were created in order to measure the evolution of forage resources on the ground. Main findings: the forage resource becomes established from the 3rd year and the forest cover regains space over the same period of time. 5,000 white mulberry plants were planted on 0.25 ha at GAEC Authier in 2017. For material reasons, ensiling the mulberry harvest to give it to livestock was not satisfactory. The farmer therefore integrated the plot of mulberry trees into the livestock's grazing route in order to manage the grass cover before the plants explode. When the grass reserves run out during periods of extreme heat, the mulberry plants take over. The wood mulching experiment was carried out within two GAECs. No significant difference was observed between the two types of mulching (pure straw and mixture) on the behavior of the livestock. The visual appearance of the cleanliness of the livestock is much better on litter with a pad underlay, although the appearance of the litter itself is dirtier. Finally, the fruit experiment was carried out in parallel with the silvopastoralism experiment on a farm. The partners noted that the plots having undergone the greatest removal of stems (40% compared to 30% and 0% for the control block) produced the most fruits.
Lessons learned (1200 characters max.)	For farmers, the project offered a support framework to appropriate and implement agroforestry and silvopastoral practices. For forest owners, AGROSYL made it possible to get closer to breeders and to implement silvopastoral practices in their forests. For advisors, the project defined a prototype of agro-sylvo-pastoral advice that could be applied in their territories. For research institutes, the project provided references acquired through the monitoring of pilot sites, on a subject bringing innovation. The white mulberry seems to be adapted to many soils and pedoclimatic contexts and resistant to drought. For some breeders, wood mulch represents an alternative to straw from cereal producers, the purchasing costs of which are high. The continuation of the project consists in particular of supporting breeders who own wood to integrate silvopastoralism. It is also desirable to continue the production of knowledge on fodder trees by adopting new planting methods as well as other types of livestock farming.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 5 - 21

Title of innovation	**Biological control of Chestnut blight (Cryphonectria parasitica) by virus infection (hypovirulence)**
ITHub	5
FOREST4EU partner (short name)	USC
Operational Group (short name)	CASTANEA
Operational Group (name)	Operational group for the valorization of the Extremadura chestnut tree
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	3 farmer associations, 1 company, 1 research center and 1 University
Link from OGs database	http://gocastanea.eu/
Country, region, city	Spain, Extremadura
Type of innovation	Process
Keywords	Agroforestry, forest degradation, Sustainible Forest Management
Approach and main results (4000 characters max.)	Agroforestry with chestnuts is a traditional land use system in North West Spain where this type of trees are widely affected by the chestnut blight (Cryphonectria parasitica). This tree disease is characterized by affecting the aerial part of chestnut trees, destroying the tissues in the trunk and branches. Studies carried out within the framework of the CASTANEA operational group indicate that this chestnut disease is also a serious problem in some regions of Extremadura (southwest of Spain). Therefore, it is necessary to find effective methods of control for this destructive disease of chestnut trees. One of the objectives of the CASTANEA operational group was to design biological control strategies for chestnut blight disease with hypovirulent strains in Extremadura. In this context, it should be noted that hypovirulence is a condition in which the blight fungus itself gets sick by a virus (hipovirus CHV-1), which can be spread from one fungus to another. The results of the CASTANEA operational group indicate that an effective protocol to carry out a biological control of the chestnut blight with hypovirulent strains in a specific area has to follow these phases: i) Determination of the Vegetative Compatibility Groups (VCG) present in the area through the sampling of affected trees, isolation of the fungus and analysis of the VCG in the laboratory, ii) Determination of the MAT types (mating types) present in the area because the presence of both MAT types can favor sexual reproduction, which complicates the establishment of hypovirulence, iii) Establishment of hypovirulent strains compatible

	with the VCGs in the area, which will be selected for their white color and the presence of the virus will be confirmed with molecular analysis, iv) Production of the hypovirulent inoculum taking into account the VCG and MAT present in the area, v) Application of treatments in the field by bringing the hypervirulent strain into contact with the virulent one through scratches or perforations in the tree bark.
Lessons learned (1200 characters max.)	1. The VCG present in chestnut plantations in Cáceres have been determined by the CASTANEA operational group. In the Villuercas-Ibores-Jara region there is a clear predominance of a VCG, while in the regions of Valle del Jerte and La Vera there is more diversity. 2. The MAT types present in the different areas have been determined by molecular analysis. 3. A hypovirulent strain of VCG predominant in the area (EU-11) has been detected by the CASTANEA operational group in Villuercas-Ibores-Jara. 4. Experimental treatments with hypovirulent strains are needed and for this reason a experimental treatment has been initiated by the CASTANEA operational group in Villuercas-Ibores-Jara region.
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Links to website/report/video (if applicable)	http://gocastanea.eu/
Pictures (if applicable)	

ITHub 5 - 22

Title of innovation	**Manual of recommendations for an efficient use of water in chestnut groves**
ITHub	5
FOREST4EU partner (short name)	USC
Operational Group (short name)	CASTANEA
Operational Group (name)	Operational group for the valorization of the Extremadura chestnut tree
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	3 farmer associations, 1 company, 1 research center and 1 University
Link from OGs database	http://gocastanea.eu/
Country, region, city	Spain, Extremadura
Type of innovation	Service
Keywords	Agroforestry, forest degradation, Sustainable Forest Management, mitigation to climate change
Approach and main results (4000 characters max.)	The chestnut tree is sensitive to water deficit in the summer period. In Extremadura (Southwest of Spain), the new chestnut plantations, some of them with an agroforestry use, are established with patterns and varieties that are demanding in water. Therefore, in this region of Spain and in taking into account the current scenario of climate change, it is necessary to irrigate the chestnut trees since the water available during the summer is usually limited and irregular. Moreover, it is important to highlight that an efficient use of irrigation water in the chestnut groves must be taken into account: the water needs of the chestnut trees and what are the moments in which it is important to guarantee that the tree has all the water it needs. One of the objectives of the CASTANEA operational group was the implementation of techniques to mitigate water stress in chestnut groves associated with climate change. The results show that if there is not enough water to cover all the needs of the chestnut grove, good water status of the tree must be maintained in the periods in which drought can reduce the production and/or calibre of the chestnuts in the current or subsequent production campaigns. Moreover, localized irrigation systems seem to be the most suitable systems for irrigating chestnut groves, as they provide irrigation water where the tree can use it. Both drip irrigation and micro-sprinklers are suitable for chestnut groves irrigation, however, micro-sprinklers imply a higher need for water than drip irrigation since in the case of micro-sprinklers, water losses due to evaporation must be compensated. On

	the contrary, in shallow soils, micro-sprinklers may be a suitable option. Finally, it is important to know the water status of the tree to know if the irrigation is adequate. A method to know the water status of the tree could be visual appreciation since a stressed tree presents a series of visible symptoms (slowing of the growth of shoots and young leaves, change in the angle of the leaves, yellowing, premature fall of mature leaves...). However, the problem of visual appreciation is that this method is subjective and requires a lot of experience and it is very difficult to assess the level of stress that trees endure. An alternative to know the water status of the tree could be to measure the water potential of the trunk during the solar noon through a pressure chamber. This method is easy to use and a numerical value is obtained that can be interpreted using reference values.
Lessons learned (1200 characters max.)	Some lessons learned were: 1. Subsoil the soil before planting chestnut trees, to improve the water retention capacity of soil, facilitate drainage, increase porosity and permeability, and facilitate the development of the root system 2. Carry out a good design and execution of the irrigation installation 3. Use a spot or drip irrigation system 4. Use a programmer and volumetric water meter to make good irrigation programming 5. Take care of the cleaning and maintenance of the irrigation system, and periodically check that everything is working correctly 6. Choose an appropriate irrigation equipment based on the soil type 7. Place the drippers in the projection of the tree crown, where the absorbing roots are located 8. Adjust the number of drippers according to the growth of the tree 9. Water new plantings to avoid stress 10. Avoid applying excess water on chestnut trees 11. Maintain a good water status of the tree in the last period of fruit growth until the end of the harvest and 12. if water is available, apply prolonged irrigation to recharge the profile at the beginning of the growing cycle when the spring has been dry and also when the rapid growth of chestnuts begins
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Links to website/report/video (if applicable)	http://gocastanea.eu/

Pictures (if applicable)	  

ITHub 5 - 23

Title of innovation	**School of Agroforestry**
ITHub	5
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	NEWTON
Operational Group (name)	Agroforestry Network in Tuscany
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farms, research groups, communication company, national forest certification systems (PEFC)
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/network-lagroselvicoltura-toscana
Country, region, city	Tuscany, Italy
Type of innovation	Organisational innovation
Keywords	Agricultural production system, Farming practice, Climate and climate change, Agroforestry, sustainability
Approach and main results (4000 characters max.)	The NEWTON project promotes traditional agroforestry knowledge and innovative solutions for the implementation of sustainable agroforestry systems with a participatory approach. From 3 to 7 October 2022, at Tenuta di Paganico was held the agroforestry school. It was organized in five training module-days based on classroom lessons and field visits. The topics covered during the days were: agroforestry and forestry systems; forestry management and grazing; soil; certification and marketing. The school involved 38 stakeholders, and it saw in particular the participation of many young farmers who are environmentally aware and interested in agroforestry as a strategy for more sustainable farm management.
Lessons learned (1200 characters max.)	The school was a great success, particularly because many interested stakeholders were involved. The critical point that emerged was the lack of economic data to support the (possible) adoption of agroforestry. From the meetings with the main actors involved it emerged that agroforestry is a promising system to contrast the abandonment of agricultural land and therefore maintain farmers' presence in the internal and/or marginal areas while generating income. A further result was the raised awareness by the actors involved of the importance of social and economic sustainability. That is a fundamental aspect for the application of

	more sustainable cropping systems in the next years, in order to mitigate climate change and make agroecosystems more resilient to changing conditions.
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Pictures (if applicable)	

ITHub 5 - 24

Title of innovation	**Criteria and indicators for the certification of the sustainable management of an agroforestry system PEFC**
ITHub	5
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	newton
Operational Group (name)	Agroforestry Network in Tuscany
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farms, research groups, communication company, national forest certification systems (PEFC)
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/network-lagroselvicoltura-toscana
Country, region, city	Tuscany, Italy
Type of innovation	Process
Keywords	Agricultural production system, Farming practice, Climate and climate change, Agroforestry, sustainability
Approach and main results (4000 characters max.)	Since November 2020, the Programme for Endorsement of Forest Certification schemes – PEFC Italy - has been on a path to develop a certification standard for the sustainable management of agroforestry systems. During the NEWTON project a working group with a large number of stakeholders from the agroforestry sector was established; in the spring of 2022, the PEFC national standard was created and in the summer of 2022 three pilot tests were carried out in the NEWTON project partner companies. The PEFC analysis had as objectives the study of the tools and standards for guaranteeing the traceability and sustainability of agroforestry production and the related products processed by the project partner companies. This studies were followed by an analysis of the type of certifiable products derived from the agricultural, livestock, forestry and agroforestry components of these products. During the pilot tests conducted with the company's technicians, it was possible to concretely analyse in the field the guidelines and indicators established during the standard drafting process, highlighting the difficult application of some and improving others. The main results obtained in the study carried out in the partner companies saw the identification of 48 products (or product categories) and 13 processed and manufactured products; these 61 products are potentially subject to certification, some of them with more than 35 different schemes of environmental and quality certification schemes worldwide. Thanks to the cooperation of the project

	partners, the document 'Criteria and indicators for the certification of the sustainable management of an agroforestry system PEFC ' was produced, the first European-wide certification standard for the tree component of an agroforestry system, available from 2023, to valorise local agroforestry products.
Lessons learned (1200 characters max.)	According to the PEFC Italia scheme, the certification of the sustainable management of an agroforestry system allows access to the market with product and system traceability certifications to give the end consumer a guarantee of the correct management of the company system. The experiences and knowledge gained during the project will be taken as an example by others in the regional and national scene, and for the project partner companies it will be a document already known and easily implemented for the certification of products resulting from sustainable agroforestry management. The standard allows companies to certify their sustainable management and can be used as a marketing and communication tool for the products, enhancing a company marketing that is more prudent and respectful of environmental requirements, thus implementing farm sustainability in social and environmental terms.
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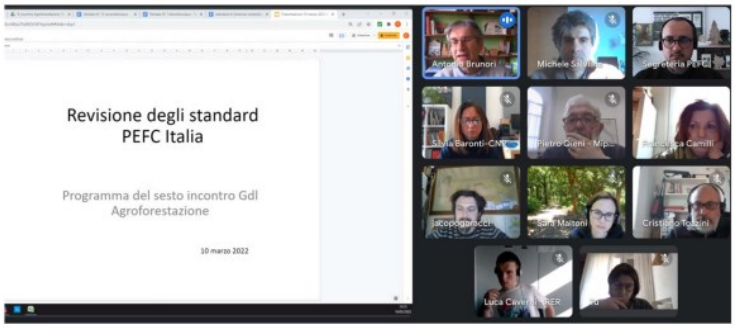
Links to website/report/video (if applicable)	https://gonewton.it
Pictures (if applicable)	 *Figura 2: Screenshot di uno degli incontri del GdL di Agroforestazione i PEFC Italia in cui sono coinvolti anche i partner del GO-NEWTON*

	 BESTIAME AL PASCOLO Si prega di chiudere il cancello PEFC	

ITHub 5 - 25

Title of innovation	**Model of a productive agroforestry system in Extremadura (Southwest Spain)**
ITHub	5
FOREST4EU partner (short name)	USC
Operational Group (short name)	CASTANEA
Operational Group (name)	Operational group for the valorization of the Extremadura chestnut tree
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	3 farmer associations, 1 company, 1 research center and 1 University
Link from OGs database	http://gocastanea.eu/
Country, region, city	Spain, Extremadura
Type of innovation	Process
Keywords	Agroforestry, Non-wood forest product, selviculturale
Approach and main results (4000 characters max.)	In Extremadura (Southwest Spain) there are around 11,000 hectares occupied by chestnut trees, most of which are traditionally managed as agroforestry systems with a mixed use of fruit production and other products. In this region, chestnut production has been used for both human and animal consumption, mainly pigs, sheep and goats. Usually, the animal consumption of chestnut fruits is carried out after the harvesting of the fruits with commercial value which reduces the incidence of pests in subsequent years. Moreover, in the chestnut groves located in flat areas, the understorey is also used to cultivate cereals, potatoes or pasture that is grazed by sheep. One of the objectives of the CASTANEA operational group was to develop practices to transform abandoned chestnut groves into high-value productive agroforestry systems under a climate change scenario. The results obtained show that it is possible to transform chestnut groves for wood production into chestnut groves for fruit production. To do this, it is necessary to thin out the chestnut groves and select some trees, leaving a distance between trees of 10-15 m. The selected trees can be cut from the stump and when the trees are thin they can be pollarded at 1.5 m and on the regrowth selected chestnut varieties can be grafted. The advantage of this procedure is the rapid production of chestnuts by the trees since already established and adult chestnut trees are used. However, the transformation of chestnut groves for wood production into chestnut groves for fruit production has an initially high cost because it is expensive to eliminate all the biomass from branches and trunks, and pollarded stems in the first years, which requires extra work to select the shoots. In any case, it is important to take into account that chestnut fruit production is compatible with other uses through

	agroforestry systems, such as intercropping in the streets between trees, pasture production, wood from clearings or prunings, edible mushrooms, etc., creating synergies between the different products, optimizing resources and the management of the plots. Moreover, this product diversification strategy allows chestnut growers to obtain complementary income on the same plot, reduce inputs and production costs, and in the case of new plantations, the return on investment is advanced and the unproductive period of the plantations is reduced. Finally, it is important to take into account that the diversification of production can be carried out in established traditional chestnut groves and in new plantations. In both cases, the uses that will be carried out in the chestnut groves must be taken into account to design the plantation appropriately for the corresponding management.
Lessons learned (1200 characters max.)	In the agroforestry system established with chestnut trees in Extremadura, the chestnut-cattle combination has been one of the classic associations with multiple mutual benefits (control of understory vegetation by livestock, improvement of soil fertility through nutrient recycling which reduces the use of fertilisers, pest control (Curculio and Cydia)...). Moreover, establishing horticultural, grain or forage crops in the rows between the chestnut trees is an interesting practice to develop in the new plantations. In this way the space is optimized, complementary income is obtained and the chestnut tree benefits from the work that the herbaceous crops receive. Chestnut trees can also be combined with the production of edible mushrooms, honey or firewood. Ecosystem services such as biodiversity or carbon sequestration are also higher in the agroforestry systems than in the exclusively agricultural and forest systems.
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Links to website/report/video (if applicable)	http://gocastanea.eu/
Pictures (if applicable)	

		

ITHub 5 - 26

Title of innovation	**LCA application on semi-extensive agrosilvopastoral systems**
ITHub	5
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	NEWTON
Operational Group (name)	Agroforestry Network in Tuscany
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farms, research groups, communication company, national forest certification systems (PEFC)
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/network-lagroselvicoltura-toscana
Country, region, city	Tuscany, Italy
Type of innovation	Process
Keywords	Agricultural production system, Farming practice, Climate and climate change, Agroforestry, sustainability, carbon stock
Approach and main results (4000 characters max.)	In order to assess the environmental impact of semi-extensive beef cattle breeding, a Life Cycle Assessment (LCA) analysis was carried out. Based on the results obtained from the LCA analysis and the evaluation of forest CO2 absorption, it was possible to determine that the impact of semi-wild cattle breeding of the Maremma breed emits 8.05 kg of CO2 eq per kg of live weight of cattle. In addition, it was estimated that the forest ecosystem was able to offset 66% of emissions in the form of climate-altering gases through the carbon stock in tree tissues. The exploitation of additional fodder resources (herbaceous and shrubby woodland) in addition to pasture and hay makes it possible to increase growth by reducing the animal farm residence. Furthermore, the diversification of fodder reduces the dependence on cereals with consequent economic and environmental benefits. The presence of trees reduces heat stress, makes it possible to maintain stable ingestion and growth levels even during the summer period, thus improves animal welfare.
Lessons learned (1200 characters max.)	It's important to be careful with livestock load so as not to overload the system, but overall, silvopastoralism offers multiple benefits. The life cycle analysis showed that enteric methane emissions are partially mitigated by the carbon sequestration of the forests of the farmland.
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Links to website/report/video (if applicable)	https://gonewton.it
Pictures (if applicable)	

ITHub 5 - 27

Title of innovation	**Evaluation of the impact of different grazing intensities of Maremma cattle on the components of the agroecosystem: soil, tree vegetation (structure, natural regeneration and biodiversity)**
ITHub	5
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	NEWTON
Operational Group (name)	Agroforestry Network in Tuscany
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farms, research groups, communication company, national forest certification systems (PEFC)
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/network-lagroselvicoltura-toscana
Country, region, city	Tuscany, Italy
Type of innovation	Process
Keywords	Agricultural production system, Farming practice Climate and climate change, Agroforestry, sustainability
Approach and main results (4000 characters max.)	Silvopastoralism is a widespread practice in Italy; it is often seen in the literature as a negative factor for regeneration, but the extent to which it is sustainable or not depends on the management objective and the grazing livestock load. In the course of the NEWTON project, four wooded areas were examined, specifically turkey oak stands of over 80 years of age with different livestock loads (expressed in UBA): calf grazing (2.02 UBA); high intensity cow grazing (0.50 UBA); low intensity cow grazing (0.32 UBA); ungrazed. For the analysis of the vegetation, the analysed varibles were the structure of the tree and shrub component, the quantity and quality of natural regeneration and the woody growth of the tree stand. However, in the main stand there were differences which may also be due to silvicultural interventions and high animal loads from past management. Grazing affects the understorey and the regeneration by reducing its development as the intensity of grazing increases, the biodiversity of tree and shrub species is higher in the non-grazed area. Although very often grazing in the forest is a disturbance to its regeneration, it has a positive effect on the regeneration of herbaceous species and integrates many nutrient resources for animal feeding. If the load is appropriate to the area and characteristics, the soil does not become compacted and the manure has a positive effect on soil fertility and seed germinability. In the four areas, soil quality was also characterised by applying certain

	chemical, physical and biological indicators. The values of biological quality, bulk density and soil permeability (Ksat) show that grazing and its intensity impact on the physical and biological quality of the soil with a trend related to animal load and grazing intensity. In general, 0.30 LU was found to be a compatible livestock load for the development of tree vegetation and soil conservation, but to be evaluated according to the forest management objective and the vegetative stage of the tree stand.
Lessons learned (1200 characters max.)	The management objective in silvopastoral systems is key in defining the appropriate livestock load. The coexistence of sustainable forest management and grazing in the forest is possible, but with a careful integrated planning that takes equal account of both agro-pastoral and silvicultural needs, especially in the final phase of forest regeneration.
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Links to website/report/video (if applicable)	https://gonewton.it
Pictures (if applicable)	

ITHub 5 - 28

Title of innovation	**Chestnut varieties recommended for cultivation in Extremadura (Southwest Spain)**
ITHub	5
FOREST4EU partner (short name)	USC
Operational Group (short name)	CASTANEA
Operational Group (name)	Operational group for the valorization of the Extremadura chestnut tree
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	3 farmer associations, 1 company, 1 research center and 1 University
Link from OGs database	http://gocastanea.eu/
Country, region, city	Spain, Extremadura
Type of innovation	Technological innovation
Keywords	Agroforestry, adaptation to climate change, production of plants
Approach and main results (4000 characters max.)	The selection of plant material (varieties/rootstock) is a fundamental aspect for the development of agroforestry systems established on chestnut groves and must respond to multiple factors such as climate change, reconversion of the traditional chestnut groves due to the high mortality of trees, the modernization of chestnut cultivation through the implementation of new techniques and cultivation systems, as well as specialization productive towards fresh chestnut trade. Therefore, two lines of work must be developed. On the one hand, the use of rootstocks resistant to chestnut ink and thermal and water stress, and on the other hand, looking for chestnut varieties with a good aptitude for fresh marketing, staggered production and adapted to the climatic conditions of the producing area. One of the objectives of the CASTANEA operational group was to create a network of experimental plots, both new and existing, in which to carry out the characterization of plant material (traditional varieties and rootstocks) at different altitudes and areas of Extremadura (Southwest Spain). In total 4 experimental plots were established where ink-resistant hybrid rootstocks grafted with a series of selected chestnut varieties were planted to evaluate the adaptation of the rootstocks and varieties and their agronomic behaviour. These plots were planted in an intensive 5x5 m frame, with two types of rootstocks (clon 111-1 and clon 7521) and were grafted with 8 selected chestnut varieties (Verata, Pablo, Bouche de Betizac, Manolo, Judía, Calvotera, Famosa y Martainha) in 4-foot blocks per variety and rootstock, with a total of 64 plants. In the short term, the rooting of the plant, the percentage of budding with different types of grafts and the development of the grafts will be evaluated. However, in the medium and long term, these

	plots will be references and the production of the different varieties will be studied to be able to recommend them to chestnut growers, in terms of plant material based on accumulated and comparative knowledge. Moreover, this network of plots can be the beginning of future research and development of novel cultivation techniques for chestnut growing.
Lessons learned (1200 characters max.)	Leaasons learned in the four experimental plots established: 1. Conclusions without taking into account the pattern: i) Bouche de Betizac is the one that reached the greatest length and Martainha the smallest, ii) Judia obtained the greatest thickness and Martainha the smallest, iii) Bouche de Betizac presented the highest percentage of yields, iv) The spike graft obtained greater length and greater thickness than the awake bud graft 2. Conclusions on the 111-1 pattern: i) Bouche de Betizac is the one that reached the greatest length and Martainha the shortest, ii) Famosa was the one that reached the greatest thickness and Martainha the shortest, iii) The spike graft presented the highest percentage of attachment, iv) 111-1 had a survival rate greater than 7521, v) 111-1 had a thickness greater than 7521, vi) 111-1 had a similar percentage of attachments to 7521 3. Conclusions about pattern 7521: i) Bouche de Betizac is the one that reached the greatest length and Famosa the shortest, ii) Judia was the one that reached the greatest thickness and Famosa the shortest, iii) The spike graft presented the highest percentage of attachment , iv) 7521 had a length greater than 111-1.
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Links to website/report/video (if applicable)	http://gocastanea.eu/
Pictures (if applicable)	  

ITHub 5 - 29

Title of innovation	**Comparing pastoral and silvopastoral management on a local beef cattle breed: productivity, animal welfare and pasture depletion in a Mediterranean extensive farm**
ITHub	5
FOREST4EU partner (short name)	UNIFI
Operational Group (short name)	NEWTON
Operational Group (name)	Agroforestry Network in Tuscany
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farms, research groups, communication company, national forest certification systems (PEFC)
Link from OGs database	https://www.innovarurale.it/it/pei-agri/gruppi-operativi/bancadati-go-pei/network-lagroselvicoltura-toscana
Country, region, city	Tuscany, Italy
Type of innovation	Process
Keywords	Agroforestry, Sustainability, Resilience, Drought, Climate change, Participatory research, Livestock, Animal welfare, Silvopasture
Approach and main results (4000 characters max.)	The demonstrative trial conducted at Tenuta di Paganico increased knowledge of silvopastoral systems in the Mediterranean area in order to improve the management of silvopastoral farms. The demonstration trial made it possible to confirm the positive role that trees play in improving microclimatic conditions and reducing heat stress in animals. In fact, cortisol levels measured in the hair, an index of chronic stress, remained lower in animals managed in the silvopastoral system, compared to subjects kept exclusively on pasture. The group of calves managed in the silvopastoral system did, however, experience a, albeit limited, reduction in the growth rates typical of the summer months. The group of calves managed in the silvopastoral system did, however, experience areduction, although limited, in the growth rates typical of the summer months. These values therefore indicated that, during the spring period, it would be necessary to drastically limit the animals' use of the forest, both to exploit the thermoregulating power of the trees while limiting the possibility of animal movement, and to maximise the nutritional value of the fodder resources present in the pasture. This could make it possible to increase cattle growth, with positive repercussions both in economic terms and in terms of environmental impact in meat production. Lastly, the limited presence of animals in the forest during the spring period could favour the growth and development of forage and shrub resources among the

	trees, which can then be exploited during the summer months, a period characterised by increasing drought.
Lessons learned (1200 characters max.)	Silvopastoral systems, being made up of different elements (forage, shrub, forest and animal components), require careful management in order to keep the system in balance, capable of perpetuating itself over time, maintaining all those ecosystem services that such a system is capable of providing. In order to enhance these management systems, the NEWTON Operations Group has suggested a number of strategies aimed at optimising production levels, maintaining high levels of animal welfare and the sustainability of the system itself, including: - monitoring and assessing the composition of the diet and its quality in the different seasons, for the various physiological phases of the animals and according to their management (silvopastoral or pastoral), - rational use of grazing during the summer period by limiting access to the forest, - use of the forest in the summer period to reduce heat stress and maintain stable growth rates.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

	

ITHub 5 - 30

Title of innovation	**Development of a platform through sensors for pasture management in the dehesa**
ITHub	5
FOREST4EU partner (short name)	USC
Operational Group (short name)	GRASSEN
Operational Group (name)	Platform to support the management of Mediterranean pastures using nearby and remote sensors
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	2 companies, 2 Research centers, 1 University, 1 Farmer association
Link from OGs database	https://cicap.es/project/go-grassen/
Country, region, city	Spain, Andalusia
Type of innovation	Technological innovation
Keywords	Agroforestry, digital tools, digital platform, proximal sensing data, Remote Sensing data, satellite, smart-application
Approach and main results (4000 characters max.)	The dehesa is the most representative agroforestry system in Europe, occupying more than 940 622 ha in Andalusia (Southern Spain). In this region, livestock is the main activity of the dehesa where pasture and acorns are the basis of livestock feeding. However, it is important to be aware that in the dehesa, the management of herbaceous pastures is not a simple task mainly due to the diversity of the soils, the presence of trees, the differentiated agricultural uses and the particularities of the Mediterranean climate. For this reason, in the dehesa it is necessary to develop pasture management tools that allow land managers to know the production and quality of the pasture in order to plan grazing, the provision of complementary feed, the pasture fertilisation or the enrichment of the seed bank. In this contex, currently, the diversity of existing and operational sensors mounted on nearby and/or remote platforms have the capacity to offer a high volume of data about the territory at low cost and with a spatial and temporal resolution appropriate to the needs of the dehesa. The aim of the operational group GRASSEN is to develop a platform to support the management of pastures in the dehesa, through the integration of information from different types of nearby and remote sensors, combined with field information. To achieve this objective, the following actions are being carried out: i) Analysis of experiences in the application of sensorisation and remote detection to pasture management in different biogeographic regions, ii) Compilation of geo-referenced data on production, structure and quality of Mediterranean pastures and forage crops in the dehesa, together with information from remote (Sentinel 1 and 2) and nearby spatial

	sensors (multispectral, hyperspectral sensors and Lidar data), iii) Development of mathematical models using different algorithms and machine learning techniques that allow estimating pasture production, structure and quality based on information from nearby and remote sensors, iv) Validation of the developed models in a pilot farm, taking into account the barriers that limit the application of this technology in the dehesa farms, v) Development of a prototype web platform with alphanumeric and cartographic information derived from the production, structure and quality models of the pastures and their temporal evolution, vi) Development of a mobile application to consult the information included in the web platform, vii) Demonstration of how to use the information included in the web platform to make decisions in pasture management.
Lessons learned (1200 characters max.)	With the development of this operational group, a series of relevant results for the agroforestry sector have currently been obtained: i) List of most common pasture varieties in Andalusia, ii) Report on the main types of pastures cultivated in Andalusia, iii) Protocols of image analysis for pasture in vegetative growth through SENTINEL-2, iv) Protocols of image analysis for pasture in vegetative growth through unmanned flights and multispectral cameras, v) Action protocol to develop mathematical models that allow estimating pasture production, its structure and quality through information from nearby and remote sensors, vi) Development of mathematical models to estimate pasture production, structure and quality through information from nearby and remote sensors
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Links to website/report/video (if applicable)	https://cicap.es/project/go-grassen/
Pictures (if applicable)	

ITHub 5 - 31

Title of innovation	**Are short rotation coppice a solution in future regional biorafineries?**
ITHub	5
FOREST4EU partner (short name)	CNPF
Operational Group (short name)	OG TCR
Operational Group (name)	OG TCR : Are short rotation coppice a solution in future regional biorafineries ?
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farmers, forest owners, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/evaluation-de-methodes-alternatives-de-desherbage.html
Country, region, city	France, Occitanie
Type of innovation	Technological innovation
Keywords	Farming/Forestry competitiveness and diversification, agroforestry, wood energy
Approach and main results (4000 characters max.)	From 2008 to 2010, as part of the CULIEXA project, short rotation coppices (TCR) with different species and at different densities were installed on four experimental plots in the Occitanie region: in Alenya (eucalyptus, black locust and willow), in Alzone (eucalyptus and black locust), in Narbonne (eucalyptus, black locust, willow, poplar and polownia) and in Ferrals (eucalyptus and black locust). Intended to be monitored over the long term (9 to 10 years), these plots aimed in particular to assess the possibilities for developing these crops at the local level. EVALUATE THE ECONOMIC POTENTIAL OF TCR UNDER MEDITERRANEAN CLIMATE The aim of the project was to compensate for the absence of an agronomic framework on the feasibility, yield and quality of short-rotation coppices in a Mediterranean climate as well as on abandoned land. The partners wanted to answer two main questions: under what conditions (density, soil, etc.) are short-rotation coppices productive enough in Occitania? What is the economic profitability of TCR for a wood-energy outlet, but also in green chemistry? At the same time, greenhouse growers also wanted to study the feasibility of using greenhouse effluent to produce wood for the wood chips used to heat their greenhouses. The objectives of the project were to:

	• Obtain knowledge on the productivity of certain rotations in short coppices which could be interesting in French Mediterranean conditions. • Develop fact sheets on species: agronomy, yield, quality, economy. • Create a network of tests covering the Occitanie region with varied climatic and soil conditions. • Produce agronomic and economic references on the production potential of these species in the Mediterranean context. • Study the feasibility of producing wafers in an ultra-short circuit for greenhouse growers. Visits to TCR harvesting sites took place in November 2016 on the experimental sites. Videos and photos concretely illustrating the harvesting of whole trees with shears as well as the grinding on the plot of whole trees for the manufacture of forest chips were produced. Species sheets have been produced for black locust (Acacia) and eucalyptus. These sheets contain botanical and historical elements of the species treated. They also present the agronomic and economic interests, the usable plant material as well as elements of cultivation management, harvesting and economic assessment. Plot sheets present simplified test results on the project's various experimental sites: Alenya, Bram-Bonanza, Ferrals and Narbonne.
Lessons learned (1200 characters max.)	The main lesson of the study is that in a Mediterranean environment and on shallow limestone soil, it is not profitable to produce energy wood with the species considered for densities greater than 2,500 stems/ha. Even with irrigation, production yields are very low and do not bring significant economic added value for the farmer. Eucalyptus is the only candidate species identified as suitable for a TCR development program aimed at biomass production, but its implementation is limited by the increased fire risk inherent to it. The results of the study are unequivocal: they can be considered as a reliable decision-making tool. The test network is original: Mediterranean and with - on certain plots - densities never tested before. These data must be adapted to the new inflationary context, in particular the increase in the price of wood energy. It would also be interesting to continue research and trials to reduce the costs of producing plants, planting and harvesting.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	

ITHub 5 - 32

Title of innovation	**A feasible step-by-step plan with practical guidelines and concrete designs to enable the application of agroforestry on farms**
ITHub	5
FOREST4EU partner (short name)	EFI
Operational Group (short name)	Experiment Agroforestry Noord-Holland
Operational Group (name)	Proeftuin Agroforestry Noord-Holland (Experiment Agroforestry Noord-Holland)
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	Farmers, researchers, advisors
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/proeftuin-agroforestry-noord-holland.html
Country, region, city	the Netherlands, Noord-Holland, Groot-Amsterdam
Type of innovation	Service
Keywords	Agricultural production system, Biodiversity and nature management, Supply chain, marketing and consumption, Farming / forestry competitiveness and diversification, agroforestry, carbon footprint
Approach and main results (4000 characters max.)	In this Operational Group, an step-by-step plan was developed to promote agroforestry integration on farms. Agroforestry offers a resilient and sustainable agricultural system, reducing production risks, enhancing ecological value, and increasing biodiversity. Agroforestry optimizes nutrient and water use, soil organic matter building, reduces fertilizer and pesticide usage, and maximizes land utilization. The project assesses prerequisites for agroforestry and involves: 1) Inventory of existing agroforestry opportunities, combining scientific and practical knowledge. 2) Developing a practical step-by-step plan with guidelines for implementing agroforestry. 3) Applying the plan to three test cases, which will serve as examples for other entrepreneurs. Agroforestry has a long tradition in farming in the Netherlands, where trees provided essential products like fruits, nuts, wood, and energy. Trees also offer ecosystem services like wind protection, cooling, and supply of nutrients. However, many such elements disappeared due to land consolidation and changes in agricultural practices. Today, agroforestry systems are being (re)developed in the Netherlands with diverse business models, including recreation, education, and cooperative ventures. The emphasis is now on providing ecosystem services.

	In Noord Holland, small-scale agroforestry systems have been developed near characteristic farms. The landscape's open areas, particularly arable land and meadows with organic soil offer opportunities for agroforestry. These systems contribute to wind erosion reduction and local biodiversity. Choosing the right agroforestry system depends on factors like farm type, size, landscape, and the entrepreneur's interests and skills. Customization is essential, as one system may not fit all farms. The design process involves several steps: - Assess the current state of the farm and determine what should be retained or improved. - Define goals and ambitions, considering biodiversity, risk management, and product diversification. - Analyze the local environment, considering soil type, groundwater levels, historical land use, nature goals, and land use regulations. - Design the agroforestry system, considering species selection, planting distances, and interactions between trees and crops. - Develop a revenue model by defining the target audience, customers, strategic partners, and sources of financing. Agroforestry designs must account for competition for resources, including water, nutrients, and light, and consider interactions between different species. Shade, windbreaks, and light competition should be addressed in the design. The agroforestry design plan emphasizes that the revenue model is crucial when choosing tree and shrub species that yield regular harvests, and maintenance is essential also for non-harvested trees in the agroforestry system. As a follow up project of this operational group, in collaboration with Nature and Environment Federation South Holland and Utrecht, Louis Bolk Institute and Fruitz for Life, knowledge needs in the field of agroforestry are further expanded. In the follow-up project, practical experience will be gained through the construction of 'test plots' and make this knowledge available to a large group of farmers through the development of Do-It-Yourself test packages with associated fact sheets. More information: https://www.mnh.nl/project/proefpercelen-agroforestry/
Lessons learned (1200 characters max.)	Due to the occurrence of open landscapes, there would be many opportunities for agroforestry in the Netherlands. Some important lessons learned include: 1) Understanding the historical role of trees in farming landscapes is essential. Recognizing that trees have traditionally provided essential products and ecosystem services for farming families can help rekindle interest in agroforestry. 2) The project demonstrates the potential for diversified business models in agroforestry. Combining agriculture with recreation, education, and cooperative ventures can generate additional income and create a more resilient farming system. 3) The need for customization and creativity in agroforestry design is a significant lesson. One size does not fit all, and the project encourages farmers to adapt agroforestry systems to their specific circumstances, considering factors such as farm type, size, landscape, and personal interests and skills. 4)

	Agroforestry design is an iterative process. It evolves as more knowledge is gained, and this allows for ongoing improvements in agroforestry systems.
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Links to website/report/video (if applicable)	Website: https://www.mnh.nl/project/voedselbossen-en-agroforestry/ Brochure: https://www.mnh.nl/wp-content/uploads/sites/15/2019/01/LBI-brochure-Agroforestry.pdf Video: https://youtu.be/hvVJmQFeCYY?si=VVkYJsj3zam2s_ur and https://youtu.be/vJmTlzP7uZM?si=jJ-MYhXDNQCFhA00
Pictures (if applicable)	  

ITHub 5 - 33

Title of innovation	**New management practices in rainfed olive groves**
ITHub	5
FOREST4EU partner (short name)	ANSUB
Operational Group (short name)	GO Olival
Operational Group (name)	New practices in rainfed olive groves: strategies for mitigation and adaptation to climate change
Type of OG's partners (farmers, forest owners, researchers, advisors, businesses, environmental groups, consumer interests groups or other NGOs)	1 Association, 5 Landowners, 3 Industrial companies, 2 Universities
Link from OGs database	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/novas-pr%C3%A1ticas-em-olivais-de-sequeiro-estrat%C3%A9gias.html
Country, region, city	Portugal
Type of innovation	Process
Keywords	Agricultural production system; Climate and climate change; Farming practices; Soil management/functionality; Water management
Approach and main results (4000 characters max.)	In great part of Southern Europe, where olive trees are grown it is expected the rise of temperatures, less precipitation with bigger periodicity, that can be characterized by less rainy days however with more precipitation, and the increase of extreme natural events, such as droughts. To combat the effects of the climate change new management practices must be explored and applied. Seven objectives were proposed to be accomplished, they were: 1 - Comparing the effect of different herbaceous soil compositions versus the control of spontaneous plant growth; 2 – Assessing the effects of different biologic residues applied as compost/fertilizer; 3 - Evaluating the use of Bio-stimulants for the plants, this meaning the use of fungi and bacteria in a symbiotic relation with the plant; 4 – Assessing the genetic varieties of olive trees in Portugal, and categorise them by their adaption the climatic conditions; 5 – Evaluating the effect of using different chemical substances in the induction of drought resistance mechanisms. The data collected in the experiments allowed the creation of scientific articles, technical articles, university thesis and outreach sessions. In the end all the information is going to be resumed in a “Manual of good practices”, this document is not yet created because some of the trials are still running.

	To measure the efficiency of the different studied management practices, in all the experiments different parameters were measured related to the tree physiology, growth, the properties of the soil and the quality of the produced fruit and oil. From the results available to this day, we can take some conclusions. In relation to soil cover management practices, taking in mind the climate change and the normal site conditions (Mediterranean climate, soils with low quality and depth), they should allow the development of herbaceous vegetation in the Winter (increasing the organic matter present in the soil and decreasing the risk of erosion) and limit the expansion of the vegetation from the beginning of the Spring, in this way controlling the competition for water. From the different management practices studied, two of them comply with the objective explained above. The use of leguminous plants soil cover with a short cycle allows the protection of the soil from erosion, the increase in organic matter, the increase in nitrogen deposition, and at the same time since it as a short cycle the competition for water does not occur in the driest period. The use of herbicide after the spontaneous vegetation sprouts, in the beginning of the Spring, also add the best results since it fulfils the objectives of soil protection and reduced water competition. The most common soil management practice, low depth tillage, didn't fulfil the criteria since it cuts the roots of the trees reducing their capacity to absorb water, and at long term it decreases the quality of the soil, since it becomes more susceptible to erosion. In relation to the use of mycorrhizae fungi, it was verified the increase in plant growth and resilience to dry condition. This was achieved because this symbiotic relationship allows an increase in nutrient mobilisation inside the soil and bigger water capturing area (since the mycelium net works as a "second root system" for the plant). Other benefits are the decrease of the impact from toxicity of heavy metals and the increase tolerance of plants to the soil salinity. The use of nitrogen fixation microorganisms had good results, allowing an increase of available nitrogen present in the soil. The use of abscisic acid (ABA) as a foliar pre-treatment had good results in increasing drought tolerance and recovery capacity. Under water deficit conditions, ABA is responsible to control stomatal closure, hydraulic conductivity, and root development. When applied to the leaves of the plant, it attenuated the drought induced decline in biomass production, induced root growth and enhanced water use efficiency.
Lessons learned (1200 characters max.)	In Portugal one of the productions that is going to be most affected by the climate change is the olive production, since most, around 90%, of the area of this trees species are grown in rainfed systems. The shift in climate conditions is expected to impact the physiology of the trees, reducing their production, increasing the variability of annual production, and increasing the severity of the damages caused by pests and diseases. Finding an alternative solution such as irrigation is not a feasible solution since the availability and quality of water is going to decrease in the coming years. The solution is to use management practices compatible with the climate, that increase the performance of the production systems, maintain/increase the soil qualities, and keep the trees in good vigour, decreasing their susceptibility to pest and diseases.
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Links to website/report/video (if applicable)	
Pictures (if applicable)	