



LIFE Project Number
LIFE15 CCA/ES/000060

Final Report
Covering the project activities from 01/10/2016¹ to 30/06/2022

Reporting Date²
30/09/2022

LIFE PROJECT NAME or Acronym
LIFE MixForChange

Data Project

Project location:	Catalonia (Spain)
Project start date:	01/10/2016
Project end date:	30/09/2021 Extension date: 30/06/2022
Total budget:	1,302,051 €
EU contribution:	781,229 €
(%) of eligible costs:	60.00%

Data Beneficiary

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¹ Project start date

² Include the reporting date as foreseen in part C2 of Annex II of the Grant Agreement

This table comprises an essential part of the report and should be filled in before submission

Please note that the evaluation of your report may only commence if the package complies with all the elements in this receivability check. The evaluation will be stopped if any obligatory elements are missing.

Package completeness and correctness check	
Obligatory elements	✓ or N/A
Technical report	
The correct latest template for the type of project (e.g. traditional) has been followed and all sections have been filled in, in English <i>In electronic version only</i>	✓
Index of deliverables with short description annexed, in English <i>In electronic version only</i>	✓
Final report: Deliverables not already submitted with the MTR annexed including the Layman's report and after-LIFE plan Deliverables in language(s) other than English include a summary in English <i>In electronic version only</i>	✓
Financial report	
The reporting period in the financial report (consolidated financial statement and financial statement of each Individual Beneficiary) is the same as in the technical report with the exception of any terminated beneficiary for which the end period should be the date of the termination.	✓
Consolidated Financial Statement with all 5 forms duly filled in and signed and dated <i>Electronically Q-signed or if paper submission signed and dated originals* and in electronic version (pdfs of signed sheets + full Excel file)</i>	✓
Financial Statement(s) of the Coordinating Beneficiary, of each Associated Beneficiary and of each affiliate (if involved), with all forms duly filled in (signed and dated). The Financial Statement(s) of Beneficiaries with affiliate(s) include the total cost of each affiliate in 1 line per cost category. <i>In electronic version (pdfs of signed sheets + full Excel files) + in the case of the Final report the overall summary forms of each beneficiary electronically Q-signed or if paper submission, signed and dated originals*</i>	✓
Amounts, names and other data (e.g. bank account) are correct and consistent with the Grant Agreement / across the different forms (e.g. figures from the individual statements are the same as those reported in the consolidated statement)	✓
Mid-term report (for all projects except IPs): the threshold for the second pre-financing payment has been reached	N/A
Beneficiary's certificate for Durable Goods included (if required, i.e. beneficiaries claiming 100% cost for durable goods) <i>Electronically Q-signed or if paper submission signed and dated originals* and in electronic version (pdfs of signed sheets)</i>	N/A
Certificate on financial statements (if required, i.e. for beneficiaries with EU contribution ≥750,000 € in the budget) <i>Electronically Q-signed or if paper submission signed original and in electronic version (pdf)</i>	N/A
Other checks	
Additional information / clarifications and supporting documents requested in previous letters from the Agency (unless already submitted or not yet due) <i>In electronic version only</i>	N/A
This table, page 2 of the Mid-term / Final report, is completed - each tick box is filled in <i>In electronic version only</i>	✓

**signature by a legal or statutory representative of the beneficiary / affiliate concerned*

Instructions:

Please refer to the General Conditions annexed to your grant agreement for the contractual requirements concerning a Mid-term/Final Report.

Both Mid-term and Final Technical Reports shall report on progress from the project start-date. The Final Report must be submitted to the Agency no later than 3 months after the project end date.

Please follow the reporting instructions concerning your technical report, deliverables and financial report that are described in the document [Guidance on how to report on your LIFE 2014-2020 project](#), available on the LIFE website. Please check if you have the latest version of the guidance as it is regularly updated. Additional guidance concerning deliverables, including the layman's report and after-LIFE plan, are given at the end of this reporting template.

Regarding the length of your report, try to adhere to the suggested number of pages while providing all the required information as described in the guidance per section within this template.

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2. List of key-words and abbreviations

APFSBE	Forest Owners Association of Serra de Bellmunt-Collsacabra
APMC	Forest Owners Association of Montnegre i Corredor
CPF	Forest Ownership Centre
CTFC	Forest Science and Technology Centre of Catalonia
EAC	Experts Advisory Committee
EMT	External Monitoring Team
EShMmf	European Sub-humid Mediterranean mixed forests
EUBIA	European Biomass Industry Association
GA	Grant Agreement

3. Executive Summary (maximum 2 pages)

The main aim of LIFE MixForChange Project is to contribute to the adaptation to climate change of European Sub-humid Mediterranean mixed forests (EShMmf) by increasing their resilience, ensuring their conservation and enhancing their productive, environmental and social functions. This Final Report presents the outcomes of the whole project, which started in 01/10/2016.

The project has been successfully accomplished, and, in general terms, has followed the work plan foreseen in the Grant Agreement (considering the Amendment Request for project extension), despite some deviations and delays that did not compromise the general project development. All **53** deliverables and **68** milestones have been accomplished, both at the Mid-term report (23 and 32, respectively) and in this Final Report. The expenditure certified has reached 1,357,915.26 € representing more than the 100% of the total budget.

The main outputs and deliverables of the project are the following:

a) **Development and implementation in 164 ha of demonstrative stands of an innovative silvicultural approach** based on climate change adaptation criteria and close-to-nature management principles, suited for Mediterranean sub-humid forests. These models are developed for each of the four forest formations of the project area and then fine-tuned at stand level. The main deliverables are the description of the silvicultural models from actions [C1 – holm oak](#); [C2 – chestnut](#); [C3 – oak](#); [C4 – pine forests](#).

b) **Replication** of the innovative silvicultural models in additional 56 ha in 10 private and public estates. Main deliverable: [Report: replication of MixForChange silviculture \(2022, in Spanish\)](#)

c) Development of a **methodology for describing and assessing the effect of silvicultural interventions based on multiple criteria** in the demonstrative and replication stands. The main deliverables are the description of the methodology of [Action D2 – ecological assessment](#); [D3 – silvicultural assessment](#) and [D4 – socio-economic assessment](#) and the results obtained in these assessments: [ecological assessment \(D2\)](#); [silvicultural assessment \(D3\)](#); [product-derived economic impact \(D4\)](#) and [impact on ecosystem services \(D4\)](#).

d) **Transferring** the lessons learnt in the application and assessment of the innovative silvicultural models, and related topics (valuable trees identification, logistics, etc) to technical recipients: practitioners, forest owners and students. The aim was to enhance the application of this silviculture and its potential and limitations: we conducted several transfer activities along the project, including [1 handbook on adaptive and close-to-nature management](#), [1 protocol for easing the identification of valuable trees](#), [1 pilot system of logistics and marketing of forest products](#), 2 specialization courses, 6 transfer days, 10 technical papers and 8 communications in technical conferences and seminars. The handbook and the protocol were produced in English, Spanish and Catalan.

e) **Support policy making and advocate on the need to integrate 3 essential concepts: sustainable forest management, climate change adaptation and local policies.** The aim was to stress the relevance on these issues among policy makers and technical staff from local administrations: municipalities, province councils, metropolitan councils and other supra-municipal entities. The main deliverables have been a [handbook on integrating local policies, climate change, peri-urban forest management](#), a [Memorandum of regulatory aspects to be modified](#), a description of a [Real case of integration of these aspects in Mataró municipality \(Barcelona\)](#), a [Report on the aspects to modify in the Catalan forest management guidelines ORGEST](#) and a [Cartography of climate change vulnerability in the working area](#). Both the handbook and the cartography has been produced in in English, Spanish and Catalan.

f) **Networking:** we have actively interacted with 29 projects related to MixForChange topics, and have participated in 18 networking events at regional, national and international level, with a total of 127 contacts from 9 countries. Moreover, we have conducted two technical exchange trips to [central Italy \(2019\)](#) and [southeast France \(2021\)](#).

g) **General dissemination to society:** we have conducted several activities aimed at raising awareness among society in general (non-specialist audiences). The main tools have been 34 appearances in mass media (25 press, 6 radio, 5 TV), 9 appearances in specialized media, the project [web page](#) (7,173 unique users), 10 editions of the [bi-annual Newsletter](#), the [Layman report](#) (produced in English, Spanish and Catalan) and 12 informative panels installed in highly frequented areas near the demonstrative stands.

The main difficulties faced have been related to two main factors:

- **Delay in the application of silvicultural interventions** (actions C1-C4): it was planned to apply all the silvicultural interventions between Autumn 2017 and spring 2018. However, it was not possible to maintain this deadline in all demonstrative stands, because of a cascade delay in action A3 (the technical discussion between partners to reach common management principles for all demonstrative stands took longer than expected), D2-D3 (the definition of the monitoring protocols was also delayed because of technical discussions) and to inherent factors affecting Actions C1-C4: the heavy rainfall during year 2018 (40-100% higher than the historical average) made it necessary to wait until the forest roads were dry to prevent soil compaction; moreover, because of regulatory restrictions linked to fire prevention it is not possible to implement silvicultural treatments near summertime. The consequence of this delay is that the final inventory (autumn 2020) was done 2 growing seasons after the silvicultural interventions, instead of 3 as initially foreseen, in 63% of D2 plots and 82% of D3.

- **Impact of COVID-19 outbreak**: the 1.5 months lockdown in Spain (mid March – late April 2020) and the subsequent mobility restrictions affected significantly the project development. Among other consequences, the autumn field work campaign of all beneficiaries was overloaded with postponed tasks from MixForChange and other projects, making it impossible to fulfil all the D2 and D3 inventories by late summer, as initially expected, but only in January 2021. This 4-months delay had a cascade effect on various actions based on these inventories, i.e. the C6.3 handbook on adaptive silviculture, training and transfer events (E4), technical articles and conferences (E7). Another action affected was D1, as the third meeting of the Experts Advisory Committee meeting, scheduled for 12/03/20, had to be cancelled the day before, which affected the deliverables to be discussed at the meeting: C6.2, C7.2 and C6.4. The contingency measure was the request of a 9-months project extension and a re-scheduling of all the deliverables due for 2021. The project was finally ended on June 30th, 2022.

4. Introduction (maximum 2 pages)

4.1. Background, problems and objectives (as foreseen in the proposal)

4.1.1. Climate related problem/issue addressed

The main aim of the Project is to contribute to the adaptation to climate change of European Sub-humid Mediterranean mixed forests (EShMmf) by increasing their resilience, ensuring their conservation and enhancing their productive, environmental and social functions. EShMmf are ecosystems of high singularity and relevance at European level. Their area of occurrence is characterised by mild temperatures and a high precipitation rate. These forests occur in coastal or pre-coastal mountain areas from NE Spain to SE Balkans and include a wide range of forest types including (EEA, 2006): "Termophilous deciduous forest", "Broadleaved evergreen forest", some "Mesophytic deciduous forest" and transitions to "Coniferous forests of the Mediterranean region". Most of these stands include a wide diversity of species, some of which are relicts or at their limit of their distribution area (rear- edge species), showing a high biogeographic value (Costa et al, 1997). According to IPCC (2022), the temperatures have already raised 1.5°C since pre-industrial values, and it is expected an increase in the frequency and intensity of droughts, storms, heat waves and other extreme episodes as well as a slight-to-moderate reduction in precipitation. The main impacts of these disturbances include loss of vigour, increase of sensitivity to pests and diseases and of mortality (Carnicer et al, 2011) and an increase in the intensity of forest fires (Pausas and Fernández-Muñoz, 2012). In the case of EShMmf this situation is aggravated by their: i) intrinsic vulnerability (low tolerance to water deprivation); ii) a high rate of abandoned (unmanaged) forests that are overdense and with a simplified structure; iii) low economic sustainability of the current management, based on low added-value products (fuelwood); iv) occurrence of these stands close to densely populated areas, which depend on the ecosystem services they provide; v) poor perception of the vulnerability of these stands to climate change, which hampers appropriate action by policy makers and managers.

4.1.2. Solution to be demonstrated / verified by the project

The tool selected to revert the vulnerability of these stands to climate change is an **innovative silviculture** based on adaptation and close-to-nature criteria and has been applied in 164 ha of demonstrative stands.

4.1.3. Description of the technical / methodological solution

The main principles of the demonstrative silviculture are:

- i) Reduce the competence and water stress, increasing stand stability and vitality.
- ii) Increase complexity in terms of species composition and structural heterogeneity.
- iii) Enhance biodiversity conservation values.
- iv) Increase forests' productive value to ensure long-term economic sustainability of this silviculture.

These principles are defined in more details for each of the four forest types of the project (mixed forests dominated by holm oak, chestnut, oak or pine) and then at stand level. Finally, the specific treatments applied are defined at micro-site level, considering the role of each tree in the stand and paying attention to potentialities and restrictions at micro-site level. These interventions are the basis for developing new tools for promoting climate change adaptation of EShMmf in the policy and legal framework related to forest management, as well as to strengthen the forest management economics. The outcomes are transferred to the main regional, national and European stakeholders (forest owners and managers, public administration, companies and decision-makers) in order to improve the long-term management and conservation of these habitats, and to raise social awareness about the relevance of the problems addressed within the project and about the need for maintaining a sustainable economic activity that guarantees the conservation of these forests.

4.1.4. Expected results and climate action related benefits

The main expected results were:

- Implementation of 164 ha of pilot demonstrative forest stands, distributed across 4 areas representative of the bioclimatic gradient and the diversity of Sub-humid Mediterranean forests and the problems that they face related with climate change.
- The implemented innovative models reduce the stand competence, increasing its vitality and water use efficiency. Improvement of the indicators related with these parameters after the interventions.
- The implemented innovative models increase forest complexity. Improvement of the indicators of forest structural diversity after the interventions.
- The implemented innovative models increase forest biodiversity. Improvement of the indicators of biodiversity after the interventions.
- Added value products from Sub-humid Mediterranean forests catalogued and disseminated to sectors with potential demand and opinion leaders.
- Design of a pilot system for the logistics and commercialization of products from these stands, accepted and validated by the local forest owners.
- Improvement of the forest legal framework in order to integrate the management particularities of Sub-humid Mediterranean forests to climate change adaptation.
- Transferability achieved. Target stakeholders reached adequately. At least 215 specialized participants in the dissemination and training activities. Innovative models included in the Guidelines for Sustainable Forest Management in Catalonia (ORGEST) system.
- Impact in decision-making: at least 5 municipalities participating actively in the development of Project actions
- At least 10 municipalities attending the communication and dissemination actions.

These factors will increase the stand resilience and resistance to climate change, having and aggregated impact at regional and European level based on the dissemination activities.

4.2. Expected longer term results (as anticipated at the start of the project)

The Project addresses the following EU policy priorities:

- Cross-sectoral approach: the multiple components of the problems addressed are tackled with a holistic approach: forests, economy, society and policy-regulatory framework.
- Green infrastructure, green employment and climate-smart management in urban and peri-urban areas planning: most of the demonstrative stands are located besides urban areas, being subject to specific restrictions and regulations and planning instruments that consequently affect forest management. At the same time, some of the forest-related climate change disturbances are particularly relevant, as the case of forest fires, whose propagation in these conditions would threaten human lives, houses and infrastructures. The silvicultural method proposed pretends to ensure the maintenance of the provision of the fundamental ecosystem services that these forests provide, by increasing their functionality and resilience.
- Conservation of biodiversity, particularly in EU Habitats 9180, 9340, 9240, 9260 and 9330.
- Sustainable water use and soil protection, by ensuring the hydrological forest functions and increasing water use efficiency and long-term carbon sequestration in the soil and on long-life forest products.
- Bridging the gap between knowledge on ecology and forest dynamics and the socio-economic and operational practices, to improve the forest-related bioeconomy.
- Active social involvement, including a wide range of stakeholders.

The replicability and transferability aspects are capital within the project, being addressed in specific actions: C6 (Tools to integrate climate change in policy and regulations), C7 (Replicability and transferability), and D Communication and dissemination actions.

The market strategy and economic feasibility are addressed by actions C5 (Strengthening bioeconomy), D4 (socioeconomic assessment) and D6 Life Cycle Analysis.

5. Administrative part (maximum 1 page)

The project management follows the following structure, as foreseen in the Grant Agreement:

- a) Project Director: Dr Míriam Piqué (CTFC)
- b) Administrative management team: led by Ms Àngels Jovells and Ms Dúnia Riu (CTFC) and with one participant from each project beneficiary
- c) Coordination Committee: besides the project director, this committee is composed of Dr Jaime Coello (CTFC) as technical project manager, Dr Teresa Cervera (CPF), Mr Martí Rosell and Ms Lúdia Guitart (APMC) and Mr Jordi Vigué (APFSBE).).

Finally, the Experts Advisory Committee (EAC), composed of a total of 34 members, acts as a consulting body for specific issues during project development (see Deliverable D1).

The main project decisions are taken by the Coordination Committee, which has met eight times (see Deliverable F2) to present and discuss the progress and plan for each action (including objectives, milestones, deliverables), administrative and financial issues (including certifications) and the analysis of deviations and contingency plans. All decisions were taken by consensus between all partners, with no remarkable problem encountered with regard to decision-making. The decisions at smaller scale, both from technical and administrative issues, are taken based on the regular contact between the partners by specific meetings. The only modification in the project coordination structure during the project development has been the change of the legal representative of CTFC (Dr. Antoni Trasobares) in December 2016.

The relation with Ms. Sara Barceló (External Monitoring Team, EMT) has been fruitful, with regular contact and a total of 4 meetings with the project consortium, including 3 visits to the project demonstrative stands. The relation with the Agency, and in particular with the project Officer Ms Hana Mandelikova has also been effective, including a meeting with all project beneficiaries and EMT and a field visit on May 2022.

Regarding other interactions during project lifespan, we have built a strong partnership with Barcelona province council, particularly in the actions related to the replication of the demonstrative silviculture (action C7, with 33 ha replicated) and to the integration of local policies and adaptive forest management: C6.4 (co-authoring the handbook), E5 final seminar, E4 technical transfer days, E7 articles and conferences, etc. This entity is a major regional actor in sustainable forest management application and on municipalities coordination.

The Grant Agreement had to be reformulated in July 2021 to request the abovementioned project extension, with the corresponding updates required in Actions' duration and deadlines for deliverables and milestones, as well as on the final reporting date. We also agreed with the EMT and the Agency upon some further changes from the project proposal that were deemed necessary during project implementation, being the most remarkable ones:

- The demonstrative area of intervention is, as budgeted, 164 ha instead of the 177 ha
- We merged the technical trips foreseen in E3 (3 networking trips to 2 other European countries) and E9 (2 training sessions in other countries) for a more meaningful networking and training activities, and to increase the number of project partners participating in the trips.
- We merged the second and third specialization courses (1 day each) into a single course of a total of 4 days conducted in collaboration with LIFE Biorgest.
- We also merged the final seminar (E4.3) and the Conference on periurban forests management (E5) in a single event, to take benefit from a single meeting in Barcelona.

6. Technical part (maximum 25 pages)

6.1. Technical progress, per Action

Action A1. Meeting with forest owners, preparation and signature of intervention agreements

Foreseen start date: 10/16

Actual start date: 10/16

Foreseen end date: 11/16

Actual end date: 03/17

In this action we prepared and achieved the signature of the agreements with the forest owners in whose estates the demonstrative silvicultural interventions (C1-C4) took place. During the last trimester of 2016 CPF, APMC and APFSBE met with various forest owners to have a written agreement on the use of their forests to host the implementation of the innovative management models in the agreed area. The owners committed themselves to:

- Ease the administrative procedures providing the documentation required.
- Not perform any intervention in the 10 years following the project's interventions that could put into risk the demonstrative value of the stands.
- Allow the staff of the project partners to access the stands during the project duration.

In total, 19 agreements were signed, accounting for 163.86 ha, representative of the Mediterranean sub-humid conditions. Most of these owners had already provided commitment letters during the preparation of the project proposal.

We encountered no problem during the development of this action, although the collection of the last signatures took longer than expected. In any case, this delay did not affect the progress of the subsequent Action A2.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	Agreements signed	11/16	03/17
<i>Milestones</i>	100% agreements signed	11/16	03/17

Action A2: Initial diagnose of the stands to intervene: inventory and mapping

Foreseen start date: 10/16

Actual start date: 10/16

Foreseen end date: 09/17

Actual end date: 11/17

This action consisted in conducting the initial diagnosis of the demonstrative project stands secured in Action A1, as a previous step to plan the silvicultural interventions (Action A3). The development of the action was as follows:

- Visit of representative stands to have a first approach to their current features and agree on the data to collect. With this purpose we organized various on-field technical meetings with all beneficiaries in spring 2017.
- Design of the data gathering protocol, and first tests on the field. We followed an iterative approach to improve this protocol until achieving a final version, provided in the Annex T2 of the First Progress Report.
- Implementation of the diagnosis during summer and autumn 2017.

In brief, this diagnose is applied at stand level and includes both office and field work, in order to collect all relevant information related to the physical, ecological and legal features affecting the silvicultural interventions planning. In parallel to this assessment, it was calculated the value of the Potential Biodiversity Index of each stand, which is one of the indicators considered during project evaluation (Action D5). Annex T3 of the First Reporting Period showed the deliverable “Ecologic, dasometric and cartographic report on each stand”, summarizing the outcomes of this diagnosis and integrating the two deliverables foreseen, while Annex T1 of the Mid-Term report provided the GIS database showing the location and perimeter of each demonstrative stand.

There was a small delay in ending up this action, which affected the subsequent one (A3), that had to start with 1 month of delay.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
Deliverables	<i>Ecologic and dasometric report of each stand</i>	<i>09/17</i>	<i>10/17</i>
	<i>GIS-based database</i>	<i>09/17</i>	<i>11/17</i>
Milestones	<i>Diagnoses accomplished in all the stands, reports prepared and GIS database available</i>	<i>09/17</i>	<i>11/17</i>

Action A3: Silvicultural interventions planning: preparation of terms of reference and permits issuance

Foreseen start date: 04/17
Foreseen end date: 12/17

Actual start date: 09/17
Actual end date: 06/18

This action started in autumn 2017 instead of spring 2017, as it was decided to start it only when all the information gathered in Action A2 was available before analysing it. Based on that, we planned the innovative forest management models at stand level, considering all forest types together, as it was agreed to make a coherent planning in all sites at the same time. A draft version of these plans was presented and discussed to the EAC (Action D1) on 1st December 2017, to have their feedback. Based on it, CTFC prepared during the first trimester 2018 the proposal of intervention in each stand, which were subsequently discussed and agreed by the partners. Once validated, CPF issued the permits of intervention, supported by APFSBE and APMC, which were progressively available between winter, spring and summer 2018.

The delay in achieving the final agreement for all sites, which ended up being of six months, had a negative effect on the implementation actions C1-C4, besides other unexpected situations described in those actions.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>Terms of reference with the technical and administrative description of the demonstrative interventions to implement in each stand</i>	<i>12/17</i>	<i>05/18</i>
	<i>Issuing the permits for the implementation of the foreseen interventions</i>	<i>12/17</i>	<i>06/18</i>
<i>Milestones</i>	<i>All terms of reference and permits achieved on time</i>	<i>12/17</i>	<i>06/18</i>

Action C1: Management models for the adaptation of *Quercus ilex* sbsp. *ilex* forests

Foreseen start date: 06/17
Foreseen end date: 12/18

Actual start date: 02/18
Actual end date: 01/19

In this action we implemented the innovative silvicultural treatments on holm oak stands. CPF and APMC conducted this work, supported by CTFC. As mentioned previously, this action was delayed because of various reasons:

- the time needed to achieve Action A3 took longer than expected
- the impossibility to conduct silvicultural treatments during summer time, because of legal restrictions linked to forest fire prevention
- the extremely high rainfall during 2018 in general (40-100% higher than the historical average) and in autumn in particular, which was the wettest in the last 20 years in the areas of work. These heavy rains impeded the access to the stands in order to prevent damaging the soil and the roads, and led to an accumulation of pending work for the forest companies conducting the works.

In spite of these problems, most of the interventions (88% C1 area) could be implemented in spring 2018 while the rest could be completed in the next vegetative dormancy (autumn 2018 and winter 2018/19), as shown in Annex T2 of the mid-term report. This delay in 12% of the area had a negative effect in project actions D2 and D3, as, in those cases, we could only assess the evolution of the stands 2 growing seasons after the interventions, instead of 3, as initially expected.

Upon the end of the intervention in each stand, the beneficiary responsible certified the quality of the work and the area treated. The area of the control plots (not intervened) of Action D2, besides a buffer zone around them, was not intervened. Annex T3 of the mid-term report described the innovative management models applied in C1 Action.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>Document describing the innovative management models applied</i>	12/18	01/19
<i>Milestones</i>	<i>Implementation of the demonstrative models (30.74 ha)</i>	06/18	01/19

Action C2: Management models for the adaptation of *Castanea sativa* forests

Foreseen start date: 06/17

Actual start date: 02/18

Foreseen end date: 12/18

Actual end date: 01/19

In this action we implemented the innovative silvicultural treatments on chestnut stands. CPF and APMC conducted this work, supported by CTFC. The problems faced and their consequences were similar to what was described in C1.

Only a small part of the interventions (10% area) could be accomplished in spring 2018 while the rest was completed only between autumn 2018 and winter 2018/19, as shown in Annex T2 of the mid-term report. Annex T4 of the mid-term report described the innovative management models applied in C2 Action.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>Document describing the innovative management models applied</i>	<i>12/18</i>	<i>01/19</i>
<i>Milestones</i>	<i>Implementation of the demonstrative models (27.56 ha)</i>	<i>06/18</i>	<i>01/19</i>

Action C3: Management models for the adaptation of *Quercus pubescens*, *Q. petraea* and *Q. canariensis* forests

Foreseen start date: 06/17
Foreseen end date: 12/18

Actual start date: 02/18
Actual end date: 01/19

In this action we implemented the innovative silvicultural treatments on oak stands. CPF, APMC and APFSBE conducted this work, supported by CTFC. The problems faced and their consequences were similar to what was described in C1.

As in C2, only a small part of the interventions (18% area) could be accomplished in spring 2018 while the rest was completed only between autumn 2018 and winter 2018/19, as shown in Annex T2 of the mid-term report. Annex T5 of the mid-term report described the innovative management models applied in C3 Action.

		Foreseen deadline	Real deadline
Deliverables	<i>Document describing the innovative management models applied</i>	12/18	01/19
Milestones	<i>Implementation of the demonstrative models (58.87 ha)</i>	06/18	01/19

Action C4: Management models for the adaptation of *Pinus* forests

Foreseen start date: 06/17
Foreseen end date: 12/18

Actual start date: 02/18
Actual end date: 01/19

In this action we implemented the innovative silvicultural treatments on pine stands. CPF, APMC and APFSBE conducted this work, supported by CTFC. The problems faced and their consequences were similar to what was described in C1.

As in C2 and C3, only a small part of the interventions (12% area) could be accomplished in spring 2018 while the rest was completed only between autumn 2018 and winter 2018/19, as shown in Annex T2 of the mid-term report. Annex T6 of the mid-term report described the innovative management models applied in C4 Action.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>Document describing the innovative management models applied</i>	<i>12/18</i>	<i>01/19</i>
<i>Milestones</i>	<i>Implementation of the demonstrative models (46.69 ha)</i>	<i>06/18</i>	<i>01/19</i>

Action C5: Strengthening the bioeconomy associated to the products of the Mixed Mediterranean subhumid forests

Foreseen start date: 01/18
Foreseen end date: 06/21

Actual start date: 01/18
Actual end date: 04/22

This action is composed of three sub-actions:

C5.1. Developing a protocol to identify and classify standing timber quality: we created a tool to ease decision-making during silvicultural assessment: a fast (5-10 seconds) evaluation of the potential of a stand to produce high quality timber, and operations such as stand marking and choice of future crop trees. This protocol is led by CPF and CTFC. The species chosen, agreed by all partners, are maple, oak, cherry, chestnut and ash. The protocol consists of two modules: 1. Evaluation of the potential quality of small and intermediate trees (up to 27.5/32.5 cm diameter) to be promoted as future crop trees (possible categories: Yes / No); 2. Timber quality of intermediate and large trees (over 27.5/32.5 cm diameter); possible categories: A, B, C, less than C (following official ISO rules of roundwood and sawnwood classification). Moreover, we included some annexes with further factors to consider when assessing certain species, how to identify them and proposals of field charts for the assessment of timber quality at stand level.

The preparation of the content followed the following plan:

- 1.0 version presented at the EAC meeting in December 2018 whose main topic was timber quality assessment
- 2.0 version produced in spring 2019 and circulated among experts in silviculture and timber industry, for receiving additional comments on its content and use, including a protocol with a questionnaire for easing the assessment of the field usability of this tool. We also made a practical exercise during the first exchange trip in Italy on the use of this protocol, receiving various comments from the local experts.
- 3.0 version produced in spring 2020, edited in [Spanish](#), [English](#) and [Catalan](#) and disseminated online. This deliverable is provided in Annex T1. This implied a 3-months delay that did not affect any other action.

We did not deem necessary to make a further adjustment of this protocol based on cutting the assessed stems in sawmills, as considered initially in the proposal, because we could incorporate several experts from the timber industry on the preparation of the protocol and considered that it was consolidated enough.

We expect that this tool will ease the adoption of single-tree silviculture criteria in forests with potential for valuable timber production.

C5.2. Promotion of added value products from EShMmf: we have produced a visual catalogue compiling the main (present and potential) added-value products made of timber from species typical of EShMmf, as a dissemination tool to demonstrate the potential of these species and promote the interest of the general society toward this local, sustainable resource. The content of this catalogues is as follows: an introduction to valuable broadleaves, how the timber of these species can be obtained with sustainable forest management, what are the main destinations of this timber in Catalonia and, finally, interviews with managers of companies transforming or using this timber in Catalonia. The preparation of the content followed the following plan:

- During 2019 CTFC made several contacts through e-mail with various companies and experts dealing with these species, and in particular with the Wood and Furniture Guild of Catalonia (GFIM) and the Catalan Timber Institute (INCAFUST) to involve them in the preparation of this catalogue, including the selection of companies to interview (11 in total), supported by APMC and Barcelona Province Council. Moreover, some of the companies contacted to participate in the 2nd EAC meeting in December 2018 were part of the interviewed entities.
- In early 2020 CTFC prepared a draft version of the catalogue, agreed with the collaborators and we worked with an external graphic design company for achieving a high-quality visual edition.

· In late spring 2020 the catalogue was produced in [Spanish](#), [English](#) and [Catalan](#), and disseminated online. This deliverable is provided in Annex T2. This implied a 1.5 year delay that did not affect any other action or put in risk the quality of dissemination, and in fact allowed incorporating further collaborators in the publication.

Another minor deviation was that it was foreseen to produce 2 deliverables in this action (*Informe definitivo de catalogación de los diferentes productos de alto valor añadido fabricados con madera de bosques mixtos mediterráneos subhúmedos*) (12/2018) and “*Catálogo visual editado de los productos de alto valor añadido fabricados con madera de bosques mixtos mediterráneos subhúmedos*” (C5.2; 12/2018) which were, in fact, the same deliverable.

We expect that this document will raise awareness on the potentialities of this sub-sector and the demand of timber products made with local wood.

Moreover, in this sub-action we contacted with experts and companies working with this type of timber in other Mediterranean countries. As a result, we produced a [database of companies using this timber in the Mediterranean](#), organized by species, type of products and region.

C5.3. Pilot system of logistics and marketing of forest products: this sub-action was developed in 2021-22, coordinated by APMC, and involved the concept, planning and design of a GIS-based system for optimising logistics of timber products, with a pilot version at Montnegre-Corredor massif scale. This system includes the design of the logistics system, network of roads, logistic platforms and industries to transform the timber. Another part of the system is the legal and administrative issues related to timber logistics, which includes the main legal and regulatory restrictions, contract models, issuance of permits, etc, to ease the agreements between the various stakeholders involved: forest owners, forest companies, timber industries, etc. Finally, there is a short guide on how to adapt this methodology in further sites. We paid special attention to the inclusion of the particularities of MixForChange silviculture within this system, both from the point of view of the resource (potential areas where valuable timber might be produced) and of logistics (extraction and transport of valuable timber).

This ended up in a 150-pages [publication](#) (Annex T3), delivered in spring 2022. This implied a 9-months delay, caused by unexpected problems with GIS programming and on the definition of the legal-administrative issues linked to the change of position of Mr. Martí Rosell (former manager of the Association until 2021 and co-author of the publication). We had therefore less time for disseminating this tool, so we made an additional effort to increase its visibility, including its inclusion into the “[publications](#)” web section, and a [communication](#) at the 8th Spanish Forest Congress (June 2022).

We expect that this system will ease decision-making for APMC day-to-day activities and for other users:

- companies of forest works operating in Montnegre-Corredor area: information on forest resources, network of forest roads, industries consuming forest products, criteria for forest products transportation.
- private and public land managers: forest owners, practitioners, Barcelona Province Council: information on forest resources, better understanding of forest products’ logistics and needs to increase efficiency.
- present and potential entities utilizing local timber (municipal biomass boilers / district heating, industries of timber processing): forest resources, better understanding of forest products’ logistics.

Moreover, this system can be adapted, with adjustments in the GIS data and steering coefficients, to new massifs where a similar tool would be required.

		Foreseen deadline	Real deadline
Deliverables	<i>Protocol of identification and visual classification of standing timber quality</i>	12/19	03/20
	<i>Edited catalogue of added-value products made with timber from mixed subhumid</i>	12/18	06/20

	<i>Mediterranean forests</i>		
	<i>Pilot system of logistics and marketing of forest products</i>	<i>06/21</i>	<i>03/22</i>
Milestones	<i>Protocol of identification and visual classification of standing timber quality</i>	<i>12/19</i>	<i>03/20</i>
	<i>Catalogue of added-value products made with timber from mixed subhumid Mediterranean forests</i>	<i>12/18</i>	<i>06/20</i>
	<i>Pilot system of logistics and marketing of forest products</i>	<i>06/21</i>	<i>03/22</i>

Action C6: Tools to integrate climate change adaptation to forest policy and regulations

Foreseen start date: 01/18

Actual start date: 01/18

Foreseen end date: 12/21

Actual end date: 06/22

This action aimed at developing tools for decision-making for policy makers with regard to the adaptation to climate change of EShMmf. It consists of four sub-actions:

C6.1. Assessing vulnerability to climate change: we mapped the vulnerability of EShMmf in Catalonia regarding the two main threats related to climate change in these conditions: water deficit and large forest fires. This mapping was done by CTFC during 2018, resulting in the following outcomes:

46% of the area of EShMmf in Catalonia is in a situation of high or very high vulnerability to water deficit

47% of the area of EShMmf in Catalonia is under intermediate or high vulnerability to large forest fires.

Annex T8 of the Mid-term report described the methodology and outcomes of the vulnerability assessment, which are also [available online](#). We faced no problems or delays in the development of this action. We transferred this cartography in the policy making related events and publications, including the C6.4 handbook, the D1 EAC third meeting that dealt with policy issues (March 2021) and the final seminar (June 2022).

This tool allows land managers to prioritize forest management interventions aiming to:

- reduce water deficit and/or to apply silviculture with eco-hidrological criteria to increase blue water availability

- reduce fire vulnerability, particularly in strategic areas for forest fire prevention, i.e. areas whose treatment would reduce significantly the area burnt in the case of forest fire.

C6.2. Memorandum of regulations to facilitate climate change adaptation of Mediterranean subhumid mixed forests: in this sub-action we have identified 19 potential measures to be included in 7 key regulation and planning instruments. Measures deal with the removal of legal constraints for the manufacturing of local high quality softwood, the need for high-quality tree selection in mixed forest thinnings, changes in the methodologies used in forest inventory, or the promotion of mixed forests in planning instruments for the Mediterranean subhumid domain and in climate change adaptation strategies. This sub-action was coordinated by CPF.

In the original GA it was expected that the deadline for the Deliverable “Memorandum of regulations to facilitate climate change adaptation of Mediterranean subhumid mixed forests” would be 12/18, but it was agreed by the partners, and accepted by the external monitoring team, that it was more convenient to submit this deliverable by 12/19. However, it was deemed more interesting to present a pre-definitive version of this document at the 3rd EAC meeting, related to forest policy. This meeting was foreseen in March 2020 but had to be postponed to March 2021 (please refer to Action D1 description), and the document was ready right after that meeting. This delay allowed the incorporation of the conclusions of the abovementioned meeting, and still allowed for more than 1 year for dissemination, mainly by incorporating some of its conclusions at the C6.4 handbook and in the policy paper “[A step forward in EU forest policy: the Mediterranean perspective](#)”, produced in 2022 in collaboration with EUBIA and 7 further LIFE projects (see Action E3). The final version, which was updated following the proposals from the Agency in September 2022 is provided in Annex T4.

We expect that the *Memorandum* will make it easier for regional policy makers to have a clearer idea of the forest regulations framework in a single document, and especially to consider the needs and limitations to solve.

C6.3. Guidelines of recommendations and technical measures for the adaptation to climate change in Mediterranean subhumid forests management:

This sub-action aimed at producing a technical handbook on the planning and implementation of climate change adaptive silviculture, in order to promote its adoption among practitioners. This document, coordinated by CTFC, summarises the outcomes of actions A1-A3, C1-C6 and D1-D4, and its preparation was supported by collaborators from within and outside the project beneficiaries. The structure is organised in four blocks: an introduction describing Mediterranean forests, climate change and adaptive silviculture; a description of the silviculture developed in MixForChange including practical lessons for its implementation; the main effects of this silviculture from ecological, dasometric and economic perspectives, and a final block providing tools and challenges for the adoption of this silviculture in Mediterranean conditions. This handbook, provided in Annex T5, is one of the most important project outcomes, and has been edited, translated to English (with professional translation), Catalan and Spanish, printed in Catalan and Spanish and disseminated in Action E8.

It was foreseen to have this document ready by 12/21, while it could be only finished in 05/22, as the process of data analyses, gathering contributions and reflections from the different collaborators took longer than expected. Despite being available in paper format only in June 2022, we distributed it in the final seminar and during the 8th Spanish Forest Congress (June 2022) and by post mail afterwards. Moreover, a massive distribution of the electronic version (e-mailing to the project's distribution list + social networks) is being done during summer 2022.

We expect that this guide will be a reference handbook at national level for forest managers, practitioners and university students, to promote the adoption of this type of silviculture.

C6.4. Guidelines to integrate, in local policies, climate change adaptation in peri-urban mixed Mediterranean subhumid forests:

This guide seeks to build bridges between local policies, the management and conservation of forest services and values, and in particular peri-urban areas, and the challenge of adapting to and mitigating the impacts of climate change. These three aspects are strongly interrelated, and therefore it is essential to explore how to progress towards integrating them. The publication is structured in two blocks: the first one presents the main features and values of peri-urban forests (green infrastructure, environmental services...), the regulations related to them, the threats due to climate change and the importance of multifunctional and sustainable forest management with adaptation criteria to face these threats. The second block provides examples of measures and actions that can be used as local policy proposals for promoting peri-urban forests that are more resistant and resilient to the impacts of climate change: we identified 45 specific measures organised in 9 categories, that can be implemented from local administrations, and present 5 cases of local policy measures to promote adaptive forest management.

Finally, we produced four annexes-summaries aimed at specific audiences: government and council technical staff, policy makers, the media, and high school students. The publication is aimed at technical staff of local councils, people in charge of developing local policies and society in general, especially those living in municipalities with peri-urban forest. It was coordinated by CTFC, with the participation of all other beneficiaries and 20 contributors from entities outside the project consortium, especially, members of the EAC participating in the third EAC meeting (March 2021), which included representatives of 3 municipalities (Sant Celoni, Tordera and Mataró). The content has also incorporated some of the content of the Memorandum of regulations (Action C6.2) and of the policy measures developed in Mataró municipality (Action C7.2). This handbook, provided in Annex T6, is one of the most important project outcomes, and has been edited, translated and printed (in Spanish, Catalan and English – with professional translation) and disseminated in Action E8, besides its four annexes-summaries.

The content (text and pictures) was available in May 2021, in line with the plan established in the project extension request.

We expect that this guide will be a reference handbook for forest planners and technical and political staff from local and regional administrations, in order to achieve better coordination in policies and regulations affecting forest areas.

		Foreseen deadline	Real deadline
Deliverables	<i>GIS database, vulnerability mapping and report describing the methodology and the main outcomes</i>	<i>12/18</i>	<i>12/18</i>
	<i>Memorandum of regulations to modify to facilitate CC adaptation of Mediterranean subhumid mixed forests</i>	<i>12/19</i>	<i>03/21</i>
	<i>Guidelines of recommendations and technical measures for the adaptation to climate change in Mediterranean subhumid forests management</i>	<i>05/21</i>	<i>05/21</i>
	<i>Guidelines to integrate, in local policies, CC adaptation in peri-urban mixed Mediterranean subhumid forests</i>	<i>12/21</i>	<i>05/22</i>
Milestones	<i>Vulnerability cartography available</i>	<i>12/18</i>	<i>12/18</i>
	<i>Memorandum and 2 guidelines available</i>	<i>12/21</i>	<i>05/22</i>

Action C7. Promotion of replicability and transferability of innovative management models

Foreseen start date: 10/19
Foreseen end date: 03/22

Actual start date: 10/18
Actual end date: 03/22

In this action we aimed to multiply the territorial impact of the project, by replicating the innovative silviculture in further forests (besides the demonstrative forests C1-C4) and by supporting and advising on the implementation of changes in local policies and activities in a municipality.

C7.1. Replication of innovative silviculture at commercial scale: we provided technical support to the operational-scale replication of the innovative silvicultural models developed during MixForChange project. Additional to the 164 ha of demonstrative stands of Actions C1-C4, we induced the replication of a total of 54.8 ha in 10 private and public estates following MixForChange principles, with the support from the project partners, especially, APMC and CTFC. Out of this area, 33.3 ha corresponded to replication stands implemented by Barcelona Province Council, a major actor of the forest sector in Catalonia, with a relevant capacity for adopting and implementing these principles in the natural parks managed by this entity. The support provided included guidance on stand assessment, treatment design, training on tree marking and support to logistics. Moreover, in the case of Barcelona Province Council, we capacitated the staff to replicate the D2-D3 monitoring as well, so that the results obtained could be part of the general MixForChange outcomes. This action has allowed the applied knowledge transfer to various stakeholders including forest works companies, forest owners and practitioners from both public and private entities. We provide the description of the replication stands, including their location and pictures, in the deliverable shown in Annex T7. The initial plan was to replicate these treatments in 40 ha, so we achieved replication in almost 40% additional area. This action did not suffer from any delay.

We expect that this action will lead to further areas of replication of this silviculture beyond the project, based on the experience achieved and the owner-to-owner dissemination.

C7.2. Real case of adaptation of local policies to integrate climate change adaptation in peri-urban EShMmf: in this sub-action we supported (coordinated by APMC) the adoption of policy and regulatory changes to help adapting to climate change the peri-urban EShMmf within Mataró municipality, a coastal city close to Barcelona. We present in the deliverable (Annex T8) a review of the current local policies related to awareness, dissemination, forest management and land planning, as well as the current planning instruments, as well as a compilation of general and specific actions to be considered for integration into the municipal policies for facilitating climate change adaptation. The document was developed based on meetings with representatives of different sections (both technical and political staff) of the city council and with the participation of *Escola de Natura del Corredor*. This document was produced in March 2021, three months after it was expected, linked to the delay in the third EAC meeting (March 2021, related to local policies and adaptive forest management), where a representative of Mataró municipality participated. To reach further municipalities, the outcomes of this action were included in the C6.4 handbook and were also presented in the final seminar (E4.3+E5), where a representative of Mataró municipality participated in the round table. Finally, Annex T9 shows an update from January 2022 of the plan for adopting the measures foreseen in the deliverable. We found no relevant problems during the implementation of this action, besides the delay caused by the impact of Covid-19 mentioned above.

We expect that this action will reinforce the visibility and empowerment of the technical unit within Mataró municipality behind these policies, and the position of this municipality as a reference of good practices in local policies, which should allow their replication in further municipalities.

		Foreseen deadline	Real deadline
Deliverables	<i>Final report on commercial scale replication (C7.1)</i>	<i>03/22</i>	<i>03/22</i>
	<i>Report on the adaptation of the political-regulatory context for the pilot municipality</i>	<i>12/20</i>	<i>03/21</i>
Milestones	<i>Commercial replication implemented (C7.1)</i>	<i>03/22</i>	<i>03/22</i>
	<i>Report on the adaptation of the political-regulatory context for the pilot municipality</i>	<i>12/20</i>	<i>03/21</i>

Action D1. Experts Advisory Committee to support project actions

Foreseen start date: 10/16

Actual start date: 10/16

Foreseen end date: 04/22

Actual end date: 05/22

This action, coordinated by CTFC and supported by all other partners, aimed at establishing an External Advisory Committee (EAC) to support project implementation, providing their expertise in the various project topics. During the first coordination meeting it was agreed to conduct thematic EAC workshops-meetings to address specific issues that were particularly relevant to the status of project implementation at each time.

The topics of the workshop-meetings were the following:

1. Silviculture of mixed forests (December 2017): to support A3, C1-C4, D2-D3
2. Timber quality assessment and market prospective (December 2018): to support C5 and C6.3.
3. Synergies between peri-urban forest management, land planning and climate change adaptation (March 2021): to support C6.2, C6.4, C7.2
4. General project overview and how to promote the replicability of adaptive & close-to-nature silviculture (March 2022): to support C5, C6.3, C7, D2, D3, D4, E.

A total of 34 people were members of the EAC, 8 of which participated in more than one meeting. We aimed at various complementary profiles, including representatives from private companies and the public administration, researchers and forest owners.

We initially planned to conduct 5 meetings of the EAC, but we agreed with the EMT to have only 4 meetings, as the 3rd meeting had to be postponed for almost 1 year (it was planned for March 2020 and had to be postponed the day before the meeting due to mobility restrictions). There were no further mishaps in the development of this action.

Annex T10 shows the minutes and participants in each EAC meeting.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
Deliverables	<i>Minutes of the meetings of the Experts Advisory Committee</i>	<i>04/22</i>	<i>05/22</i>
Milestones	<i>Experts Advisory Committee established</i>	<i>06/17</i>	<i>12/17</i>

Action D2. Ecological assessment of the forest interventions

Foreseen start date: 04/17

Actual start date: 04/17

Foreseen end date: 09/21

Actual end date: 10/21

In this action we evaluated the effects of the silvicultural interventions of Actions C1-C4 on the forest ecosystem: flora richness and equitativity, tree growth (indicator of vitality and stability), tree competence (Hegyí index), evolution of forest strata (arboreal, juvenile trees, regeneration, undergrowth) to estimate the forest structural vulnerability to large forest fires (Action D4); dead wood and soil moisture. We also characterised soil texture and depth, to ease the modelling with Medfate package in Action D4. We also gathered the information to assess the Forest Biodiversity Index, evaluated in Action D4. This action, together with D3 and D4, sustained the main activities related to communication and knowledge creation and transfer (Actions C5, C6, E) and was therefore capital in the project.

During spring and summer 2017 we worked on the protocol, synthesizing updated literature and approaches to determine and assess the most relevant indicators. CTFC led this process, and the final protocol for data gathering was presented, discussed and agreed with the other beneficiaries. In autumn 2017 we started the inventories (initial stand status), with a joint work of CTFC and all the other beneficiaries. We installed and inventoried, in winter 2017/18 and spring 2018 a total of 22 plots (11 intervened areas, 11 non-intervened), all of them sized 1,000 m², in stands representative of all the forest types and geographical areas of the project except for *Pinus* stands at Ripollès area (C4), where the silvicultural intervention foreseen will not lead to significant changes in forest structure. As the inventory work started, we made some amendments to the protocol to improve it in an iterative process, including contributions from the EAC (1st meeting, December 2017). Annex T12 of the Mid-term report provided the final version of the protocol, including the distribution of inventory plots and the variables measured. After gathering hemispherical pictures in the pre-treatment and the post-treatment inventories, to estimate light availability, we decided not to conduct again this measurement at the final inventory, as the preliminary results of this variable were deemed unsatisfactory and could not be compared between different inventories. The rest of variables were gathered with no relevant problems, which were limited to the destruction of few soil moisture probes caused by wild boars.

As the demonstrative interventions (C1-C4) were applied, we conducted the post-intervention D2 inventories, at the 11 intervened plots. These inventories have therefore faced the same delay as the implementation of silvicultural treatments: we managed to conduct the post-intervention inventory of 4 plots during spring 2018, while in the remaining 7 plots the post-intervention inventory could be achieved between autumn 2018 and winter 2018/19. In September 2021 we conducted the final inventory, 2 or 3 growing periods after the interventions in the 22 plots, following the same methodology. The Annex T11 shows the report on D2 monitoring.

		Foreseen deadline	Real deadline
Deliverables	<i>Monitoring protocols D2</i>	<i>05/17</i>	<i>10/17</i>
	<i>Report on D2 monitoring</i>	<i>09/21</i>	<i>10/21</i>
Milestones	<i>D2 Inventory plots installed</i>	<i>08/17</i>	<i>11/17</i>
	<i>D2 inventory of forest stands pre-treatment completed</i>	<i>10/17</i>	<i>03/18</i>
	<i>D2 inventory of forest stands 3 years after treatment completed</i>	<i>09/21</i>	<i>09/21</i>

Action D3. Silvicultural assessment of the forest interventions

Foreseen start date: 04/17

Actual start date: 04/17

Foreseen end date: 09/21

Actual end date: 12/21

In this action we aimed at characterizing in detail the silvicultural interventions of Actions C1-C4 and evaluating the response of the forest structure and dynamics to these interventions. This action, together with D2 and D4, sustained the main activities related to communication and knowledge creation and transfer (Actions C5, C6, E) and was therefore capital in the project.

During spring and summer 2017 we prepared the monitoring protocol, based on updated literature and expert knowledge, in order to determine and assess the most relevant indicators. As in the case of D2, CTFC led this process, and the final protocol was presented, discussed and agreed with the other partners and the EAC 1st meeting (December 2017) for minor adjustments. In autumn 2017, and finishing in January 2018, we conducted the initial forest inventory (initial stand status), by APMC, APFSBE and CPF, supported by CTFC. We installed a total of 65 circular plots, with 10-17 m radius, in 28 stands representative of all the forest stand types and working areas of the project, where we measured all the adult trees and conducted a monitoring of juvenile trees, understorey and regeneration.

As the demonstrative interventions (C1-C4) were applied, we conducted the post-intervention D3 inventories few weeks after treatment. These inventories have therefore faced the same delay as the implementation of silvicultural treatments and D2 monitoring: we conducted the post-intervention inventory of 12 plots during spring 2018, while in the remaining 53 plots the post-intervention inventory has been achieved between autumn 2018 and winter 2018/19. In later summer and early autumn 2021 we conducted the final inventory, 2 or 3 growing seasons after the interventions, with the same methodology.

Annex T13 of mid-term report showed the final version of the protocol, while the current Annex T12 shows the report with the conclusions of D3 inventories, with the presentation of the objectives of the silviculture applied for each forest formation and a complete description of the evolution of the indicators along the project, for each forest formation: main dasometric variables (tree density, diameter, height, dominant height, growing stock, dead trees density, proportion of adult and juvenile trees), species composition, characterisation of future crop trees, and an annex with the results at inventory plot level.

We had no relevant mishap in the development of this action, additional to the delay mentioned above that affected the post-treatment inventories. The production of the 2 action deliverables had slight delays that did not compromise the development of the action or the elaboration of conclusions.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>Monitoring protocols D3</i>	<i>06/17</i>	<i>10/17</i>
	<i>Report on D3 monitoring</i>	<i>09/21</i>	<i>12/21</i>
<i>Milestones</i>	<i>D3 Inventory plots installed</i>	<i>10/17</i>	<i>11/17</i>
	<i>D3 inventory of forest stands pre-treatment completed</i>	<i>12/17</i>	<i>03/18</i>
	<i>Silvicultural characterisation of forest interventions (post-treatment inventory)</i>	<i>06/18</i>	<i>04/19</i>
	<i>D3 inventory of forest stands 3 years after treatment completed</i>	<i>09/21</i>	<i>10/21</i>

Action D4. Project socioeconomic assessment

Foreseen start date: 03/17
Foreseen end date: 10/21

Actual start date: 03/17
Actual end date: 06/22

In this action we aimed at evaluating the project socio-economic impact, through two modules:

Module 1: impact derived from forest products: the main aim was to analyse the technical, social and economic outcomes of the innovative silviculture, compared to a conventional one, i.e. the silviculture commonly applied in the area of work. We have based this study in 6 indicators: technical results of the silviculture, employment generated, direct beneficiaries of the silviculture implementation, costs, returns and economic balance, considered at a 1-ha basis. In these calculations we considered the destination industry for the different forest products obtained, as well as the transport costs. The methodology was agreed by all partners, led by APMC, to define how to gather the data for characterising the 6 indicators on the innovative silviculture. It was decided to use the data from D3 inventories (pre & post intervention), and to conduct a series of surveys (totalling 93) that were filled up by the forest workers and foremen implementing the innovative silviculture. The definition of the “conventional” silviculture was made based on expert knowledge and on the mentioned surveys, by asking on specific differences between conventional silviculture and the one applied in the project. These surveys were conducted during and after the application of the silviculture.

Module 2: impact on ecosystem services:

This module focused on comparing the impact of the innovative silviculture (based on D2 and D3 data) with the theoretical application of a conventional silviculture defined in Module 1, with respect to key ecosystem services related to climate change adaptation: fire vulnerability, biodiversity, water availability and water use efficiency (transpiration, relative blue water). We also considered carbon sequestration (related to tree growth) as a key ecosystem service related to climate change mitigation. This study was done for each of the four forest types, at a 1-ha scale. This module was led by CTFC. We decided to cancel the surveys on the impact of the different management alternatives on ecosystem services and landscape values, as it was foreseen to be done in summer and autumn 2020 among the visitors of the project areas, but the restrictions imposed by Covid-19 made it unfeasible to follow this methodology. We therefore decided to use standard, quantitative indicators based on published models and tools.

The deliverable foreseen (“Project socioeconomic assessment report”) was split into 2 deliverables: “Module 1: impact derived from forest products”, delivered in its final version in March 2022 (Annex T13), and “Module 2: impact on ecosystem services”, delivered in its final version in June 2022 (Annex T14). The delay in accomplishing the first deliverable (6 months) did not affect the dissemination of its conclusions, which were transferred progressively in 5 conferences and 5 technical articles produced between 2021 and 2022, besides the handbook C6.3, Layman report (E2) and After-LIFE plan (F4). However, the delay in the second deliverable affected the preparation of the Handbook C6.3, Layman report (E2) and after-LIFE plan (F4), whose content could be ended only upon completion of the conclusions of this Module, in May 2022.

This action also foresaw to monitor qualitative socioeconomic indicators that were included in the KPI table, but it was decided that it would be more efficient to report on them in Action D5. This action, together with D2 and D3, sustained the main activities related to communication and knowledge creation and transfer (Actions C5, C6, E) and was therefore capital in the project.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
Deliverables	<i>Project socioeconomic assessment report</i>	<i>10/21</i>	<i>06/22</i>
Milestones	<i>Project socioeconomic assessment report</i>	<i>10/21</i>	<i>06/22</i>

Action D5. Follow-up of project progress and LIFE Key indicators

Foreseen start date: 01/17
Foreseen end date: 04/22

Actual start date: 01/17
Actual end date: 06/22

This action was composed of two sub-actions:

D5.1 Project progress monitoring: we conducted a regular monitoring (every 2-3 months) of project progress based on the follow-up of the status of development of the deliverables and milestones, either by contacting the beneficiaries responsible for each action / sub-action, or by direct reporting during each coordination meeting, reporting period and/or during the regular update reports and visits by the EMT.

Despite the delays and changes described for each action and summarised in section 6.2, the consortium has successfully achieved all project deliverables and project objectives.

D5.2 Key Project Indicators monitoring: we have updated the status of the KPIs at three different moments: I Progress Report (01/18), Mid-term report (03/19) and at the final Report (08/22). We found no relevant difficulties when filling up the KPIs in the webgate portal, thanks to the support by EMT. Annex T15 shows the final KPIs export.

		Foreseen deadline	Real deadline
Deliverables	<i>Progress and LIFE key indicators table at the I Progress Report</i>	<i>10/17</i>	<i>01/18</i>
	<i>Progress and LIFE key indicators table at the Mid-term Report</i>	<i>03/19</i>	<i>03/19</i>
	<i>Progress and LIFE key indicators table at the II Progress Report</i>	<i>06/20</i>	<i>07/21</i>
	<i>Progress and LIFE key indicators table at the end of the project</i>	<i>06/22</i>	<i>08/22</i>
Milestones	<i>Progress and LIFE key indicators table at the I Progress Report submitted</i>	<i>10/17</i>	<i>01/18</i>
	<i>Progress and LIFE key indicators table at the Mid-term Report submitted</i>	<i>03/19</i>	<i>03/19</i>
	<i>Progress and LIFE key indicators table at the II Progress Report submitted</i>	<i>06/20</i>	<i>07/21</i>
	<i>Progress and LIFE key indicators table at the end of the project submitted</i>	<i>06/22</i>	<i>08/22</i>

Action D6. Life cycle analysis

Foreseen start date: 01/18
Foreseen end date: 12/21

Actual start date: 01/19
Actual end date: 04/22

We conducted a Life Cycle Analysis (LCA) on four forest management models: the innovative silviculture applied to oak and pine stands, respectively, and the conventional silviculture (defined in D4 and fine-tuned for the specific stand features used for the LCA) applied to the same 2 types of stands. This study was contracted as an external assistance to a specialist in LCA that had previously worked in other LCA assessments of silvicultural models in LIFE Climark project. The methodology was the one established in the rules ISO 14040:2006 and ISO 14044: 2006. The timespan chosen was 150 years, and considered the forest products obtained, the emissions associated with their extraction and service life, as well as the substitution of alternative raw materials.

APFSBE monitored the preparation of LCA, supported by CTFC to define the four forest management models, and by CPF and APMC for interpreting the results.

The LCA (Annex T16) was prepared in April 2022, with some minor editions conducted afterwards. This delay of 4 months did not affect any other project action, and it only reduced the time during which the final document could be disseminated, which was done together with the other final project products.

There has been a deviation with respect to the original proposal, where the idea was to assess the LCA of the project development. However, it was deemed much more interesting from the transfer point of view, and agreed with the EMT, that a study of different forest management models would lead to much more valuable results.

This action is one of the first applications of LCA methodology in silviculture models, and could be a starting point for defining silvicultural methods and treatments with a carbon emissions prospective all along the products value chain.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
Deliverables	<i>Project Life Cycle Analysis</i>	<i>12/21</i>	<i>04/22</i>
Milestones	<i>Project Life Cycle Analysis accomplished</i>	<i>12/21</i>	<i>04/22</i>

Action E1. Project logo, corporate image and communication plan design

Foreseen start date: 10/16

Actual start date: 10/16

Foreseen end date: 09/17

Actual end date: 09/17

This action pretended to achieve the maximum and most consistent visibility for the project. The draft project logo and corporate image were proposed by CTFC and discussed between the partners until agreeing the final appearance. Annex CD1 of the first reporting period showed the final result.

The Communication Plan set the steps to achieve the maximum impact in terms of dissemination and outreach of the project outcomes, aiming at a wide range of target publics. It was prepared by CTFC and amended and agreed by the consortium and provided at the Annex CD2 of the first reporting period.

There were no relevant mishaps during the development of this action. Moreover, the communication plan (which was developed through the communication actions E2-E9) was successfully accomplished.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>Project logo and corporate image kit</i>	<i>06/17</i>	<i>06/17</i>
	<i>Communication plan</i>	<i>06/17</i>	<i>06/17</i>
<i>Milestones</i>	<i>Project logo and corporate image kit completed</i>	<i>06/17</i>	<i>06/17</i>
	<i>Communication plan completed</i>	<i>06/17</i>	<i>06/17</i>

Action E2. General dissemination

Foreseen start date: 10/16

Actual start date: 10/16

Foreseen end date: 04/22

Actual end date: 06/22

In this action we produced general dissemination (addressed at non-specialist public) elements of the project, following the Communication Plan (E1):

E2.1. Small dissemination materials (coordinated by CPF, formats and quantities agreed with all partners):

- **Project brochure** in electronic and paper format in Catalan, Spanish and English (Annex CD3 of the first reporting period). This brochure is available at the webpage and was progressively distributed in paper format in the events where the project partners participated. We produced 1,500 units in Catalan, 500 in Spanish and 500 in English, which was the half of the initial expectation. We decided to reduce the number to ensure that all the units could be distributed, based on experiences with other projects.
- **Rollup poster** in electronic and physical (80x200 cm) format in Catalan, Spanish and English altogether, instead of having one rollup per language, as planned in the proposal. We produced 3 physical units, displayed in the project public events (Annex CD1 of mid-term report), as foreseen in the project proposal.
- **General dissemination materials:** design and production of 50 T-shirts, 200 packs of notebook + pen and 400 folders (see Annex CD2 of mid-term report). These materials were progressively distributed between the project partners and relevant networking contacts and participants in the project events. We decided to make some changes in the initial expectation (500 folders, 500 cotton bags, 200 USB drives, 100 T-shirts, 12 jackets, 12 trousers) as the prices were higher than expected.

These materials were expected to be available in June 2017, but they could not be achieved until spring 2018 because of the lack of high-quality pictures (the last ones were taken during the inventories A2, D2 and D3 in the second semester of 2017). In the case of the general dissemination materials, it took longer than expected to agree on the type and number of the general dissemination materials, as several alternatives were discussed with regard to the products, number of units, format and whether to produce them all simultaneously or progressively during project progress, being finally achieved in autumn 2018. This delay did not affect the dissemination and visibility of these products, as most of the project's public events where these products could be distributed were organised during the second year of the project, and all of them could be distributed by the end of the project.

E2.2. Panels, web page and Layman report (coordinated by CTFC, format, content and physical quantities produced agreed with all partners):

- **Information panels:** we produced 12 information panels in Spanish, English and Catalan altogether (Annex CD3 of mid-term report): 5 indoor units with a general project description (sized A-1 or A-0) installed in the beneficiaries' facilities (1 per partner) and in the Montnegre-Corredor Natural Park Office; 7 outdoor units introducing the project and the silvicultural treatment performed in a nearby forest (100x150 cm); panels installed in autumn 2018 in highly concurred areas near the forest stands intervened. This implied a delay of 11 months, because of the above-mentioned lack of high quality pictures to illustrate the panels and the time needed to arrange the logistics of transporting and mounting the panels (purchase of poles, fixing the panel to the poles, installation). This delay reduced in some months the time during which the panels were available to the public, although the 9-months project extension compensated this shortage. It is expected to keep project panels during at least 5 years after project completion. The initial expectation was to produce 4 outdoor panels and 8 indoor panels, but we decided that, in spite of the higher costs, it would have more impact to increase the number of outdoor panels.

- **Web page:** the web page (www.mixforchange.eu) was available in Spanish, Catalan and English since March 2017, as initially expected. The initial structure focused on introducing the project concept and the context of the work area, while the structure was adapted to outline the progressively available publications and technical reports, to provide more visibility to the project outcomes. It also includes a

window showing the project's twitter account activity. The webpage was announced through all the communication channels of the beneficiaries, and in all the dissemination events and products. It will be available during at least 5 years after project completion. Contrary to the initial expectation, it was not deemed necessary to include a tool for an automatic translation to the main EU languages, as this is a tool available in most browsers.

· **Layman's report:** this 20-pages report, addressed to non-specialist public, shows the project's context, objectives, development and results. It was produced in an attractive format in early June 2022 in 3 versions: Spanish, Catalan and English (with professional translation). Moreover, we printed 100 units in Catalan, to be distributed in the final seminar. Annex CD1 provides this report. Compared to the initial plan, we increased the size of this document (from 5-10 pages to 20) to adequately disseminate the content, but printed less units (initial expectation: 300 units), as agreed with the EMT, as we did not foresee suitable dissemination events in Spanish or English with non-specialist public. The Layman's report was produced with 4 months of delay, because of the time needed to have all the conclusions of D4 action (only available in May 2022) and to edit and translate the content of this report. To compensate a shorter time for dissemination, we gave this report a highly accessible position in the webpage (at the top of "Documentation and products" section) and have distributed it by e-mail.

E2.3 Periodic newsletter: we produced, led by CTFC and validated by all the beneficiaries, 10 bi-annual Newsletters (March and September, from 2017 to 2021) showing the project progress and news, and announcing the upcoming events. The newsletter was produced in Spanish, English and Catalan and distributed by e-mail to networking contacts of the project partners, through the webpage and by automatic submission to the subscribed recipients. It was expected to produce 9 issues, but the project extension made it necessary to produce an additional one in September 2021 to keep the bi-annual rate. We decided not to produce another newsletter in March 2022 as in the last months we disseminated the final project outcomes and publications individually. Annex CD2 shows the list of newsletters produced.

		Foreseen deadline	Real deadline
Deliverables	<i>Project brochure edited and printed</i>	06/17	04/18
	<i>Rollup produced in 3 languages (EN, SP, CAT)</i>	06/17	03/18
	<i>Project dissemination materials</i>	06/17	04/18
	<i>Panels (7 outdoors, 5 indoor)</i>	12/17	11/18
	<i>Webpage programmed and updated</i>	03/17	03/17
	<i>Fourth newsletter</i>	09/18	09/18
	<i>Layman's report prepared, edited and printed</i>	02/22	06/22
	<i>10 newsletters prepared, edited, distributed</i>	04/22	11/21
Milestones	<i>Webpage online</i>	03/17	03/18
	<i>Newsletter I</i>	03/17	03/18
	<i>Newsletter II</i>	09/17	09/17
	<i>Newsletter III</i>	03/18	03/18
	<i>Newsletter V</i>	03/19	03/19
	<i>Newsletter VI</i>	09/19	09/19
	<i>Newsletter VII</i>	03/20	03/20
	<i>Newsletter VIII</i>	09/20	09/20
	<i>Newsletter IX</i>	03/21	03/21
	<i>Project dissemination materials</i>	06/17	04/18
	<i>Panels prepared and installed</i>	12/17	11/18
	<i>90% of dissemination materials distributed</i>	03/22	06/22
	<i>Layman's report prepared and available</i>	02/22	06/22

Action E3 + E9. Networking, exchange activities and specialised trainings in EU

Foreseen start date: 01/17
Foreseen end date: 04/22

Actual start date: 01/17
Actual end date: 05/22

It was agreed with the EMT to merge E3 and E9 actions that involved technical trips to other EU countries, to allow all beneficiaries to participate (in the initial plan only CTFC and CPF were expected to participate in E9 trips) and make a more effective use of resources.

E3. Networking and exchange activities: in this action, coordinated by CTFC and participated by all beneficiaries, we explored synergies with projects and entities dealing with the project topics. Annex CD3 shows the report on networking activities (delivered with 1 month of delay, which did not impact any other action, as it is a confidential deliverable), which comprised:

- Participation in 18 networking events at local, regional, national and EU level. This list does not include technical or scientific seminars (Action E7) nor the transfer events organized by MixForChange project (actions E4, E5, E6). The main EU-level networking events where MixForChange was present are:

- EU LIFE [Platform Meeting on Mediterranean CC Adaptation in Agriculture and forestry](#), 03/18.
- [Showcasing best climate practices in agriculture, forestry, food systems and bioeconomy](#), 10/20.
- EIP-AGRI seminar: [Turning Forest Innovation into practice](#), 11/21.
- "A step forward in Forest policy: the Mediterranean perspective", [presented in Brussels](#), 05/22.

- Interaction with 29 projects, including some that were initially identified at the proposal (MontadoAdapt, ResilForMed, PProSpoT, SUMMACOP).

- A total of 127 direct networking contacts (from an initial expectation of 50) from 9 countries.

- Direct contributions in MixForChange activities from 6 projects (initial expectation: 3): representatives of PProSpoT, SUMMACOP, ResilForMed and GoProFor collaborated in the technical trip to Italy (09/19); the technical trip to France and the specialization course conducted in September-October 2021 were organized with LIFE Biorgest; the LCA analysis of Action D6 was done following the methodology as in LIFE Climark. Moreover, representatives of these and other projects participated as collaborators in the publications C5.1, C6.3 and C6.4 (i.e. a brief description of LIFE Clinomics in C6.4 handbook).

- We invited 4 experts from networking projects to be part of the EAC (initial expectation: 1): G. Borràs (LIFE MedAcc); P. Sabín (Era-Net Reform); A. Sanitjas (LIFE Clinomics) and J.M. Tusell (LIFE Suber).

Finally, we made a final mailing to the list of networking contacts (and other professional contacts) after project ending for a final dissemination of the main project outcomes.

E9. Specialised training in other UE countries: in this action, coordinated by CTFC, we planned to conduct two 8-hours trainings in other EU countries collaborating with local experts, announced in collaboration with Pro Silva association; in Action E3 it was planned to organize 3 networking trips to other EU countries; 3 days and 2 project representatives per trip). As mentioned above, we merged these trips into 2 trips where all project partners could participate, with a duration of 2-3 days each (Annex CD4):

- Tuscany and Umbria (Italy): 23-25 September 2019: we organized a seminar in Orvieto with 19 external participants, and a 2-days trip with 16 external participants. This trip was organised with ProSilva Italy and the collaboration of CREA, UMCM and FODAF Umbria.

- Occitanie (France), 20-21 October 2021: two-days trip; the first one visiting LIFE Biorgest demonstrative stands (19 external participants) and the second visiting the Forêt Irregulière École (14 external participants). This trip was organized with ProSilva France and the collaboration of CNPF Pyrénées Orientales & Lozère.

It was foreseen to reach 40 participants in each trip, which could be achieved when considering the participants from MixForChange project.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>Networking report with the list of contacted persons/institutions and interaction type (E3)</i>	<i>04/22</i>	<i>05/22</i>
	<i>Report: training sessions in other countries (E9)</i>	<i>12/21</i>	<i>12/21</i>
<i>Milestones</i>	<i>Networking final report (E3)</i>	<i>04/22</i>	<i>05/22</i>
	<i>Training sessions in other countries (E9)</i>	<i>12/21</i>	<i>10/21</i>

Actions E4 + E5. Outreach events, training and final seminar

Foreseen start date: 01/19

Actual start date: 10/17

Foreseen end date: 04/22

Actual end date: 06/22

It was agreed with the EMT to merge E4 and E5 actions, organising the final seminar (E4.3) and the conference on peri-urban forests (E5) as a single event, to maximise the impact of a unique call for the speakers and the audience that allowed delivering the complete project results, instead of splitting the resources in two different events in a short time.

E4.1. Outreach events (responsible: CPF; participants: all other partners). We organised 6 outreach events along the project, with variable topics and formats adapting to the project development and the mobility restrictions. The first three events (2017-18) introduced the project, the silviculture proposed and how to conduct tree marking; they were all conducted on the field, well before the initial expectation. However, the 3 outreach events organised in 2020-22 were done as webinars, which limited the capacity to transfer certain technical aspects but allowed increasing the audience. A total of 115 people participated in these events. These figures outnumbered the initial plan, which was to organise 4 outreach events with 25 participants each. It was foreseen to conduct one event per area of work, which could not be achieved in the case of Bellmunt-Collsacabra area. The dissemination in this area included direct communications during the annual APFSBE assemblies, where the project objectives, development and results were presented to the members of the Association (forest owners and practitioners). Moreover, further practitioners from this area participated in the assembly of the Professional Board of Forest Engineers of Catalonia in 2018, held in Montesquiu Castle, within the geographical area of APFSBE, which included a visit to the project demonstrative stand C4.5 (La Coromina). Annex CD5 shows the date, venue, format, participants and evaluation of the events.

E4.2 Specialization trainings (responsible: CPF; participants: all other partners). We organised two specialisation trainings:

- “Theory and practice of forest management: adaptation to climate change in sub-humid mixed forests”, conducted in November 2019 and addressed to forestry students from Lleida University: one session (5 h) with 21 participants.

- “Specialization course in close to nature silviculture and management of Mediterranean mixed forests”, conducted in October 2021 and addressed to forest owners, and practitioners from the public and private sectors. This course was organised in four sessions: 2 webinars (2.5 h each, with 64 participants) + 2 on-field sessions (8 h each, with 21 participants). This course was organised in collaboration with LIFE Biorgest project.

Annex CD6 shows the date, venue, format, participants and evaluation of each event. The initial plan was to organize 3 courses of 8 h reaching 20 participants per course, but after the Covid-19 outbreak it was decided that it would be more efficient to merge the second and third courses in a single one, with 4 sessions and organized together with LIFE Biorgest project, to make it more attractive and compact. In total, we outnumbered the targeted participants. The evaluation surveys were very positive.

E4.3. Final seminar (responsible: CTFC and CPF; participants: all other partners). On June 22nd, 2022 we organized in Barcelona the final seminar, with the title “Forest management and climate change adaptation in periurban areas, and its integration in local policies”. The foreseen duration was a complete day (5 h indoor and 3 h on the field) but the field session had to be cancelled because of the weather forecast in the area to visit. In this seminar there were 10 speakers from outside the project, including representatives (technical and political) from municipalities, province councils, regional administration, NGOs and forest owners’ associations. The seminar programme, list of participants and conclusions are provided in Annex CD7.

The content of the seminar was in line with the proposal, including the presentation of the state of peri-urban forests, the state of the art regarding forest management for climate change adaptation and new approaches and opportunities on local policies to promote the application of adaptive climate change in periurban forests. A relevant part of the seminar (90') was a round table with representatives from local administrations to discuss on these topics. We achieved 35 participants including the speakers, while the initial plan was to reach 30 participants. We conducted the seminar in the very last days of the project, in order to have all the dissemination products available, despite it would imply 2 months of delay.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>List of participants in the trainings and report on their feedback (E4.2)</i>	<i>06/21</i>	<i>12/21</i>
	<i>List of participants in the outreach events and report on their feedback (E4.1)</i>	<i>04/22</i>	<i>06/22</i>
	<i>Report on the program, participants and conclusions of the final seminar</i>	<i>04/22</i>	<i>06/22</i>
<i>Milestones</i>	<i>1st outreach event</i>	<i>12/19</i>	<i>10/17</i>
	<i>2nd outreach event</i>	<i>06/20</i>	<i>06/18</i>
	<i>3rd outreach event</i>	<i>12/20</i>	<i>11/18</i>
	<i>Final project seminar</i>	<i>04/22</i>	<i>06/22</i>
	<i>2 specialization trainings achieved</i>	<i>12/21</i>	<i>12/21</i>

Action E6. Communication and dissemination to mass media

Foreseen start date: 01/17
Foreseen end date: 04/22

Actual start date: 01/17
Actual end date: 06/22

In this action, led by CTFC and participated by all beneficiaries, we organised the communication of project activities to a broad audience, including the society in general (through mass media and social network – project’s Twitter account) and to technical profiles (through specialised media). Annex CD8 shows the dissemination achieved in this action, which resulted in 2 press conferences (during the first public event and in the final seminar), 10 press releases published in 25 journals, 11 appearances in TV and Radio, 9 appearances in specialised media, 184 tweets and 461 followers in Twitter. We achieved all the dissemination objectives in this Action (2 press conferences, 10 press releases, 5 appearances in specialised media, 3 appearances in TV, 50 tweets. These figures are well beyond the initial expectation (3 TV appearances, 5 contributions in specialised media)

Most of this dissemination, and especially the non-specialist one, was done in the area of work (local and regional media), although we also achieved appearances in national media, including “El País” and “La Vanguardia”, two leading newspapers at Spanish level.

The deliverables and milestones were achieved with a slight delay that did not compromise the outcomes and impact of the action.

		Foreseen deadline	Real deadline
Deliverables	<i>Report on dissemination actions and impact on mass media (2 press conferences, 10 press releases, 5 contributions in specialized media, 3 TV appearances, 1 active Twitter account)</i>	04/22	06/22
Milestones	<i>1st press conference</i>	06/17	10/17
	<i>2nd press conference (project ending)</i>	04/22	06/22

(Projects funded under the Call 2014 onwards must use this format)

Action E7. Technical papers and conferences

Foreseen start date: 04/17

Actual start date: 04/17

Foreseen end date: 04/22

Actual end date: 06/22

In this action, led by CTFC and participated by all beneficiaries, we produced technical documents addressed at forest owners and practitioners. The initial plan was to produce 4 technical articles (in publicly available publications) and 2 communications in technical seminars and conferences, but we produced 10 and 8, respectively.

The technical papers were published in regional (6) and national (4) journals. Only 2 of the papers were published at the beginning of the project (spring 2018), in order to introduce its objectives, partners and foreseen methodology, while the remaining 8 articles were published in the last 18 months of the project, where we could share the results obtained. Some of the articles summarised the general project results, while others focused on specific topics, depending on the type of publication. Annex CD9 shows the list of technical-dissemination papers produced.

The conferences and seminars in which the communications were accepted for presentation included 2 regional, 4 national and 2 international events. The formats were either poster (3 communications) or oral presentations (5 communications). Moreover, most of the communications (5) were done in the last 9 months of the project, 4 of which in the 8th Spanish Forest Congress. Annex CD10 shows the list of communications in conferences and seminars.

One of the articles (10th Montseny scholars meeting) has not been published yet, although its content has been approved for publication.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>4 technical-dissemination papers</i>	<i>09/21</i>	<i>06/21</i>
	<i>2 communications in congresses</i>	<i>09/21</i>	<i>11/19</i>
<i>Milestones</i>	<i>First technical article</i>	<i>10/17</i>	<i>03/18</i>
	<i>4 technical-dissemination papers</i>	<i>09/21</i>	<i>06/21</i>
	<i>2 communications in congresses</i>	<i>09/21</i>	<i>11/19</i>

Action E8. Edition of handbooks and integration in ORGEST system

Foreseen start date: 10/20

Actual start date: 01/21

Foreseen end date: 04/22

Actual end date: 06/22

In this Action we translated, edited, printed and disseminated the handbooks prepared in C6.3 and C6.4, as described in Action C6. The dissemination of the electronic versions was done through the website, newsletter, twitter and social media of the authors, and as active mailing to selected recipients, both after completing C6.4 guide (summer 2021) and right after project ending (July 2022). The final number of pages of C6.3 and C6.4 guides is, respectively, 104 and 56, not far from the initial expectation of 60-80 pages per publication.

We (coordinated by CTFC) printed 725 units of Guide C6.4 (150 in Spanish, 500 in Catalan and 75 in English), while it was originally expected to produce 500 units in each language. However, because of budget limitations and the increase in the translation and printing costs we decided to reduce the number of units to print, while having a professional English translation. We distributed these handbooks by direct mailing (150 units sent to Barcelona Province Council, that sent them to all the municipalities with periurban forests; 50 units sent to Barcelona Metropolitan Area, to be further distributed to all their municipalities) and directly in the different project events since summer 2021 to the end of the project, including the final seminar and the 8th Spanish Forest Congress.

In the case of Guide C6.3 we (coordinated by CPF) printed 300 units in Catalan and 100 in Spanish because of the limited budget available, upon agreement with EMT. The budget available was distributed between the English review and the printing of the maximum number of units. Most of the units produced could be delivered at the final seminar and during the 8th Spanish Forest Congress, and distributed to the beneficiaries and to Barcelona Province Council, for maximum dissemination. Like in the previous case, it was foreseen to print 500 units in each language, but it turned out unfeasible because of the limited resources available at the end of the project.

This Action also aimed to incorporate new management models within the ORGEST system (Guidelines for forest management in Catalonia; this system is the base to prepare the forest management plans in Catalonia including the identification of the forest types and the management model proposed) corresponding to the formations of the demonstrative stands of the project (dominated by *Quercus ilex*, *Q. pubescens*, *Q. petraea*, *Q. canariensis*, *Castanea sativa*, *Pinus sylvestris* or *Pinus pinea*). The idea was to incorporate forest management models based on MixForChange silviculture at the end of the project. However, it was decided not make these changes directly, but to build on the knowledge gained in three different projects related to forest management in Catalonia (LIFE MixForChange, LIFE Climark and LIFE Biorgest – still ongoing), and to create working groups of experts and practitioners to discuss on the conclusions of all three projects, to define how to:

- i) improve the existing reference models, integrating biodiversity and other ecosystem services;
- ii) introduce new approaches to forest management, such as “close-to-nature” silviculture;
- iii) improve the silvicultural models for mixed stands;
- iv) explore how to incorporate eco-hydrological models;
- v) incorporate adaptation and restoration processes for degraded forests.

Annex CD11 shows the report describing this plan, which was delivered with 3 months of delay. In any case, this delay did not affect the dissemination of this document.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>Report of changes conducted in ORGEST system</i>	<i>12/21</i>	<i>03/22</i>
	<i>Guide C6.3 edited and printed</i>	<i>02/22</i>	<i>06/22</i>
	<i>Guide C6.4 edited and printed</i>	<i>06/21</i>	<i>06/21</i>
<i>Milestones</i>	<i>Both guides printed; pdf version in website</i>	<i>02/22</i>	<i>06/22</i>

Action F1. Project management (CTFC)

Foreseen start date: 10/16

Actual start date: 10/16

Foreseen end date: 06/22

Actual end date: 06/22

In this action CTFC aims to guarantee the adequate project development in time and quality, and an efficient reporting from the technical, administrative and financial points of view.

The project management is based on three basic structures, as established in the first coordination meeting:

- **Project Director:** Míriam Piqué (CTFC), supported by Jaime Coello (CTFC). The project director met with the tasks foreseen in the proposal (monitor the progress (in quality and time) of project actions and its coherence with LIFE rules; prevent risks and propose contingency plans, organise coordination meetings and prepare the minutes, validate the technical financial and administrative reporting at consortium level, send the periodic reports to the Agency, be the contact person with the Agency and the EMT, provide support to the beneficiaries on project reporting and on LIFE rules and participate in the Kick-off meeting in Brussels.
- **Administrative Management Team:** Dúnia Riu and Àngels Jovells (CTFC)
- **Coordination Committee:** project director + one representative of CPF (Teresa Cervera), APMC (Martí Rosell, substituted by Lúdia Guitart in 2021) and APFSBE (Jordi Vigué). The Coordination Committee conducted the tasks that were foreseen at the Grant Agreement: monitor and approve the accomplishment of the work plans of each beneficiary, monitor action development and establish the workplan for the upcoming months (short and long term), analyse and solve any type of mishaps and deviations, promote and support the development and control of the actions following LIFE rules.

The EAC was planned to act as a supporting entity to the coordination committee, although we found no situation where we had to request this support with regard to coordination issues.

The internal cooperation agreements between the beneficiaries were provided in Annex MG1 of the first certification. There has not been any relevant management problem during project development. The main decision that required longer discussion was to establish the length of the project extension to request, in order to find a balance between having enough time for ending the pending tasks in quality, while not postponing the final payment too long. It was agreed to request a 9 month extension (October 2021 – June 2022), although it was planned to end the project using only 7 of these months and therefore the final deliverables were planned to be ready in April 2022. Finally, it was found necessary to use the complete period requested to accomplish all the project tasks.

		Foreseen deadline	Real deadline
Deliverables	<i>This action did not foresee any deliverable</i>	-	-
Milestones	<i>Coordination committee established, project director elected</i>	10/16	10/16

Action F2. Project coordination and management meetings

Foreseen start date: 10/16

Actual start date: 10/16

Foreseen end date: 04/22

Actual end date: 05/22

This action, led by CTFC and participated by all beneficiaries, consisted on conducting periodic coordination meetings by the coordination committee and the administrative management team in order to (i) evaluate project progress; (ii) decide on possible contingency actions; and (iii) plan the work during the next months. In these meetings we covered technical, administrative and financial issues, adapting to the status of development of the project and the pace of certifications.

We have done 8 coordination meetings, with an approximate periodicity of six months during the first two years (specially to agree on the criteria for the demonstrative silvicultural treatments and the monitoring protocols) and annually onwards. Annex MG1 shows the minutes of the coordination meetings, three of which had to be done via videocalls because of mobility or sanitary restrictions. Moreover, we have done several bilateral or multilateral meetings along the project to solve specific issues. The initial plan was to conduct 7 coordination meetings, but the project extension made it advisable to conduct an eight one.

In this Action we also performed the coordination with the Agency and the EMT, consisting of:

- the kick-off meeting in Brussels (October 2016), participated by CTFC and CPF.
- Five visits by Ms Sara Barceló (EMT) to the project partners (two of which had to be done via videocall because of mobility restrictions). In the first and last visits, Mr Georgios Kostakos (EMT) and MS Hana Mandelikova (European Commission), respectively, also participated in the visits.
- Nine written reports submitted to EMT to inform on project progress, problems encountered, contingency plans and work plan for upcoming months.

We did not encounter any relevant problem in the development of this action, which was accomplished according to the work plan.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>Minutes of the coordination meetings</i>	04/22	05/22
<i>Milestones</i>	<i>1st coordination meeting</i>	12/16	10/16
	<i>2nd coordination meeting</i>	06/17	03/17
	<i>3rd coordination meeting</i>	09/17	10/17
	<i>4th coordination meeting</i>	09/18	03/18
	<i>5th coordination meeting</i>	09/19	03/19
	<i>6th coordination meeting</i>	09/20	03/20
	<i>7th coordination meeting</i>	09/21	11/20

Action F3. Financial and administrative project control

Foreseen start date: 10/16
Foreseen end date: 06/22

Actual start date: 10/16
Actual end date: 06/22

In this action we aimed to achieve a smooth and updated financial and administrative project control, in line with the work plan and in accordance with LIFE rules. This action was led by CTFC (Administrative Management Team) supported by the Project Director and the members of the Coordination Committee and the administrative and financial staff of each beneficiary.

We achieved the certification of more than 100% of the foreseen budget, with some minor deviations between actions and cost categories with respect to the initial plan, but always within the 20% flexibility rule. The main deviation was related to Other Costs category, to which some expenses had to be reallocated according to the Agency requirements. These expenses are included within the extra budget justified, so it was not necessary to request an amendment.

The percentage of the budget certified at the mid-term reporting was 42.7%,

		Foreseen deadline	Real deadline
Deliverables	<i>This action did not foresee any deliverable</i>	-	-
Milestones	<i>100% of budget implemented and certified at the end of the project</i>	06/22	06/22

Action F4. After-LIFE communication plan

Foreseen start date: 11/21

Actual start date: 12/21

Foreseen end date: 04/22

Actual end date: 06/22

The After-LIFE plan (20 pages) describes the project context, the main outcomes and the main activities foreseen for the continuation of the project beyond the financed period. These activities are addressed at different target audiences (society in general, forest owners, practitioners, public administrations) and are organised by topics: i) continuation of the monitoring of demonstrative stands; ii) website maintenance; iii) dissemination of project publications; iv) publication and participation in technical-scientific seminars; v) training activities and capacity building; vi) re-application and replication of MixForChange silviculture; vii) appearances in the media; and viii) follow-up of the adoption of the political-regulatory tools generated in the project. The total foreseen cost of these activities ranges between 104,000 – 144,000 €, to be provided by competitive funds (EU, national, regional), public administrations (Catalan government, Barcelona province council) or as self-financing by the beneficiaries. The document was edited in Spanish, English and Catalan

It was agreed with the EMT not to print this document (the initial expectation was to print 1,000 copies) and to invest the remaining resources for external assistance for printing more units of the guide C6.3 and the Layman report. Moreover, it could only be finished in May 2022, once that all the final project results were available, and was published in electronic format in June 2022. This implied a 2-months delay, which was partially compensated by giving this report a highly accessible position in the webpage (at the top of “Documentation and products” section, right below the Layman report) and a specific mentioning of this product at the “News” section of the webpage.

This report was done by CTFC and is provided in Annex MG2.

		<i>Foreseen deadline</i>	<i>Real deadline</i>
<i>Deliverables</i>	<i>After-LIFE communication plan printed and electronic version in the webpage</i>	04/22	06/22
<i>Milestones</i>	<i>After-LIFE communication plan printed and electronic version in the webpage</i>	04/22	06/22

6.2. Main deviations, problems and corrective actions implemented

Along the project, which lasted 5 years and 9 months, we faced several problems, most of which could be solved with minor corrective actions, while others had a deeper impact on the project development and required a more complex response, including a change in the Grant Agreement through a project extension request. In the previous section we presented, action by action, the problems, solutions and resulting deviations, most of which were limited to certain delays in the deliverables. We present below the main problems, corrective actions and deviations affecting groups of actions, which can be summarised in three:

A) The delay in completing preparatory actions A2 and A3 led to a subsequent delay in implementation actions C1-C4 (some of which had to be implemented one growing season after planned), which also affected monitoring actions D2-D4 (number of monitored growing seasons). This delay was consequence on the will to adopt a new and homogeneous methodology for assessing the demonstrative stands (A2). Once agreed this methodology, we conducted all the assessment, evaluated them altogether and then agree on common criteria of intervention (A3) in all the stands, regardless of the beneficiary responsible. This implied doing several technical meetings, both indoors and on the field (we visited together all the four areas of work) and receiving input from the EAC. As a result, it took longer than expected to achieve A2 and A3 actions, and we could implement only 28% of the foreseen forest area before summer 2018. Then, these interventions had to be stopped in summer because of legal constraints linked to forest fire prevention and because of the phenological limitation of oaks and chestnut, which must not be cut during the growing season. The works in autumn progressed slower than expected, because of the severe rainfall, and could only be accomplished in January 2019. The main problem caused by this delay is related to the data gathered in the final D2 and D3 inventory, in autumn 2020: it was initially foreseen that this monitoring would collect the data 3 years after the treatments were implemented, which will be the case of 4 (36%) D2 intervened plots and of 12 (18%) of D3 plots, while the remaining plots will be monitored 2 years after the intervention. This mishap did not compromise the outcomes and conclusions of the interventions, although it implied additional calculations to homogenise some indicators to annual values. All in all, and with the prospective of the complete project, we assume that it was a good decision to prioritise the adoption of consistent and homogeneous criteria by all beneficiaries, which made the results more comparable (despite the different timespan of monitoring), to capacitate the beneficiaries staff (all the participants had to think how to incorporate the particularities of all the work areas and forest types) and in order to transfer consistently these results in the communication actions.

B) The Covid-19 outbreak and its associated restrictions to mobility and to arrange public or collective events for months, had a major impact in the development of the project.

The actions more intensely affected by this event were:

- Actions D2 & D3, with a further effect on the preparation of Guide C6.3 and its edition in E8, Layman Report, Final Seminar and other dissemination actions: the impossibility to conduct field work in spring 2020 of both MixForChange and other projects where the beneficiaries participate resulted in a work overload for autumn and winter 2020, which exceeded the capacity of the teams to conduct the final forest inventories. Another key factor in this period of the year is the weather conditions (particularly, rain), which limits significantly the number of days where the field work can be conducted. Contingency measures applied: preparation of the D3 protocol of final monitoring in summer 2020, so that the inventories could start as soon as the phenology was adequate (reduction of vegetative activity, between late September and October 2020). Moreover, it was intended to prioritize, as much as possible, MixForChange project inventories over the field work of other ongoing projects. Moreover, part of the D2 field work that could not be done in spring was done in summer, to reduce the field work to be done in autumn. The consequence was a delay in the implementation of forest inventories, which could be ended only in January 2021. Once the data was collected, it was validated and managed into a single database, to conduct statistical analyses. The 4-months delay in the final D3 inventory affected negatively various actions that builds on their results: the guide C6.3 (edited, translated and printed in E8), Layman report (E2), final seminar (E4.3-E5), technical articles and conferences (E7)...

- Action D1, with a further effect on C6.2, C6.4, C7.2 and other dissemination actions: the third Experts Advisory Committee meeting was scheduled for 12/03/20, with 20 speakers confirmed. However, it had to be cancelled the day before. In this meeting it was foreseen to introduce 3 project documents: i) the first version of DL C6.2 (Memorandum of regulatory aspects to be modified to facilitate adaptation to climate change of Mediterranean subhumid forests); ii) the structure of DL C7.2 (Real case of integration of the adaptation to climate change of sub-humid Mediterranean mixed forests in local policies in Mataró municipality, Barcelona) and iii) the draft content of DL C6.4 Guide to integrate local policies, climate change adaptation and adaptive management of periurban forests. Contingency measures applied: it was intended to organize the meeting in the subsequent months, keeping its physical structure, but because of the changing restrictions over time, and the uncertainty about a suitable time to arrange a physical meeting, it was finally decided do it on an internet-based format, adapting the content, format and participants. The meeting took place in 03/21, with one year of delay. Moreover, we continued with the preparation of the 3 deliverables to be discussed or validated in this meeting, which were presented and discussed in a more advanced format. The consequence was a delay in ending up the 3 mentioned documents: DL C6.2 (from 12/19 to 03/21); DL C7.2 (from 12/20 to 03/21); C6.4 (from 06/20 to 05/21). From them, the most relevant one is the Guide C6.4, whose translation, edition and printing are done in E8 action.

Other actions whose development was affected by Covid-19 outbreak were:

- C5.2: some of the interviews with companies, foreseen in early spring 2020, had to be postponed and finally done via telephone or e-mail, and some of the pictures to illustrate the publication were provided by the companies: the resulting delay in the publication, including the translation, edition and dissemination was from 03/20 to 06/20.

- C5.3: the difficulties to work together with an external company to develop this system made it necessary to postpone this deliverable and milestone from 12/20 to 06/21.

- D4: it was foreseen to conduct surveys during summer and autumn 2020 among the visitors of the project areas, to gather their attitude towards the landscape values of the demonstrative stands, compared to business-as-usual forest management. However, the mobility restrictions made it unfeasible to follow this methodology and we focused on indicators calculated based on contrasted methodologies.

- E3 and E4.1: we had to cancel two events: an on-field transfer event in Bellmunt massif, coordinated by APFSBE, foreseen in 03/20, and a transfer event to which we were invited to present the project in Pont de Suert, foreseen in 19/03/20.

- E4.2: specialization courses: we foresaw two specialization courses for 2020 and early 2021, but we decided to merge them into a single course with 4 sessions, organised together with LIFE Biorgest project in October 2021.

C) Delay in analysing the data, discussing the outcomes and reach a joint interpretation of the information produced in actions D2, D3 and D4: these actions were the basis for producing the final dissemination and communication products, in other words, the final project messages. In each of these actions we focused the monitoring in different indicators, leading to very large datasets (data from up to 76 inventory plots, plus data from 9 additional plots in replication stands) and very variable conditions in each demonstrative stand (with various predominant and accompanying species, status of development and types of mixtures). Therefore, we invested more time than expected during winter 2021-2022 and spring 2022 to interpret all the data achieved and build consistent and nuanced key messages and overall conclusions that were representative of all monitoring actions together and agreed by all partners. This delay was the main factor that made it necessary to use the 2 months buffer (from April 2022 to June 2022) mentioned above, to end up with the last project products, being the most remarkable ones the guide C6.3, Layman's report, After-LIFE communication plan and the Final seminar.

6.3.Evaluation of Project Implementation

Project methodology

The project methodology can be described in three ways: a) the development of the demonstrative silviculture; b) the constraints and opportunities of the demonstrative silviculture that will define its replication potential; c) the process of decision making to define other key project products. In both cases, we agreed to follow a consensus-based process, taking benefit of the limited number of beneficiaries (4) and on the constructive attitudes.

a) Methodology of development of the demonstrative silviculture applied: the planning of the innovative silviculture (or MixForChange silviculture) has been articulated in a progressive and iterative manner, from general concepts to specific decisions:

- General objectives, set following the basic principles of adaptive silviculture and the vulnerabilities of the forests in the work areas. They were agreed by all partners.
- Objectives at forest type level: set based on the knowledge of the massifs of the work areas and the potential and limitations of the different forest types. They were agreed by all partners.
- Objectives at stand level: set based on a field-based inventory (A2) and detailed for each forest stand. The methodology of inventory and the planning methodology were agreed, while the specific interventions were proposed by the partner leading the management implementation and validated by CTFC searching for coherence between the different stands.
- Objectives at micro-site level: the final management decisions are set at the moment of conducting tree marking, paying attention to the present and potential role of each tree in the stand, while taking into account the objectives set at stand, forest type and general level. We agreed on the methodology of marking and on the factors to take into account, but each partner leading the management implementation did its own marking.

This system was built after several iterations and technical discussion both in meetings as on the field, including four plenary visits to the four work areas by all partners just to define the common grounds of this silviculture, and further joint elaboration of the documents defining this silviculture (A3, C1-C4).

This methodology proved to be slower than expected, which brought a delay in Actions A2 and A3, which subsequently impacted the timely implementation of the silvicultural treatments (C1-C4) and the number of growing seasons monitored (D2-D4), as described above. This deviation posed a difficulty to the interpretation of the outcomes of this silviculture. However, we are confident that this additional time spent in defining this methodology was a successful investment in:

- i) the quality of the implementation of works, which were done with common principles
- ii) capacitation of the four beneficiaries, who took benefit of these technical discussions and got a deeper knowledge of the 4 forest types, of the 4 areas of work and of the principles and implementation of adaptive and close-to-nature silviculture
- iii) the quality and consistency of the transfer products describing this silviculture and its results, as the body of knowledge created was consistent and easier to interpret.

b) Methodology of application of the demonstrative silviculture and its constraints and potential for replication: the silviculture model developed proved its benefits in multiple ecosystem services, with additional benefits expected in the future (i.e. biodiversity indicators, valuable timber production).

The main opportunities identified for the adoption of this silviculture include: i) multifunctionality and versatility; ii) sustainability from both economic and ecological points of view; iii) professionalisation of the workers along the value chain; iv) alignment with EU policies including the EU Forest strategy and EU Adaptation strategy.

However, there are constraints that can limit its adoption, including: i) difficulties (technical, capacitation, economic) to adopt a new silvicultural model; ii) limited knowledge and capacitation on the principles and techniques involved; iii) logistic limitations (product classification, industry preparedness; iv) administrative factors (integration in the forest management plans scheme and work verification).

c) Methodology of decision-making to define other key project products: we also prioritised consensus over meeting the deadlines when dealing with parts of the project which were particularly critical from the transfer point of view, in particular: the content of handbook C6.4 (the main transfer product related to policies) and the elaboration of the conclusions and lessons learnt of MixForChange silviculture (later on, elaborated in handbook C6.3 and in the last dissemination products – Layman report, final seminar, etc). Being key project outcomes, we decided that it would be more positive in the long term (final publications, which be used beyond the project) to invest additional resources in preparing them in a way that the content reflected the different views and opinions of all the project beneficiaries. Moreover, in both publications (C6.3, C6.4) we made an extra effort to incorporate external authors and collaborators, mostly from the EAC, whose last 2 meetings were related to C6.4 and C6.3, respectively, and whose members made interesting contributions to the draft content of both publications.

As in the previous case, this methodology proved to be slower and more resources consuming than other collaborative works where the chapters are prepared by different authors without major interactions between them. In our case, this meant using the last 2 months of the project (May and June 2022) to end up the last deliverables, moving most of them from the foreseen end date in April 2022 to June 2022, and reducing the time available for dissemination. However, we are confident that the final result of both handbooks (and other related products) compensates this shorter dissemination, and that their distribution beyond project timespan can be also effective.

Project results against original plan

The table below shows the degree of accomplishment and the time foreseen for visibility of the project results presented in Section 4.

Objective	Achieved	Evaluation
Implementation of 164 ha of pilot demonstrative forest stands, distributed across 4 areas	164 ha in 4 areas	Successful. Immediate visibility.
The implemented models reduce the stand competence, increasing its vitality and water use efficiency	<ul style="list-style-type: none"> · Stand competence reduced (lower Hegyi index) · Vitality increased (higher tree growth in both dominant and secondary species) · Water use efficiency increased: less transpiration (8 to 87 mm/year, depending on forest type) and more relative blue water (+2% to +17%). <p>These three factors were quantified for each project stand and forest type, in Actions D2, D4 and D4, by comparing the results in the final inventory with either the first inventory (pre-intervention) or the control plots (not intervened).</p>	Successful. Visibility after 2-3 years
Increase forest complexity / forest structural diversity	We have maintained forest complexity and structural diversity by keeping all forest strata (with punctual removal of the ladder fuel to prevent forest fires). Moreover, we paved the way for forest capitalisation in the future, which can be only achieved over time.	Partially achieved. Effects will be visible in 5 years
Increase forest biodiversity / biodiversity indicators	The biodiversity indicators quantified are two: flora richness (includes arboreal, shrub and herbaceous species, which was kept in general terms in all the formations) and Forest Biodiversity Index, which showed only slight decreases in its value (69% to 60% in holm oak forests, 64% to 56% in chestnut forests, 72% to 70% in oak forests, 57% to 56% in pine forests). We can conclude that the interventions had only a minor effect on biodiversity indicators, which could not be increased in a single intervention. Moreover, other biodiversity related factors that were improved was the release during the silviculture of the presence of trees from sporadic species and trees presenting dendro-micro-habitats of interest for wildlife, which are therefore available for long time	Partially achieved. Effects will be visible in 5 years
Added value products from Sub-humid Med forests catalogued and disseminated	In the Catalogue of valuable timber products and uses in Catalonia (C5.2) we showed the main industrial destinations for this timber and introduced 11 companies transforming this timber. We disseminated this catalogue (produced in Spanish, English and Catalan) electronically. We also produced a database of companies transforming this timber in the Mediterranean area.	Successful. Immediate visibility
Design of a pilot system for the logistics and commercialization of products from these stands, validated by local forest owners.	In Action C5.3 we produced this pilot system, especially designed for Montnegre-Corredor massif but with orientations on how to adapt the methodology for other areas	Successful. Immediate visibility; expected added visibility in 2-3 years
Improvement of the forest legal framework to integrate the management particularities of Sub-humid Med forests to CCA	We have paved the way for achieving regulatory and policy changes to promote the adoption of MixForChange silviculture and to enhance the application of adaptive silviculture. In the Memorandum of regulations to facilitate climate change adaptation of Mediterranean subhumid mixed forests (C6.2) we identified 19 potential measures to be included in 7 key regulation and planning instruments. We also participated in the identification of measures to implement to enhance climate change adaptation in Mataró municipality (C7.2), some of which were provided as measures to implement from local administrations to promote the adoption of adaptive forest management in guide C6.4	Partially achieved. Effects will be visible in 5 years

Objective	Achieved	Evaluation
Transferability achieved. Target stakeholders reached. At least 215 specialized participants in the dissemination and training activities. Innovative models included in the ORGEST system	We achieved the technical transfer activities foreseen, with 6 transfer days (initial plan: 4), 10 technical articles (initial plan: 4); 8 communications in conferences (initial plan: 2); 2 technical trips to other countries (initial plan: 3); 9 appearances in specialised media (initial plan: 5); 2 specialisation courses with a total of 5 sessions (initial plan: 3 courses in 3 sessions) and the final seminar foreseen. The total number of participants in the transfer days (115), specialisation courses (106) and technical trips (54) amounted for 275 people.	Partially achieved (only pending: ORGEST integration). Immediate visibility of the transfer activities. Including new silviculture in ORGEST will be visible in 5 years
5+ municipalities participate actively in project development	We have involved technical or political staff of 4 municipalities in project development: · <u>Mataró</u> : 1 technician participating in the 3 rd and 4 th EAC meetings, in the preparation of C7.2 report, collaborating in C6.4 handbook and as speaker in the final seminar E5. · <u>Sant Celoni</u> : 1 technician participating in the 3 rd EAC meeting and collaborating in C6.4 handbook. · <u>Tordera</u> : 1 technician participating in the 3 rd EAC meeting, in the preparation of C7.2 report, collaborating in C6.4 handbook. · <u>Sant Climent de Llobregat</u> : the mayor participated as speaker in the final seminar E5	Partially achieved. Immediate visibility
10+ municipalities attending the communication-dissemination actions.	Besides the 4 municipalities mentioned above, there were 3 municipalities attending various transfer-dissemination events: · <u>Figueres</u> : one technician participating in the second specialization course · <u>Vacarises</u> : one technician attending the final seminar · <u>Sant Cugat</u> : one technician attending the final seminar Moreover, we sent, with the help from Diputació de Barcelona and Àrea Metropolitana de Barcelona, one unit of the handbook C6.4 to all the municipalities with peri-urban forest within their area of work (more than 125 municipalities).	Partially achieved. Immediate visibility

The main project amendment (the 9-months project extension) made it possible to successfully achieve most project outcomes from 2021 and 2022. Without this project extension, the following actions would have been affected:

- D2, D3, D4: these actions would have been done in much less time, which would have made it necessary to skip or simplify notably the final inventories and the variables considered.
- C6.3, D5, E2, E4, E5, E6, E7: as a consequence of the previous comment, most of the dissemination and transfer products (handbook, KPIs, Layman's report, final seminar, transfer days, specialization courses, articles, communications in conferences, communications in specialized media) would have been produced with a less consistent information dataset, and the conclusions would have been incomplete and/or biased. The last 5 technical papers and communications in conferences and seminars would not have been done, as they would have fallen out of project lifespan.
- The Life Cycle Analysis (D6) and the last exchange trip (E3-E9) would have been done in much shorter time, with a negative impact on their quality.
- It is also likely that the beneficiaries would not have been able to certify all the activities and therefore all the assigned budget.

With regard to the replication efforts, we manage to achieve the replication of MixForChange silviculture in 54 ha, i.e. 35% more area than the initial plan (40 ha). Moreover, this area was split in 10 properties, including private and public forests. The main replication impact has been achieved in collaboration with Barcelona Province Council (*Diputació de Barcelona*), who participated in most project dissemination activities (as either organizer or providing participants) and has expressed their commitment to continue replicating this silviculture in their network of Natural Parks.

With regard to the effectiveness of the dissemination activities, we managed to reach the target audiences of all the actions related to dissemination (8th objective in the table shown above). The initial plan was to conduct all the dissemination activities as physical events, but the Covid-19 outbreak made it necessary to make some of these events as webinars, including 3 dissemination days and part of the specialisation courses. This put a limitation in the quality of the dissemination, as a certain amount of the information should rather been transferred on the field, but in the other hand it allowed reaching a higher number of participants, especially, from areas outside Catalonia.

Finally, with regard to the policy impact, the main outcomes have been the following:

- **Local administrations (Barcelona province, Barcelona metropolitan area, municipalities):** the entity managing the larger of these contexts (*Diputació de Barcelona*) is a major player in the development and application of regulations and policies affecting forests: on the one hand, this entity has a well capacitated staff and a relevant budget to implement forest management activities and capacitate forest owners through the associations that DiBa has supported. Moreover, this entity has a key role in interacting with the municipalities' technical and political staff, so they can act coordinated.

Despite the forest administration is shared between the regional and national governments, and therefore is not of its competence, there are many land management policies affecting the potential of forest uses that are managed at municipal or supra-municipal level. These policies are related, among others, to establishing the potential uses that can be applied in the different land types, regulation of accesses, forest roads, auxiliary infrastructures that could be favourable to forest management (logistic yards for storing machinery or timber) or silvopastoralisme, etc. Moreover, local entities have a major role on creating demand of forest products (i.e. installing forest biomass boilers for public equipment or district heating...) and informing the society on the importance of keeping the municipal forests in good condition, which makes it necessary to apply sustainable and adaptive forest management. Therefore, local administrations have a key role on either enhancing or posing a difficulty in the application of adaptive forest management. Because of these reasons we have worked very closely with *Diputació de Barcelona* in many parts of the project, especially, the preparation of Handbook C6.4, the third meeting of the EAC, the final seminar, various articles and communications in conferences, replication of MixForChange silviculture in 33 ha, etc. We are confident that they will have a leading role in replicating MixForChange silviculture in the 12 Natural Parks and the 17 forest owners' associations that they manage, and on continuing disseminating the Handbook C6.4, of which they sent a copy to all the municipalities of their area with periurban forests.

During the project lifespan we have not achieved direct changes in local policies, but we have involved actively 4 municipalities and have 3 additional ones participating in the dissemination activities (see table above), which we think will lead to changes in attitudes toward the consideration of forests.

Finally, we supported the preparation of the “Real case of integration of climate change adaptation measures in local policies in Mataró municipality (Barcelona)”, which is a real case of policy measures that can make a difference in order to support (or to avoid contradictions) adaptive forest management, and that can be further adopted in other municipalities.

· **Regional administrations (Forest Ownership Centre):** this entity (acronym: CPF), that has been beneficiary of the project, manages the regional subsidies to private forest owners, which represent 76% of forest area in Catalonia. During the project development, the main actions that will have a potential impact on regional policies are:

- Cartography of climate change vulnerability in the working area (C6.1) and Memorandum of regulatory aspects to be modified at regional level to promote adaptive forest management (C6.2): these tools, coordinated by CTFC and CPF respectively, will be the roadmap for implementing changes in regional policies in the future.
- Report on the aspects to modify in the Catalan forest management guidelines ORGEST (E8): the ORGEST system is the backbone of forest management and planning through forest management plans in Catalonia. This system, launched by CPF and authored by CTFC and CPF, identifies 150 forest types (referring to species composition, site quality and lithology) and sets a series of management models for each of them, according to different prevalent objectives. When preparing a forest management plan, the ORGEST type must be indicated. In the mentioned report, coordinated by CPF, there is the plan on how to incorporate climate change adaptation within this system, which includes various sessions of technical discussion.
- The fourth meeting of the EAC also dealt with forest policies, and there was a relevant discussion on how to integrate tree marking, a key step in MixForChange silviculture, into the subsidies to sustainable forest management managed by CPF, with various options to consider, being the most feasible one the consideration of providing additional points to the subsidy proposals that incorporate tree marking within the forest management plan.

The other entity in charge of regional forest administration is the Catalan Department of Climate Action, Food and Rural Agenda, which has not been a partner of the project but that has been actively involved in three EAC meetings, in the final meeting and on several dissemination activities.

· **European Union policies:** we participated in the policy paper “A step forward in EU forest policy: the Mediterranean perspective”, produced in collaboration with EUBIA and 7 further LIFE projects, and presented in Brussels on May 31st, 2022, and introduced the project context and objectives in three additional EU-level events: EU LIFE Platform Meeting on Mediterranean CC Adaptation in Agriculture and forestry (03/18); Showcasing best climate practices in agriculture, forestry, food systems and bioeconomy (10/20); EIP-AGRI seminar: Turning Forest Innovation into practice (11/21). The aim of all these actions was to present the particularities of Mediterranean forests in the EU context, to induce changes in policy making, although it is unclear to us the impact achieved so far and in the near future. In any case, the main topic of the project (adaptive silviculture and close-to-nature silviculture) are, at present, a central part of the discussion on the new EU Forest strategy.

In short, during the project we have not achieved direct policy or regulatory changes, but we have paved the ground for achieving them in the short and medium term, both at local, regional, national and EU levels.

The main barriers identified to perform these changes are:

- The generally negative perception of the general society toward forest management, because of misconceptions and lack of capacitation. This problem is reflected on technical and political staff of local administrations, that are not familiar to the reality of forests and their needs. This barrier can be overcome with capacitation and sensibilisation, as the handbook C6.4 and the real case of adaptation of local policies by Mataró municipality.
- Poor knowledge on the potential use of forest products as a tool for climate change adaptation and mitigation, with direct (more healthy forests) and indirect (substituting non-renewable sources of energy and raw materials by bio-based products) effects. Once more, capacitation is the key to tackle this barrier.
- Lack of economic sustainability of forest management in most Mediterranean sites, which hampers the possibility of self-sustained forest management. One of the aims of MixForChange silviculture is to increase the economic sustainability of forest management, through the promotion of valuable broadleaved species.
- The slow speed and fear-to-change of public administrations to conduct policy and regulatory changes. We tried to involve as many experts from public administrations as possible in project development, in order to create a critical mass of opinion favourable to promote policies that can effectively unlock forest management.
- At EU level, a policy barrier affecting the potential of promotion of forest management in the Mediterranean is the lack of consideration of the particularities of these forests, that are predominantly abandoned (harvest rate around 20%, while the average in EU is between 60-70%). Once again, by participating in the EU-level events mentioned above we aim to inform policy makers on this particularity and on the different needs of Mediterranean forests compared to central and northern European ones.

EU ADDED VALUE OF THE PROJECT AND ITS ACTIONS (Grant Agreement Form B3)

We describe below how the project has delivered the results foreseen in the Grant Agreement Form B3:

Topic	Sub-topic	Aim in Grant Agreement	Result delivery
Contribution to climate objectives	Increasing resilience	Increasing complexity and reducing competition of Med subhumid forests	<u>Partially achieved</u> : we set the principles for increasing complexity in the future through capitalisation and the maintenance of all species present. We reduced competition (Hegyi index)
		Increased economic resilience through a silviculture that is more efficient in terms of costs, value of products and logistics and with an improved product value chain	<u>Partially achieved</u> : the first application of MixForChange silviculture led to a poorer economic balance than conventional silviculture (D4). However, it is foreseen that the repeated application of this silviculture, in stands whose structure is progressively more favourable to this silviculture, and with a growing provision of added-value trees (that have been promoted in this silviculture for first time), will lead to more favourable economic results than conventional silviculture.
		Awareness raising on society with regard to forest ecosystem services	<u>Achieved</u> : we have conducted several dissemination actions aiming to raise awareness related to forest ecosystem services and the need to apply a sustainable and multifunctional silviculture to promote them
	Reduction greenhouse gas emissions	Silviculture and logistics with lower carbon footprint and higher C stocking in the forest	<u>Partially achieved</u> : the silviculture proposed leads to lower investment in forest logging, hauling and transport (D4), which could reduce C footprint of forest operations. Moreover, it aims at producing timber products with longer service life (furniture, structural timber) than conventional silviculture (focused on bioenergy and package products). However, this effect will be observed in the medium term.
Contribution to Priority Areas and EU Policy Priorities	PA climate change adaptation	Development of EU CC policy through pilot & demonstration CCA silviculture models	<u>Partially achieved</u> : we applied and assessed the effects of a silviculture incorporating climate change adaptation criteria, and the results have been transferred to a wide range of stakeholders, including policy makers.
		Improvement of the base of knowledge and experience on the management of this forest	<u>Achieved</u> : we improved the knowledge base on these forests management, based on the demonstrative stands and their multi-criteria monitoring including control (non-intervened) stands
		Development of strategies and action plans with an integrated approach (forest – society - economy) of CCA, especially at local and regional level	<u>Achieved</u> : in handbook C6.4 we developed several measures that can be implemented by local administrations to ease climate change adaptation of peri-urban forests. Moreover, the memorandum C6.2 shows the main measures to update at regional level to enhance climate change adaptation of forests
		Development of silviculture and organizational models that can be transferred and applied to larger scale and are adaptable to other types of forest systems	<u>Achieved</u> : in actions C1-C4 we implemented a silviculture whose results have been transferred through many E actions and by handbook C6.3. This silviculture was replicated in 54 ha in Action C7.1. Finally, action C5.3 provides a pilot system of logistics and marketing of forest products, and the instructions to replicate it in other areas.
	Policy Priorities of EU in 2015	Intersectoral approach: multiple components of the problem addressed jointly: forest, economy, society and political-regulatory framework	<u>Achieved</u> : the project has run over a multi-disciplinary approach including forest ecology (D2), silviculture, forest dynamics and fire ecology (D3), socio-economic issues, hydroecological modelling, biodiversity (D4) and policy framework (C6.2, C6.4, C7.2), among others.
		Considering the green infrastructure aspect of peri-urban forests with an ecosystemic approach.	<u>Achieved</u> : we focused the monitoring of ecosystem services (D4) on those that are particularly relevant for climate change adaptation but also that are particularly relevant as peri-urban forests: structural vulnerability to forest fires, water balance, biodiversity, C sequestration.

Topic	Sub-topic	Aim in Grant Agreement	Result delivery
		Innovations in silviculture models, logistics and in social and political awareness	<u>Achieved</u> : the demonstrative silviculture incorporated the best available criteria of adaptive silviculture, close-to-nature and single-tree approaches, making it a very modern silviculture. We produced (C5.3) a new pilot methodology of logistics. With regard to social and political awareness raising we used all the tools available, including web site, mailing, twitter, webinars and physical meetings to maximise the impact.
		Adaptation in vulnerable areas: mountains, including adaptation to climate change in urban planning	<u>Achieved</u> : the work areas included peri-urban and mountain forests, as well as highly frequented areas (i.e. Montseny Natural Park). These type of areas poses additional difficulties to management, but open as well new opportunities for innovative and multifunctional management approaches such as MixForChange silviculture, that become an interesting alternative to conventional approaches.
		Contribution to sustainable water management	<u>Achieved</u> : in Action D4 we studied the effect of MixForChange silviculture on water balance, using the innovative Medfate model (De Cáceres et al, 2021). We calculated the impact of management on transpiration and on relative blue water.
		Vulnerability assessment	<u>Achieved</u> : in Action C6.1 we produced two vulnerability maps according to the main threats imposed by climate change in our conditions: vulnerability to forest fires and to drought.
	PA climate change mitigation	Improvement of the base of knowledge and experience. Development of strategies and action plans with an integrated approach and development of technologies, systems and methods that contribute to mitigation.	<u>Partially achieved</u> : in Action D4 we studied the carbon balance of MixForChange silviculture, although this was not the main aim of the project and could not be studied in enough detail. However, the silviculture proposed seems to have a promising interest from the mitigation point of view, considering that the timber products that are more intensely produced with this method (long-lasting uses such as furniture and structural timber) have a longer service life than the baseline options (biomass and packaging). Moreover, the innovative silviculture consists of lower intensity interventions compared to conventional silviculture, which could also help reducing the carbon footprint of silviculture application.
	PA Governance and information	Promote the social and political awareness and facilitate exchange of knowledge and practices for adaptation, embedded in a local and regional context.	<u>Achieved</u> : several actions have focused on raising social and political awareness (C6.1, C6.2, C6.4, E2, E5, E6) and on knowledge exchange (E2, E3, E6, E7, E9) related to adaptation practices.
Multipurpose, synergies, integration, transnational, green procurement, uptake		Biodiversity: promotion of the conservation values of natural habitats through sustainable forest management	<u>Partially achieved</u> : MixForChange silviculture aims to improve in the long term the biodiversity indicators. We studied in D2 flora richness and in D4 Forest Biodiversity Index: both indicators showed a generally stable trend with the innovative silviculture, with only slight and punctual decreases. We increased the proportion of trees with under-represented species and presenting dendro-micro-habitats of interest for wildlife. We improved the habitat condition (i.e. improvement of climate change adaptation indicators) of all the intervened habitats
		Water: improve forest function of hydrological regulation, water quality and water use efficiency improvement (blue water)	<u>Achieved</u> : in the hydrological modelling conducted with Medfate model (D4) we observed an increase in relative blue water and a reduction in transpiration. We did not monitor the effect on water quality, but the silviculture proposed, consisting on low-intensity interventions, should provide a more effective soil protection than high intensity silviculture. The reduction of structural vulnerability to forest fires should avoid the impact of potential forest fires on water quality.

Topic	Sub-topic	Aim in Grant Agreement	Result delivery
		Soil: improved forest functions on soil erosion prevention	<u>Unknown</u> : we did not monitor soil erosion. However, the silviculture proposed, consisting on low-intensity interventions, should provide a more effective soil protection than high intensity silviculture. The reduction of vulnerability to forest fires should reduce the impact of potential fires on soil erosion.
		Energy: promote sustainable and efficient production of renewable energy	<u>Achieved</u> : a significant part of the timber obtained in the demonstrative stands was used for energy purposes, substituting the use of fossil fuels
		Growth and employment policies: improve the economic balance of forest management and bioeconomy, improve added value products and expanding value chains / Businesses: promote raw materials to the industry, in quantity and diversity (including added-value products)	<u>Partially achieved</u> : MixForChange silviculture aims at improving the economic sustainability of forest management in the medium – long term, by increasing the share of added-value timber products to be used in furniture, veneer and building industries, therefore enabling its use in longer and more valuable value chains. Moreover, this management requires the involvement of capacitated staff, which should improve the quality of the work force operating in the forest.
		Promoting the sustainable management of resources and developing local economies	<u>Achieved</u> : the forest management applied has proven to sustainably produce local bioeconomy opportunities.
		Green Public Procurement	<u>Achieved</u> : we applied green public procurement criteria of the Catalan regional administration (compulsory for CTFC and CPF), following the EU GPP Toolkit.
Socioeconomic impacts and C footprint reduction		Reverse forest abandonment	<u>Achieved</u> : most of the demonstrative & replication forests had not been managed for decades, so the interventions done during the project has allowed recovering their multifunctional use
		Economic revitalization of the timber industry associated with these forests, improvement of employment and product range	<u>Partially achieved</u> : MixForChange silviculture aims at improving the provision of added-value timber products in the medium – long term, which should improve the employment in longer and more valuable value chains. Moreover, this management requires the involvement of capacitated staff, which should improve the quality of the work force operating in the forest.
		Landscape improvement and biodiversity conservation, generating a tourist asset	<u>Not studied</u> : we did not conduct analyses of landscape quality or tourism generation potential. However, the promotion of mixed and more complex forests with MixForChange silviculture should lead to forests with higher aesthetic values.
		Reduction of project C footprint: prioritise public transport travelling, encourage telematic meetings, optimize car routes; minimize the use of paper and use 100% recycled one, energy efficient computer equipment	<u>Partially achieved</u> : the rural placement of three of the four beneficiaries, and of all the demonstrative stands, put a difficulty in using public transport during the project. However, we optimised the car routes, shared vehicles to the maximum extent possible and conducted several internet-based meetings and webinars (2 out of 4 meetings of the EAC and 3 out of 6 outreach events were held via webinars).
Relation with biodiversity		Promote the conservation of natural habitats and their fauna and flora through sustainable forest management: Natura 2000 areas, Tilio-Acerion forests and other habitats of interest: 9340, 9240, 9260, 9330.	<u>Partially achieved</u> : as mentioned above, MixForChange silviculture had a minimal short-term negative effect on biodiversity, while it is expected to have a positive effect in the medium and long-term, due to the increase in complexity and the maintenance of all tree and shrub species (especially the sporadic ones), trees with interesting microhabitats and the careful, low intensity interventions that allow keeping a forest micro-climate.

Moreover, during the project lifespan, two new major strategies have been published at EU level, with direct links with MixForChange:

- **Adaptation Strategy** [Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change – COM(2021) 82]: there are various references of this Strategy that are closely linked to MixForChange: i) “promoting and sustainably managing forests”; ii) “integrating adaptation considerations in the way forests are managed”.
- **Forest Strategy** [New EU Forest Strategy for 2030 – COM(2021) 572]: close-to-nature and closer-to-nature silviculture is cited 6 times in the document, as a i) biodiversity friendly practice to be better defined (i.e. guidelines) and taken into account; and ii) as a voluntary certification scheme that could benefit from an EU quality label. A close concept, ecosystem-based management, is also utilised 3 times. Moreover, the concept of adaptation to climate change is transversal in this Strategy, as an essential approach to consider in both forest management and restoration, and to be promoted not only through direct application but also in research, knowledge exchange and dissemination programmes. Other concepts promoted in MixForChange (long-lived, added value forest products) are also mentioned in the Strategy.

6.4. Analysis of benefits

1. Environmental benefits

a. Direct / quantitative environmental benefits:

We have increased the resilience capacity of 218 ha of forests, based on the outcomes of actions D2-D4: we reduced competence (to increase vitality), improved water balance and reduced structural vulnerability to forest fires, without affecting biodiversity indicators or structural diversity. This was achieved beyond the initial expectation of 204 ha.

b. Qualitative environmental benefits

We have demonstrated the positive effects of an innovative silviculture that integrates climate change adaptation and close-to-nature criteria with the aim of achieving environmental and economic sustainability in the medium term. These two factors are essential to guarantee the adoption of these principles in the future, especially in order to prevent the abandonment of these forests. However, this silviculture system requires some adaptations in all the steps of the forest value chain, from an increase in the capacitation of forest workers, training of forest managers and practitioners, the consideration of this silviculture in the subsidy policy and support from local administrations and the general public. In the project lifespan we paved the way for a change in the way forests are managed in the work area and captured the attention of the Catalan forest sector on the benefits and potential of this innovative silviculture. Indeed, there are institutions as the Barcelona Province Council, a major actor in the regional forest sector, that have participated in the replication of MixForChange silviculture and that is planning to extend these principles in the 12 Natural Parks and the 17 forest owners' associations that they manage. In general, the attitude of the forest workers that applied the silvicultural treatments and of the practitioners that took part in the project trainings was very positive toward this management system, and we are confident that many of them will incorporate them in their daily activities. The activities with local administrations that are not directly involved in forest management (municipalities, supra-municipal councils, etc), as the guide C6.4 and the third meeting of the EAC, might have induced a change in attitudes toward the need to sustainably manage forest resources to generate bioeconomy opportunities while helping to adapt forests to climate change.

2. Economic benefits

The silvicultural method applied aims to increase the environmental and economic sustainability of forest management. The latter objective is based on the identification and continuous promotion of trees with high potential for valuable timber production. This aim is planned to be achieved in the medium and long term, and therefore during project lifespan we aimed at achieving a first step of identification of these added value trees and conduct, if adequate, a first release (selective thinning to promote them). We have therefore taken a first step in this process, although this aim can only be achieved if the silvicultural principles applied in MixForChange are continued in the future.

In the project we created 6.6 FTE, half of which corresponded to sub-contracted activities. This sub-contract activities (particularly forest works) were done, to a large extent, by non-qualified staff.

3. Social benefits

The silviculture applied aims to have more resilient forests, and therefore to guarantee the provision of the ecosystem services they provide for the benefit of local populations and the society in general. This was achieved successfully, as described in Action D4, where we showed the positive impact of this silviculture on ecosystem services including C sequestration, vulnerability to wildfires, biodiversity and water balance.

Moreover, a significant social benefit of MixForChange silviculture is that it is based on a detailed application which requires the increase in the capacitation (and therefore, the prestige) of planning and logging workers. The project resulted in a practical training of the forest workers participating in the application of the demonstrative silvicultural interventions, increasing their technical capacity and skills.

Finally, more than half of the FTEs of the project beneficiaries corresponded to female workers, so we contributed to balance the general male predominance in the forest sector.

4. Replicability, transferability, cooperation

There is an enormous potential, and a high likelihood of replication of MixForChange, both in the work area and beyond, while there are no technical limitation to its adoption. At present, the most feasible options for boosting the replication of this silviculture in the area of work are:

- the project beneficiaries: especially in the area of work of the 2 forest owners' associations that participated in the project, besides CPF as the entity supporting forest management in private forests (which represent 80% of forest area in Catalonia). Moreover, it is expected to continue promoting this silviculture in new projects, such as LIFE GoProForMed, which will start in autumn 2022.
- Barcelona Province Council: as mentioned previously in this section, this entity plans to continue with the capacitation of its staff in the planning and application of this silviculture, and its replication in the 12 natural parks and 17 forest owners' associations managed by this entity.

Moreover, only minor adjustments would be required to apply this silviculture in neighbouring bioclimates, including forests dominated by beech (*Fagus sylvatica*) or by other oaks (*Quercus*

faginea, *Q. pyrenaica*) or pines (*Pinus nigra*; *P. pinaster*) not considered in MixForChange work area, as well as on alluvial forests. Therefore there is a great potential for replicating this silviculture, being the sensibilisation of forest owners and the technical capacitation of forest workers and managers the main limiting factors.

The potential replication in Spain and at EU level is also very relevant, through entities as Pro Silva (present in most EU countries) and building upon emerging initiatives that aim to promote adaptive and close-to-nature silviculture, which has reached the political agenda in the frame of the EU Forest Strategy and the EU Adaptation strategy mentioned above.

The target of achieving economic sustainability is in the core of this silviculture, which focuses on rationalising forest works, that are concentrated on promoting the trees which will increase their value exponentially in the future. However, this aim can be only achieved in the medium and long term, which disincentivise the potential for market-driven support to this silviculture. At present, it seems more feasible to achieve a policy-driven replication, i.e. public entities (and custody organisations) who take the lead and adopt this silviculture as a demonstration of good practice. In this sense, it is likely that a limiting factor to the application of forest management in general, that is the misled social concern on the possible negative impact on forests, could be overcome based on the environmental benefits demonstrated by this silvicultural approach, which can receive support by stakeholders such as environmental NGOs.

Moreover, new market-driven opportunities can come up in the current framework of raw materials crisis, with increasing costs of imported resources, which could increase the interest toward promoting the application of forest management, including the model proposed in MixForChange. There are also emerging potential sources of funding for this added-value silviculture as the Climate credit developed in LIFE Climark project: this system aims to create a market to finance forest management considering its impact on carbon, water and biodiversity together, three factors that are addressed by MixForChange silviculture, unlike silvicultural alternatives focused only on carbon.

5. Best Practice lessons:

In the development of the project we have identified the following best practices:

- The detailed application of this silviculture is the best guarantee to achieve all the multiple goals set at stand level, although they are individually prioritised at micro-site level. In this sense, tree marking, which is only seldom applied in the work area, is essential to achieve an accurate application of this silviculture.
- We created tools to ease the planning (pilot logistics system C5.3; guide C6.3) and application (protocol for standing timber quality assessment C5.1; guide C6.3) of this silviculture.
- The capacitation in this silviculture must be done preferably on the field. We conducted 3 on-field trainings and 3 on-field transfer days, and the future training efforts should continue this approach.
- The interaction between the forest sector and the local administrations without direct competence on forest management (municipalities and supra-municipal entities) led to fruitful debates and created interesting synergies. It came up that the integration and coordination of local policies, climate change adaptation and forest management, especially in peri-urban forest is a major gap which must be explored.

6. Innovation and demonstration value

Innovation and demonstration were at the forefront of MixForChange project, with the development, assessment and transfer of a silviculture that incorporated up-to-date criteria of climate change adaptation and close-to-nature principles as the core of the project. We demonstrated the benefits and potential of this silviculture to multiple stakeholders.

As mentioned above, we created innovative tools to ease the adoption of this silviculture and to improve forest management practice in general: pilot logistics system C5.3 and protocol for standing timber quality assessment C5.1.

Moreover, we used innovative tools during project development:

- GIS-based mapping of vulnerability to drought and wildfires (C6.1) to support decision-making on where to prioritise silvicultural interventions.
- MedFate model of water balance (De Cáceres et al, 2021), which allowed the calculation of the impact of MixForChange silviculture on relative blue water and transpiration.
- Forced by the covid-19 mobility restrictions, we conducted several coordination meetings, 2 workshop-meetings of the EAC and 3 transfer events as webinars, all of which was foreseen to be conducted as physical meetings. Some of these events were recorded so they can be consulted in the future. Compared to physical meetings, this form of information exchange helped reducing time, emissions and travel costs, and increased the number of participants in the events, although they inherently limit information fluxes between all the participants. However, these information channels will remain as eligible models in the future.

7. Policy implications

The policy implications of the project can be organised at two levels:

- Local administrations (municipal and supra-municipal entities): the main tangible outcome was to prepare, in collaboration with Mataró municipality, the Real case of integration of adaptive forest management in local policies (C7.1, Annex T8), whose implementation is ongoing (Annex T9). Other actions aimed to induce policy changes in local administrations, based on a close collaboration with them, were the C6.4 handbook, the third workshop-meeting of the EAC and the final seminar, all of them focused on sensibilising on the need to integrate local policies and adaptive forest management.
- Regional administration: we were not able to meet the aim of inducing changes in the ORGEST system (Guidelines for forest management in Catalonia), as CPF, project beneficiary and entity managing this tool, decided to postpone these changes based on the knowledge gained in three different projects related to forest management in Catalonia (LIFE MixForChange, LIFE Climark and LIFE Biorgest – still ongoing). Moreover, we produced tools to support decision-making, such as a Memorandum of regulatory aspects to be modified in the regional policies to promote adaptive management of sub-humid Mediterranean forests (C6.2), the cartography of climate change vulnerability of these forests (C6.1) and the catalogue of timber products done with valuable broadleaves in Catalonia (C5.2). It was also discussed at the 4th workshop-meeting of the EAC how to incorporate tree marking at the regional policy of forest subsidies.

In short, we could only have a limited impact on policies during project lifespan, limited by the slow dynamics of public administrations, although it is expected that in the first years of the after-LIFE period there will be changes implemented both at local and regional level.