

# Deliverable N<sup>o</sup> 21

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## **REPORT OF PARTICIPATORY PROCESS**

UPV

7/19/2021

This document presents the report on public participation for the development of the Decision Support System.

## ***PARTICIPATORY PROCESS***

### ACTIONS C.1:

Development of a decision support system



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**Deliverable 21; name:** *Report on participatory development of the DSS tool*

**Beneficiary responsible:** UPV

**Action C.1:** *Development of a Decision Support System*

From month 9 – month 34

Name of the Deliverable	Number of associated action	Deadline
Report on participatory development of the DSS tool	C.1	07/2021

## 1. Introduction

Decision support systems (DSS) are essential tools that enable forest managers to consider the offsetting among different Ecosystem Services (ES) and its economic and legal implications that interfere with forest planning (Segura et al., 2014). DSS are interactive and flexible tools that enable managers to make appropriate management and planning decisions when confronted with an ill-structured or unstructured problem through direct interaction with data and analysis models (BfG, 2000; Mc Nurlin and Sprague, 2004). When based on computer programming, they can provide help to decision makers to solve complex problems, as thanks to computer processing, the process of human judgment or processing can be accelerated to achieve the best results (Rauscher, 1999; Martinsons & Davison, 2007).

In natural ecosystems, a multitude of complex processes take place, which when it comes to making decisions, makes it difficult for the manager to act. In order to achieve sustainable management of ecosystems, it is necessary to understand the trade-offs among ecological, economic and socio-political aspects involved in their processes, where DSS can play a crucial role. Developing a useful DSS tool implies having a good technical but also practical background, otherwise, the tool could be technically good but fail in its applicability or vice versa. In order to achieve both qualities, besides relaying on a good and multidisciplinary technical team, working with the final users is also crucial. Including the insights of the final users in a tool (or a product) may increase its potential.

The DSS tool developed in this project, CAFE, aims to be flexible and applicable to any forest ecosystem, which means many different socio-ecological realities and needs, and including all of them (or as much as possible) necessarily implies working with the final users at different levels and in different countries. Private and public forest owners could have different needs and goals, usually public owners are more focused on conservation and the aesthetic values of forests, while private owners are probably more focused on productivity. Engaging both actors would lead to a useful and broad tool, which is one of the goals of this project. This engagement is usually carried out through participatory design, which entails user participation in design for work practice. It is a democratic process for design (social and technological) of systems involving human work, based on the argument that users should be involved in designs they will be using, and that all stakeholders, including and especially users, have equal input into interaction design (Kuhn & Muller, 1993).



As stated by Schell and O'Brien, 2015, co-design sessions such as those established in a participatory design, have several benefits for the design process. By bringing “non-creatives” in at our ideation stage and encouraging them to contribute, we demystify our process and give stakeholders a sense of ownership of the ideas. A demystified process leads, in the long term, to better requirements and feedback, as stakeholders learn what works for us. Ownership of the ideas gives stakeholders more impetus to comprehend and internalize the thinking behind design decisions, and leads stakeholders to defend those decisions when they are challenged.

This document presents the process and results of the participatory design and development of the DSS tool. However, RESILIENT FORESTS team would like to highlight that this process is not over yet, as we plan on working with the users for at least 4 more years and provide and apply improved versions of the tool by periodically including their insights.

### **3. Objectives**

The main goal of the action C.1 is to develop a tool (a geospatial Decision Support System, DSS) that enables a better forest management and the adaptation and mitigation of forests to climate change. In this sense, this particular deliverable contributes to this action by compiling the collected information from all the stakeholders contacted during the participatory design and development of the DSS tool.

## 4. Methodology

Co-design workshops, webinars and/or workshops are about starting the process or gaining consensus on a creative direction to solve an individual problem (Schell and O'Brien, 2015). Once the event is complete, the outputs can be collected and used to inform the work, sieving out the ideas that don't work and honing the ones that do (Schell and O'Brien, 2015). The participatory development of the DSS tool has been carried out by working directly with the stakeholders at national and international level. This work has been carried out by individual meetings, webinars and/or workshops at each country. Each team is different, and it is necessary to spend time working out which encouragement techniques work for your individual participants (Schell and O'Brien, 2015). Thus, each event was adapted to the type and interest of the stakeholder/s reached, although a common general methodology was followed:

1. Stakeholder's mapping: at this step, each partner develops a list of potential stakeholders to contact with. This list is not static, but it is continuously improved with the progress of the project.
2. Contact to explain the project: the stakeholders are individually contacted to explain the project and the work we would like to develop with them. If at this step we are looking for a broad public, here we used social networks to promote the event.
3. Explaining the DSS tool and its state: once the public (broad or specific) knows about the project, we explain with more or less detail, depending on the public, the DSS tool and its current state. The main points are:
  - a. What is it?
  - b. What can I use it for?
  - c. How can I use it?
  - d. What do I need to use it?
4. Feedback: at this point, we ask about their opinion on the tool, what would they modify, include and/or remove, if it would be useful, etc. This feedback could be asked using a debate format or as written questions to be answered anonymously.
5. Analysing and including the feedback into the DSS tool: all the feedback is collected and analysed. Then, the technical team of the DSS development study the possibility of including this feedback into the DSS tool, and if so, it is included.

These events have been carried out using both, online and presential formats, according to the pandemic situation of each country.



## Description of the activities developed under Action C1

The developed activities are described according to the targeted audience, differentiating between national and international.

### 1.- Practical workshops with GVA

A series of three participatory workshops with public owners from Valencian Regional Government (GVA) was developed (05/2019). The workshops were designed on the one hand, to show the project to a very relevant stakeholder, and on the other hand, to ask their feedback about the metrics that should be considered into the DSS tool and also about the current barriers in forest management. The workshops had a duration of 4 hours, with an intermediate coffee break. The participation combined online, debate and written formats in order to give the attendants as much flexibility as possible when expressing their opinion. The structure of the workshops was the following:

1. Welcome.
2. 2 firsts questions using the tool mentimeter (<https://www.mentimeter.com/>):
  1. Which do you think are the main forest ecosystem services?
  2. Which do you think are the main challenges of forest management?
3. Antonio del Campo contribution: eco-hydrological silviculture.
4. Alberto García-Prats contribution: tools for forest management.
5. 2 more questions with the tool mentimeter.
  1. Which do you think the main goals of forest management should be?
  2. What should be the scale when implementing sustainable forest management?
6. María González-Sanchis contribution: LIFE RESILIENTFORESTS.
7. Question with mentimeter.
  1. Rate from 1 to 5 the main obstacles of forest management.
8. Coffee break.
9. Participation LIFE RESILIENTFORESTS.
  1. Brief presentation.
  2. Discussion about the previous answers to mentimeter's questions.
  3. Case study: a practical example to set the forest management priorities.
  4. Last mentimeter question.
    1. Rate the usefulness of the DSS tool from 1 to 10.

5. Questionary about the workshop: paper that the attendee has to fill and give back to us (Figure 1).

#### 10. Closing.

A total of 30 participants attended the workshops, and all of them contributed with their feedback about the DSS tool (see Results section for contribution details’).



Coupling water, fire and climate resilience with biomass production in Forestry to adapt watersheds to climate change (LIFE17 CCA/ES/000063)

#### JORNADAS DE GESTIÓN FORESTAL ANTE EL CAMBIO CLIMÁTICO (UPV-GVA)

FECHA: 03/05/2019

LUGAR: Castellón

#### ENCUESTA

Por favor responde a las siguientes preguntas:

1.- Empresa en la que trabajas:

2.- Cargo que desempeñas

3.- Edad:

4.- Sexo:

Valora del 1 al 5 las siguientes afirmaciones, siendo 1 totalmente en desacuerdo y 5 totalmente de acuerdo.

1.- El alcance y la agenda de la jornada fueron claros y comprensibles

1	2	3	4	5
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2.- El diseño de la jornada fue adecuado para alcanzar los resultados esperados

1	2	3	4	5
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3.- Las discusiones entre grupos fueron bien moderadas e inclusivas con todos los participantes.

1	2	3	4	5
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4.- El lenguaje fue adecuado y entendible

1	2	3	4	5
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5.- ¿Qué fue lo que más te gustó de las jornadas?

6.- ¿Hay algún aspecto que mejorarías?

Figure 1: Questionary.

## 2.- Individual meetings

DIVALTERRA

Two individual meetings with the company Divalterra (with Álvaro Escrig, head of Forestry Brigades) were carried out. The aim of the meetings was to show Divalterra the potential of the DSS tool, and to ask for their feedback about the usefulness and the metrics to include into the tool.

Meeting 1: During this meeting (07/2020), the project RESILIENT FORESTS was exposed to Divalterra, and more detailed, the DSS tool. A discussion was opened about how the project could be useful for the forest management carried out by Divalterra, and if was there anything about the DSS tool that should be improved to become more useful.

Meeting 2: It was an online meeting where both parts agreed on the particularities of the case study that would be run with the DSS tool. The case study was located in Serra, and the Forest Working Units (FWU) they were interested in corresponded to the Strategic Management Points the regional government developed. Furthermore, among these points, Divalterra was only interested in those whose owner was the public administration (see Figure 3).

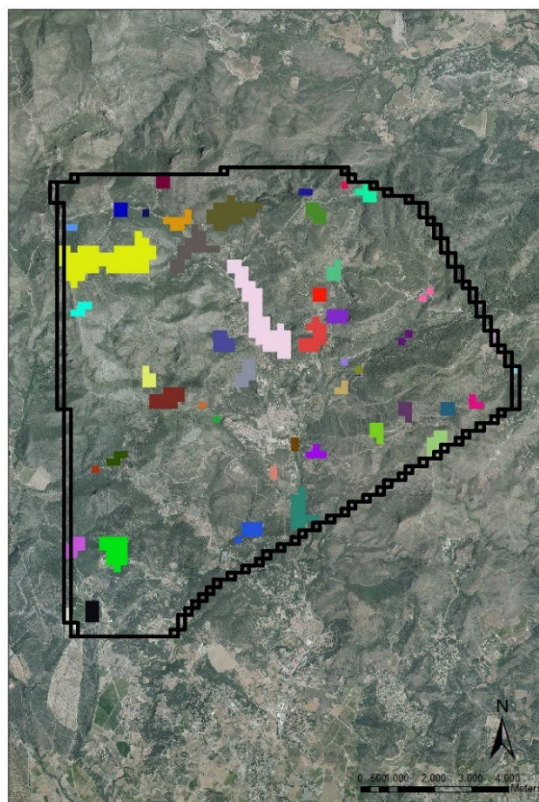


Figure 3: Selected FWU for the case study with Divalterra.

One individual online meeting with Centre Propietat Forestal de Catalunya (27/04/2021) was held in order to show the DSS prototype and its potential applications, asking them for their feedback about the usefulness and the metrics to include into the tool.

#### *DIRECCIÓN GENERAL DE BIODIVERSIDAD Y RECURSOS NATURALES* of MADRID

One individual online meeting with Dirección General de Biodiversidad y Recursos Naturales (5/6/2021) was carried out to show them the DSS tool prototype and talk about multiobjective forest planning and management.

#### FAO

One meeting with FAO (23/06/2022) at their headquarters in Rome was organized in order to present the DSS tool prototype and seek the possibility of combining the DSS tool with their tool (Forest & Landscape Water Ecosystem Services (FL-WES) Tool).

### **3.- Technical course**

A technical presentation of the idea of the DSS tool was developed (08/11/2019) together with a course of the platform Google Earth Engine in order to seek the possibility of including it into the DSS tool as an easy way to prepare the tool inputs. A total of 25 people participated in this event and gave us their feedback about including GEE in the DSS tool.

### **4. Webinar with Portuguese audience**

A webinar named “*Uma ferramenta de apoio à gestão florestal em bacias hidrográficas*” (EN: A tool to support forest management in watersheds) for a Portuguese audience on 26 February 2021, was organized by ADAI, iama and Eubia. The webinar focused on the Decision Support Tool and its application in different case studies developed in Portugal (Ceira River Basin), Spain and Germany. The presentations were given in Portuguese and in Spanish, spoken slowly for better understanding of the attending audience.

The workshop had a duration of two hours, according with programme presented in the next table. Since the limit of the number of participants in the webinar was 500 (limits of the contract with Zoom), and because the day before the event we already had 493 registrations, the webinar was extended to the ADAI YouTube channel ([www.youtube.com/user/ceif2011](https://www.youtube.com/user/ceif2011)). At the end the participation in the webinar was: 156 participants in the main hall (Zoom) and 141 attending through the Youtube Channel. So far, the number of visualizations is 540.

Table 3: Program of the Webinar on 26th of February 2021, organized by ADAI.

Hour	Description	Speaker (Institution, country)
11h00	Welcome	Domingos Xavier Viegas (ADAI, PT)
11h10	Portugal: forest profile	João Pinho (ICNF, PT)
11h30	Resilient Forests Project	María González Sanchis (UPV, SP)
11h45	The decision support tool “Resilient Forests”	Javier Pérez Romero (IIAMA-UPV, Sp)

12h00	Biomass management: the case study in Spain	Pilar Mocé (Ayuntamiento de Serra, SP)
12h10	Ecosystem management: the case study in Germany	Harrie Jan Franssen (Julich, GE)
12h20	Forest fire risk management: the case study in Portugal (Ceira Basin)	Alicia García Arias (IIAMA-UPV, SP) / Miguel Almeida (ADAI, PT)
12h30	Debate	Moderator: Luís Mário Ribeiro (ADAI, PT)
13h00	Closure	Domingos Xavier Viegas (ADAI, PT)

## 5.- Meeting with Eiffel National Park (Germany)

In November 13<sup>th</sup> of 2019 the project held a meeting with Eiffel National Park where the project was exposed and its utility was discussed. The participants were from RESILIENT FORESTS side, Jülich, UPV and EUBIA teams, and from the Park, the director of the Park.

## 6.- Workshop with German audience

On May 26 2020 the Forschungszentrum Julich organized a n online workshop, with the aim to present the results of the Resilient Forests project in more detail to the most important stakeholders, and to get also their feedback and contributions in the form of presentations. Another main aim was to present the DSS to the German stakeholders and get their feedback. The program of the webinar is listed below in Table 4.

First work by FZJ, mostly in the context of the Resilient Forests project was presented. The work by Klaus Goergen presented the regional climate projections for the Resilient Forests sites and feedback from the stakeholders was, to which degree these projections also capture specific local conditions, and that extreme events would play an important role and that climate projections should improve in this regard. Lukas Strebel presented the developed methodological framework with land surface model simulations and data assimilation, and the impact of climate change on drought and fire risk for the Wustebach area in Germany, which is one of the Resilient Forests sites. Nicolas Brüggemann presented experimental work in this area with a focus on the drought period of the last years and the massive tree mortality in the area. There were also two presentations by the European Forest Institute focusing on forest management and resilience of forests.

Table 4: Program of the workshop organized by FZJ on 26 May 2020.

13:00 - 13:05	Welcome and short introduction
13:05 - 13:20	Regional climate (change) information related to the Resilient Forests DSS (Klaus Goergen, Forschungszentrum Julich)
13:20 - 13:35	Forecasts for the future risk of droughts and fires in European forests (Lukas Strebel, Forschungszentrum Julich)
13:35 - 13:50	MOSES measurement campaign Northern Eifel 2020-21 on the effects of the dry years 2018-20 on spruce forests – first results (Nicolas Brüggemann, Forschungszentrum Julich)

13:50 - 14:00	Resilience Assessment of the Forest Socio-Ecological System (Marcus Lindner, EFI Bonn)
14:00 - 14:10	Martelscope as a training tool for integrative forest management (Jakob Derks, EFI Bonn)
14:10 - 14:30	Short question and discussion round
14:30 - 15:00	Presentation of Decision Support Tool Resilient Forests (Maria Gonzalez-Sanchis, Technical University of Valencia):
15:00 - 15:30	Feedback and discussion on the decision support system

Finally, Maria Gonzalez-Sanchis presented the DSS tool. Afterwards, there was a quite long discussion about the tool which was also longer than originally expected. The three main questions which were discussed in this round were: (i) should more objectives be added to the DSS and should they be differently weighted?; (ii) which additional stakeholders should be talked to?; (iii) how can the DSS tool be used in practice? Important feedback was that the EFI stressed that it would be important that the DSS is based on sound simulations, which have been proven to reproduce reality quite well. In this sense, Marcus Lindner from EFI stressed a stronger focus on the model simulation tools and the careful evaluation of the realism of the simulations.

## Description of the activities developed under other Actions but that did contribute to DSS development

### 1.- Networking

Despite the fact that Networking activities are not included into this action, we would like to report the ones that significantly contributed to the DSS development. At Spanish level, two projects were involved into this participatory development of the DSS tool: [Silvadapt.net](https://silvadapt.net) and [SINCERE](https://sincere.es).

[Silvadapt.net](https://silvadapt.net): is a national Spanish project to unify the results obtained by the different research groups in Spain, trying to give clear answers about the disturbances and problems associated with climate change, and thus help in the generation of new criteria to manage the forest. LIFE RESILIENT FORESTS participated in the first meeting of Silvadapt.net (20-21 February 2020) and show the project members the experimental plots that provide the necessary field data to feed the DSS tool development. The DSS tool was exposed during the meeting, and their feedback was collected in a debate format. From this meeting, RESILIENTFORESTS started to work closely with the Biodiversity working group in order **to include X-Biodiversity as a management goal**.





Figure 5: Visit of Silvadapt.net to the experimental plots used in RESILIENT FORESTS.

**SINCERE:** Spurring INnovations for forest eCosystem sERvices in Europe (SINCERE) is a project funded through the European Commission's Horizon 2020 programme that will develop novel policies and new business models by connecting knowledge and expertise from practice, science and policy, across Europe and beyond. The contact with this project consisted in the participation of RESILIENT FORESTS in a Management Meeting of SINCERE (March 2020). During this meeting, both, the project and the DSS were exposed. As a result, RESILIENT FORESTS established contact with Bizkaia regional government, Berriatúa's forestry association (private owners) and [Basoa](#) foundation and started the participatory DSS development process that led to not only to the DSS improvement, but also to the establishment of an experimental plot to validate the DSS results (see more details in the Results section). From this very same meeting, several online meetings with Bizkaia regional government, Berriatúa's forestry association and [Basoa](#) foundation have been held and will continue at least until the end of the project. The first meetings were devoted to show them in a detailed way the DSS too, its potential and application possibilities. From there, the stakeholders gave us their insights, with which we improved the DSS tool and applied to a particular study case in Berriatua.



Figure 6: Visit to the potential experimental area in Berriatua, Basque Country (Spain).

## 2.- Workshop / Info Day Portugal (E1.4)

On 21 October 2019, the 1<sup>st</sup> Resilient Forest Workshop /Info Day in Portugal was held at the Laboratory for Studies on Forest Fires, in Lousã (Coimbra). The main purpose of this workshop was to make the project known to several local and national entities and inquiring about the possibility of cooperation. This event was attended by representatives of various entities with responsibilities in the areas of forest management, namely: Municipality of Lousã, Municipality of Gois, Municipality of Pampilhosa da Serra, Municipality of Arganil, Municipality of Miranda do Corvo, Portuguese Association for the Environment, Institute for Conservation of Nature and Forestry (ICNF), CESAM – UA, Center for Biomass for Energy (CBE), Reflorestar a Lousã com Espécies Nativas, Civil Protection Authority (ANPC), Agency for the Integrated Management of Rural Fires, Lousã Community Land Association, Vila Nova Community Land Association, Forest Association of the Municipality of Góis, Dueceira, Pine Forest Association (Aflopinhal), Social and Agro-Forestry Cooperative of Vila Nova do Ceira (CRL), Agency for the Tourist Development of the Schist Villages (ADXTUR). Following this event, the Resilient Forest Project was disseminated in several regional newspapers. As mentioned before, this is an info-day that belongs to Action E1.4, but some useful information to improve the DSS tool was obtained and therefore used.

The agenda of this event is presented in the following table.

Table 2: Agenda of the Workshop /Info Day on 21th of October, 2019, organized by ADAI.

Hour	Description
14h00-14h15	Welcome and presentation of LEIF (ADAI, Coimbra University)
14h15-14h30	Presentation of the project and objectives of the meeting (Universidad Politécnica de Valencia and ADAI)



14h30-	Study carried out in the Ceira River Basin (CESAM, Aveiro University)
14h50	Presentations of projects with the participation of Municipal Councils: <ul style="list-style-type: none"> <li>- Lousã Municipal Council,</li> <li>- Góis Municipal Council,</li> <li>- Pampilhosa da Serra Municipal Council,</li> <li>- Arganil Municipal Council,</li> <li>- Miranda do Corvo Municipal Council</li> </ul>
15h45	Interventions of the context <ul style="list-style-type: none"> <li>- Portuguese Environment Agency</li> <li>- Nature Conservation and Forests Institute</li> <li>- Reforestation of Lousã with Native Species</li> <li>- Dueceira</li> </ul>
16h00	Discussion and exchange of ideas to define the possible applications of the project
17h00	Group photo, social snack and demonstration

### 3.- International webinar (E1.4)

After the outbreak of the pandemic crisis, RESILIENT FORESTS started to organize online dissemination events focusing on the activities carried on within the project and on the DSS tool. In one of these activities there was a direct interaction with the audience that contributed to the development of the DSS tool. It was a webinar that took place on the 27<sup>th</sup> May 2020, entitled “*Innovative solutions for Forest management: the experience of LIFE Resilient Forests*”. The event was moderated by Maurizio Cocchi (EUBIA) and the main speakers were Maria González Sanchis, Antonio del Campo, Félix Francés, Manuel Pulido (All from UPV).

### 4.- Individual meetings (E1.4)

In April 2021, an individual meeting with private forest owners from Finland was held. The meeting lasted for two hours during which the project and DSS tool was explained using Divalterra’s practical example. Then, a debate was initiated in order to receive the feedback about the DSS tool performance and usefulness.

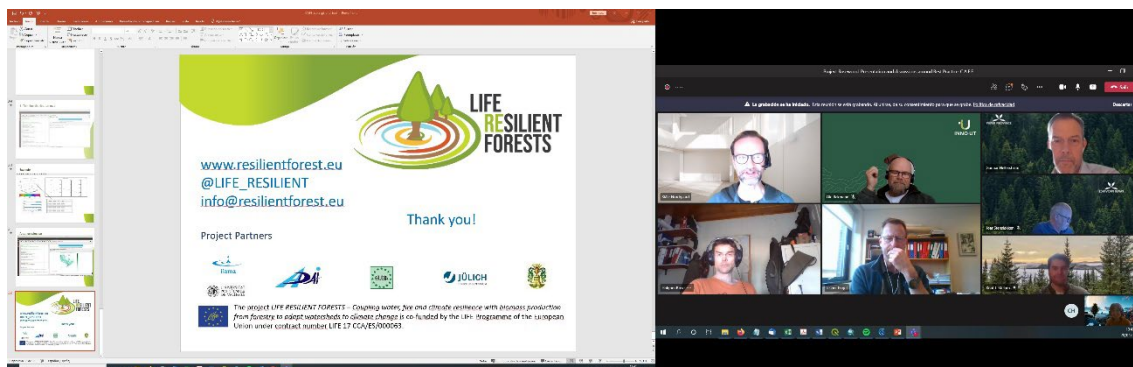


Figure 7: On-line meeting with private forest owners from Finland in April 2021.

## 6. Results

The particular results and contributions from each event are exposed here below.

### AT NATIONAL LEVEL:

#### 1.- ACTIVITIES WITH SPANISH AUDIENCE

##### 1.1.- Workshops

##### 1.1.1- Practical workshops with GVA

As mentioned before, during these workshops specific questions were asked to the audience in order to collect their feedback about the DSS tool and also, about the current barriers in forest management. Regarding the DSS feedback, there were two key questions that gave us the feedback we needed to tune the DSS, and they were:

1. Which do you think are the main forest ecosystem services?
2. Which do you think the main goals of forest management should be?

Figures 7 and 8 show the answers of the 30 attendees, expressed as percentage, to these questions. According to the answers, forest management should consider as main goals: water (quantity and quality), climatic resilience, fire risk, biodiversity and soil protection and recovery. RESILIENT FORESTS team received this feedback and started to analyze the possibility of translating all these management goals into metrics that the DSS tool can work with.

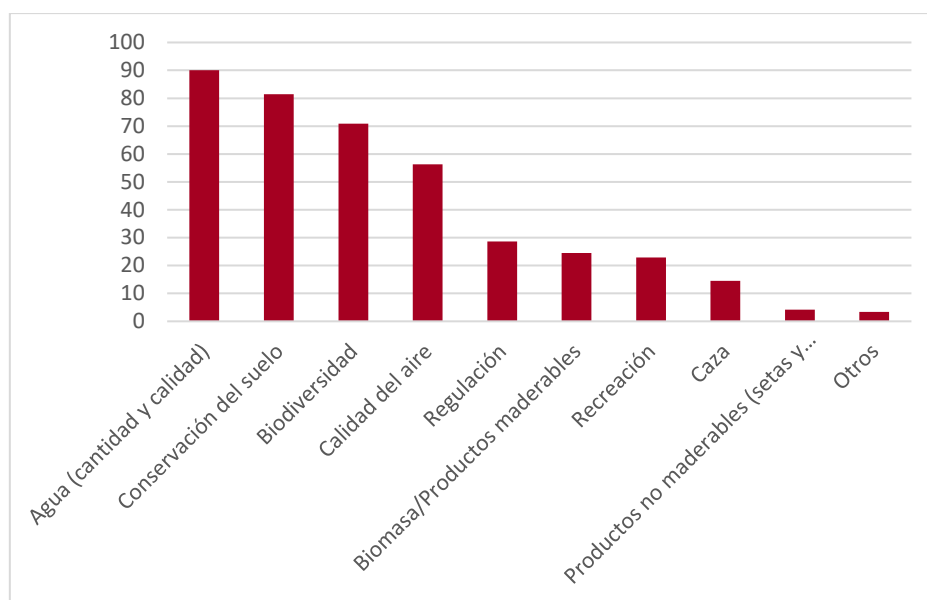


Figure 7: Answers to the question: Which do you think are the main forest ecosystem services?

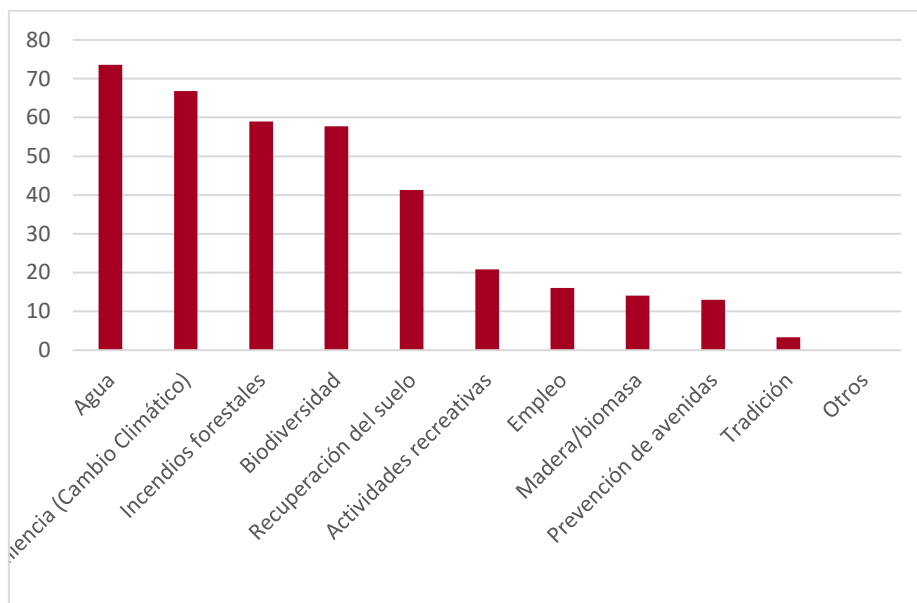


Figure 8: Answers to the question: Which do you think the main goals of forest management should be?

Likewise, some questions and debate were established in the workshops in order to identify the main barriers that forest management presents nowadays at this particular region (Valencian region). In this sense, we asked: Which do you think are the main challenges of forest management? To the audience, followed by an open debate with the answers (as the questions were formulated using mentimeter).

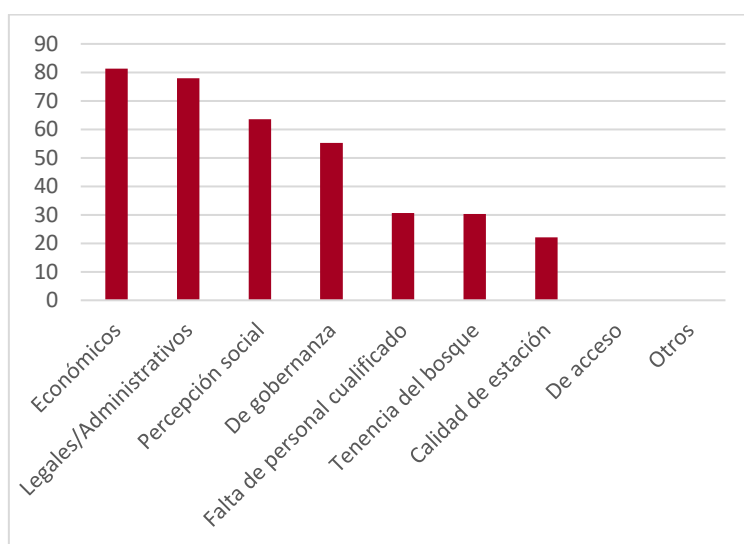


Figure 9: Answer to the question: Which do you think are the main challenges of forest management?

Figure 9 shows the answers expressed in percentage. According to this result, it was clear for RESILIENTFORESTS team that some economic aspects of forest management should be explicitly

included into the DSS tool, and some extra work should be carried out in order to help changing the social perception of forest management.

## RESULTS AND CONCLUSIONS:

These workshops reinforced the need to include water (quantity and quality), climatic resilience and fire risk as metrics into the DSS tool. These three metrics were already being considered into the DSS development, however, it was necessary to verify its acceptance and usefulness among the potential users. On the other hand, the audience also stated the need **to include both biodiversity and hunting** into the DSS tool. In this sense, biodiversity has been included as a metric, but hunting remains in standby until the development team finds the way to do it.

### 1.1.2.- Practical workshop at Serra

Action C3.1 held a participatory workshop in Serra in order to develop the replication and transfer strategy. Although this event does not belong in the current action C1.4, some results where also used to improve the DSS tool as follows:

1. About the DSS utility for municipal competences the audience highlighted it under the following situations:
  - a) Villages with high forestry area and wildland urban interface in order to manage the fire risk.
  - b) Prioritising interventions in these villages that present their Forest Fire Management Plans that are nowadays mandatory in order to maximise financial resources they have.
  - c) To enhance and prioritise the economic contribution from the public government for forest management.
  - d) To define which ES should be prioritized.
  - e) To carry out a common forest management approach when the owner of a public forest is more than one City Hall.
  - f) To know the potential ES provisioning and management of a forest.
  - g) The tool is also useful in pedagogical terms to justify and/or raise awareness about the actions of groups or individuals who do not consider forest management necessary and oppose the actions.

These inputs **reinforced the utility of the DSS** tool not just to optimize the forest management, but also to quantify the forest ES.

2. Regarding those important elements (some ecosystem services, some requirements/conditioning or/ and variables of forest management) they consider important for their work and miss in the DSS tool:
  - a. Recreational value
  - b. Management costs
  - c. Hunting
  - d. Other managements such as bee keeping, grazing, etc.

RESILIENT FORESTS team acknowledges the input and will work in the future on including hunting, recreational value and other managements, at least agricultural. Regarding the management costs, the development team is already working on this, but not as a decision variable, just an informative metric, otherwise, the optimization will change from multi-objective to mono-objective.

3. Limitations and/or constraints to implement forest management models provided by the DSS
  - a. Prevalence of private ownership hindering forest actions
  - b. Lack of awareness among local people about the need of forest management and/or the risks of non-management
4. Prioritization of the ES included in the DSS. Figure 10 shows the ES rated, where fire risk reaches the highest value followed by water and climatic resilience. This result states once again the high interest on the used metrics, and therefore the utility of the DSS tool.

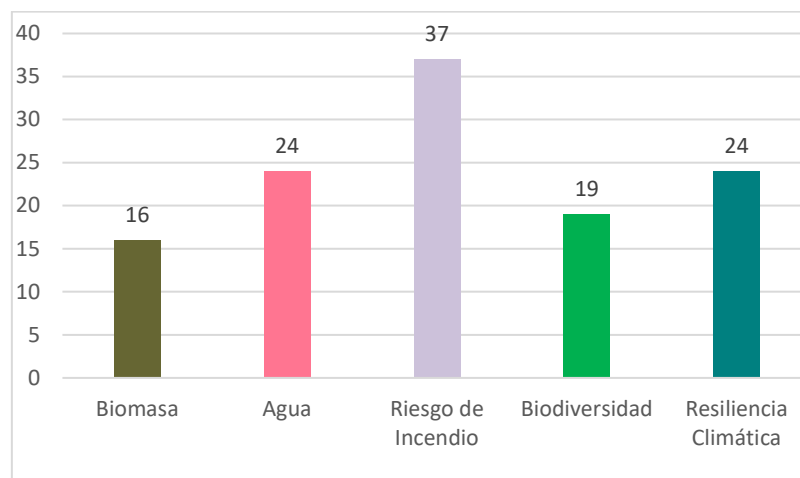


Figure 10: Rates of the considered ES in the DSS tool at the Serra's workshop.

### 1.2.- Individual meetings.

Meetings with Divalterra constituted the first real case study outside of the project partners where the utility of the tool as both, quantifier and optimizer, could be demonstrated and evaluated. In this sense, Divalterra first stated their interest into accompanying their forest management with an accurate quantification of ES as a way to boost forest management and make it more attractive to forest owners and regional governments. Subsequently, after focusing on the study case of Serra (see methodology section), one FWU was selected to apply

the obtained management and generated the following conclusions: *“The strategic management area is located in the municipality of Serra and has a surface area of 7.4 ha populated by a regular pure mass of *Pinus halepensis* in a high and dense low-lateral stem state, approximately 100 years old, accompanied by a subfloor of dominated and drowned feet. Its geographical location, perimeter to an urbanized area, suggests the adoption of fire prevention measures. In this context, the decision support tool CAFE of the LIFE RESILIENT FORESTS project proposes thinning that eliminates 60% of the mass, which would mean obtaining 4 tons of biomass, reducing the risk of fire in that area by up to 28%, improving the gamma biodiversity index by 2 points (goes from 10 to 12) and increase the organic C of the soil by 20%”*.

This participatory development gave us the opportunity to **improve the results representation** in the DSS tool and highlighted the need of developing a **graphical use interface** even if it was not initially included in the proposal.

The individual meeting with Centre Propietat Forestal de Catalunya highlighted the potential of the DSS tool in quantifying the goods and services provisioning. Particularly, we were suggested to include metrics at different spatial levels within the same simulation domain, which in this case was the water percolation. As a result, the DSS tool now includes this possibility.

The individual meeting with Madrid resulted in drawing a complete forest management strategy that goes from the initial analysis and evaluation of potential management goals to the DSS tool application. In other words, thanks to their suggestion CAFE tool is now more than a software, it is now a forest management approach that includes the software.

### 1.3.- Networking

**Silvadapt.net:** The networking with this project led us find the way to include **X-biodiversity** as an optimization goal. It was possible thanks to the interaction with the Biodiversity Working Group led by “Centre de la Propietat Forestal de Catalunya (CPFC)”. CPFC proposed and explained the application of the Potential Biodiversity Index (PBI) of LIFE BIORGEST. After attending two meetings where PBI was exposed, RESILIENT FORESTS started to work on its implementation into the DSS tool.

**Basque Country stakeholders:** this participatory process resulted in the second study case (aside from the ones established in the project) where the DSS tool was applied and demonstrated. The study case was a forest plantation of *Pinus radiata*, where the stakeholders needed to quantify the water contribution during the whole rotation period. From there, RESILIENT FORESTS also proposed to quantify C sequestration and fire risk. Nevertheless, in order to quantify the ES during the whole rotation period, the plantation should also be included. After a few individual meetings where we showed the DSS tool and talked about possible improvements, RESILIENT FORESTS development team decided to include **forest plantation** as a management into the DSS tool, which was possible thanks to the inclusion of the eco-hydrological model BIOME-BGC\_MuSo used in the preparatory actions. As a result, the DSS tool has now forest plantation, being the plantation density one of the questions that the DSS is capable of answering.

## **2.- ACTIVITIES WITH PORTUGUESE AUDIENCE**

### **2.1 – Initial Workshop /Info Day**

This initial event that was held in Lousã had two main outcomes. On the one hand, the participation of several local entities helped the consortium to understand which municipal projects and strategies are foreseen for the Ceira river basin, which helped in the development of the case study. On the other hand, it revealed that the philosophy promoted by the project of an integrated strategic vision, rather than disjointed municipal measures, of the Ceira River Watershed was well explained and accepted by the attendees. It is therefore expected to have contributed to the union of the municipalities and to the seeding of future projects that see the basin as a whole and not as a part of each municipality independent from the other municipalities that share it.

### **2.2 – Webinar**

The main contribution from this webinar to the DSS tool development was, the confirmation of its usefulness, mainly in terms of fire risk, which according to the attendants, was one of their priorities. On the other hand, the high participation in this webinar had reflected into a high number of contacts received after the project. Among these contacts is the Institute for Nature Conservation and Forestry (ICNF), the Portuguese authority on forests, which expressed interest in applying the DSS tool in a watershed to be defined later. Applying the DSS tool into a larger study case with barely available field data constitutes a challenge, and RESILIENT FORESTS team is working on including into the DSS tool package, the necessary GEE scripts to obtain the required information to use the DSS.

## **3.- ACTIVITIES WITH GERMAN AUDIENCE**

### **3.1.- Meeting with Eiffel National Park**

This meeting highlighted once again the need to include biodiversity into the DSS tool as one of the metrics to work with, along with climate change projections.

### **3.2.- Webinar**

This webinar ended with a very interesting discussion with very different stakeholders that went from forest owners to land use planners. This discussion contributed not just to the development of the DSS tool, but also to the way we should explain and communicate the DSS and its utility, which should be tuned according to the type of stakeholders. On the other hand, it was also highlighted, and therefore noted by RESILIENT FORESTS, the need to present the results together with field validations, at least in terms of vegetation and water dynamics. In this sense, RESILIENT FORESTS offers now the possibility of not just a training on the DSS usage, but also on field measurements to enrich the DSS results and performance.



#### 4.- INTERNATIONAL ACTIVITIES

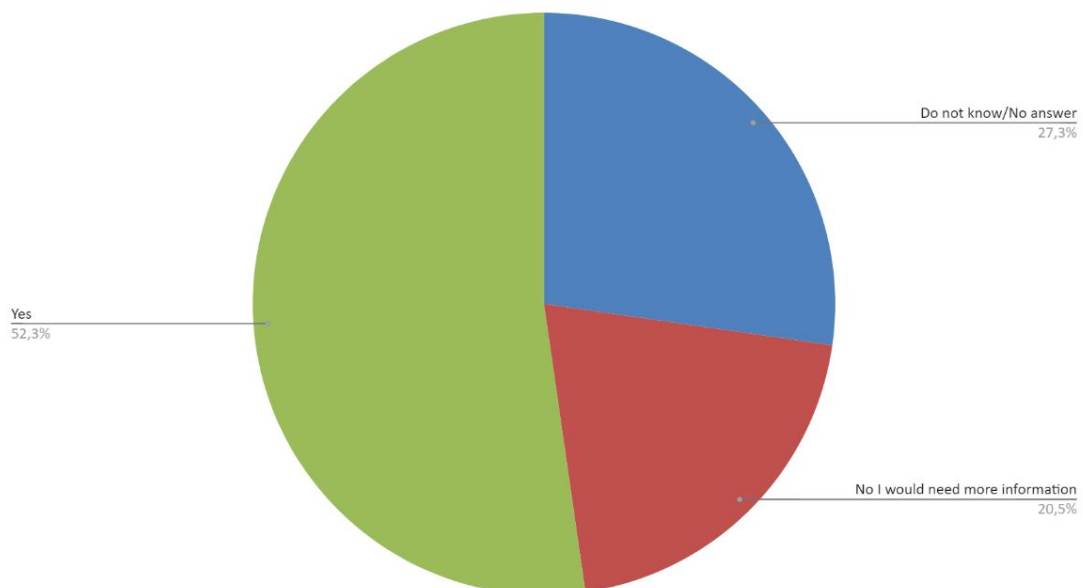
The event was attended by several attendees mainly working in academia or research institutes.

The presentations and recording of the event are available [here](#)



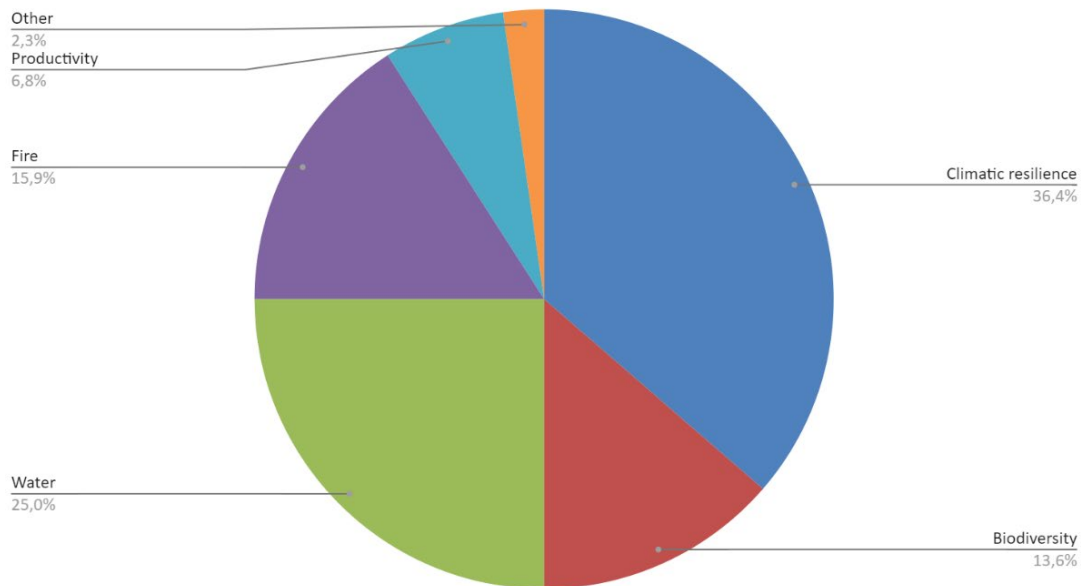
During this event, we presented the audience with a short survey made by two questions on the DSS tool. You can find the questions and the answers down below.

Do you think you would use the DSS tool?





Which group of management goals do you consider most important?



**Individual meetings:** the feedback received during the meeting with the forest owners from Finland consisted, on the one hand, on a positive evaluation of the tool, and on the other hand on raising the following concerns:

- 1.- They were not sure about the technical performance in a climate such as the one in Finland.
- 2.- They though using the tool would require a high technical level.
- 3.- The need of field data for a good calibration.

Regarding to the first concern, there is not necessary changing anything within the tool as being based on mechanistic models, it is capable of accurately reproducing any forest ecosystem. Nevertheless, the other two concerns implied some short of modifications. On the one hand, a clear **user manual** is being performed in order to make the tool usage easier and clearer. On the other hand, we are currently working on providing the necessary tools to easily work with **remote sensing information** that is currently available in Google Earth Engine.

## 7. Conclusions

In general, the development of participatory events, whether they are workshops, meetings, webinars, etc. have significantly contributed into the project development as they always constitute an enormous opportunity to learn and land the project approach. For this reason, the project plans on a long-term developing this kind of events as a strategy to improving and boosting the DSS tool. By now, in general, the project has raised a strong interest among stakeholders that has been reflected in the participatory development of the DSS tool. This interest has been focused not just on the optimization part of the DSS tool, but also on the quantification of the Ecosystem Services (ES) with and without forest management. From that, RESILIENT FORESTS has learned the relevance of this quantification, and has improved the DSS tool accordingly. As a result, the participatory process has resulted in the following significant improvements of the DSS tool:

- Including both distributed and non-distributed simulation models, so the user can choose among different complexity levels.
- Including forest plantation and not only thinning as decision variables.
- Answering the 4 key questions of forest management: When do we have to develop the next/s management/s? How do we do it? Where do we do it? and How much do we do it?
- Including new metrics to optimise as structural biodiversity.
- Including a metric that compares the ES performance before and after forest management
- More detailed quantification of the fire conditions during high meteorological fire risk periods.
- Always quantifying all ES even if they are not selected as optimization goals.
- Including economic balance.
- Developing a better and more detailed user manual that includes modelling manual.
- Including programmed scripts to run in Google Earth Engine that can help with the modelling calibration and validation, improving data input for simulation.
- Increasing the potential of the DSS tool and framing it into the “CAFE approach” that includes both the software and the initial analysis of the potential management goals.

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