Report on the monitoring of the impact of the project actions.

Action D.1.- Project results monitoring

Task D1.1 Monitoring of project impacts (M9 – M48).

The indicators reported here correspond to the case study of Serra's village (SE of Spain), and are the result of direct measures and/or calculations using different methodologies. The study site has an extension of 5730 ha, where around 95 % is within the Natural Park "La Serra Calderona", and 85 % correspond to forest land use, where 49 % is public forest while 51 % is private. RESILIENT FORESTS has developed a forest management plan and a biomass management plan whose application is expected to affect both, environmental and socio-economic elements of Serra's village and Carraixet's catchment. In this sense, the indicators derived form the biomass management plan are based on direct calculations, as this plan is already being executed by Serra's authorities. On the contrary, the indicators derived from the forest management plan are estimated based on different modeling approaches (as foreseen in the proposal) for two main reasons:

1.- The plan has been approved but not yet applied.

2.- The temporal scale of forest processes exceeds that of a LIFE project. Within a LIFE project time frame only the early effects can be measured and reported, but the impacts in forestry are measured under a longer temporal scale. Hence, simulation processes become here essential to estimate the expected impacts.

The modeling processes always imply compiling the necessary input information (which depends on the model), analysis of this information and modification, if necessary, calibration of the model, which usually means running an important number of simulations and analyzing its results, a validation process (comparing the simulation outputs with field and or satellite data) and finally the simulation and analysis of the case study.

In addition, the local participatory process carried out by the project provided additional indicators. Workshop participants identified the local socio-economic activities most dependent on the ecosystem services generated by the forest, and they proposed their indicators. These are included here with their values in 2018 (the project's starting point) and 2021.

1.- Environmental-related indicators:

1.1.- Climate regulation and carbon sequestration:

Climate regulation is the ecosystem service that regulates processes related to atmospheric chemical composition, the greenhouse effect, the ozone layer, precipitation, air quality, and moderation of temperature and weather patterns (including cloud formation), at both global and local scales (Costanza et al., 1997). According to this concept, the project has the following impacts on these variables:

1.- Forest management reduces the potential burned area and the fire risk, and with it, the possibility of a sudden CO_2 release to the atmosphere derived from a wildfire.

To calculate this indicator the FlamMap software has been used. This software uses as inputs:

- Digital terrain Model (DTM): obtained from the National Center of Geographic Information (CNIG).
- Fuel model: obtained by combining the National Forest Inventory, Serra's forest Inventory and deliverables 2 and 4.
- Meteorologic information: obtained from Bétera's meteorological station.

First the model is calibrated with the current fuel models, and subsequently, these fuel models are modified following to the forest management plan. According to the results, the potential burned area is reduced 30 %, which decreases the potential C emissions to the atmosphere from 300 Mg to 90 Mg.

2.- The biomass production and consumption in house heating, replaces the use of other energy sources such as fuel. This replacement reduces CO_2 and nitrogen emissions to the atmosphere.

The application of some of the suggested improvements in the biomass plant increased the biomass production to 72 Mg/year, which reduced the CO2 emissions 99.26 Mg/year (according to del Canvi Climàtic, O. C. (2013)).

1.2.- Fire hazard reduction:

Fire hazard has been calculated for the forest area included into the Forest Management Plan by using the modified KBDI index following Garcia-Prats et al. (2015). To calculate this variable the needed input is soil moisture, which has been obtained with the process based model RHESSYS as follows:

1.- Model inputs preparation: DTM, spatial soil characteristics, spatial vegetation characteristics (species composition, stratums and canopy cover) and meteorological data.

2.- Model calibration and validation: the model has been calibrated and validated using experimental data from other Spanish research projects (Hydrosil, Silwamed and Cehyrfomed). To that end, more than 1000 simulation have been performed until the calibration was completed, which implied two weeks working with the model.

3.- Results analysis: the results have been analyzed by using RStudio software.

As a result an average KDBI of 352.65 was obtained, which changes the fire risk from High to Above average (Figure 1).

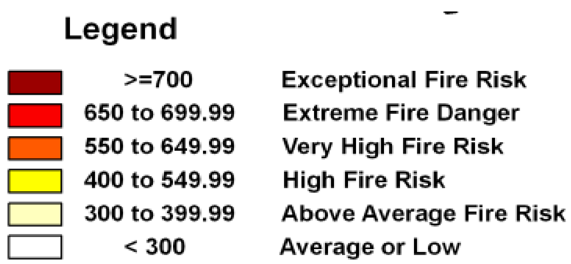

Figure 1: Scale of KBDI index

Rotermel model has also been used to calculate the fire metrics: rate of spread, Fireline intensity and flame length (see Table 1). The values are compared to those of the whole Natural Park. From this comparison, it is clear that Serra needs to manage the forest and decrease the fuel load and continuity, which will automatically decrease the fire metrics in at least 25 %.

Table 1: Fire metrics calculated with Rotermel model. Fire frequency was obtained from the official regional fire statistics.

Fire variables	Serra	Natural Park
Rate of Spread [m/min]	0.23	0.23
Fireline Intensity [kW/m]	19.0	18.7
Flame Length [m]	0.30	0.22
Fire frequency (fire/yr)	22.6	

1.3.- Climate resilience:

Resilience is the capacity of a forest to withstand (absorb) external pressures and return, over time, to its pre-disturbance state. In the context of climate change, the external pressure is therefore derived from climate change such as a severe drought, temperature increase, precipitation decrease, etc. Since the study site is located in a semi-arid area, drought is one of the most important challenges to face under climate change, and the forest resilience to this phenomenon will condition its future.

To study resilience against drought two variables were selected: recovery time and water use efficiency (WUE). First, the reference drought event of the water years 2013-2014 was selected, where the registered precipitation was 161 mm, almost 200 mm under the average. Then, the effects of this event were analyzed by means of process based model and remote sensing analysis. Regarding to remote sensing, a time series of NDVI calculated from Landsat (Figure 2) were analyzed. According to this analysis, the average recovery time from this drought event was 5 months, although there were several forest stands that never recovered from it and died.

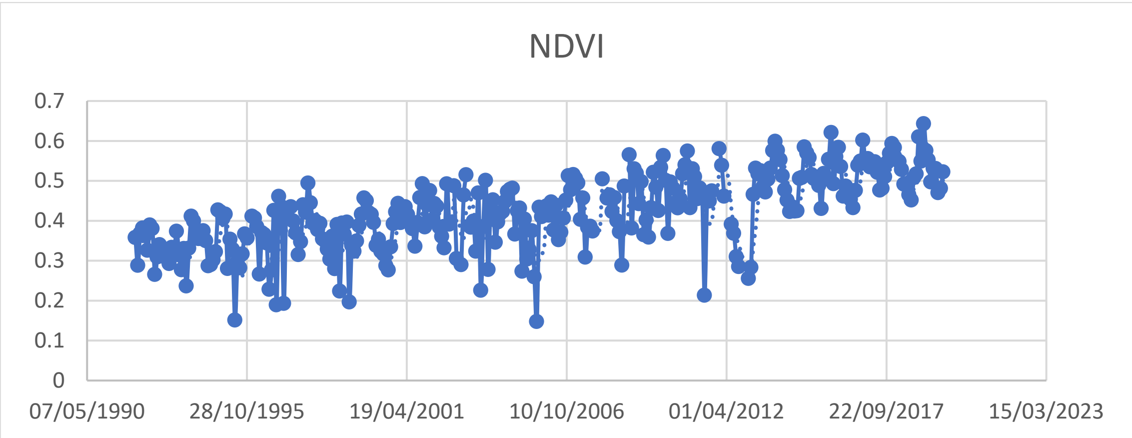

Figure 2: Averaged time series of Landsat NDVI values for the study site.

CAFE was also applied to calculate the WUE before and after forest management, which increases from 2.3 to 2.8 mm/KgC was obtained. Figure 3 shows the evolution of WUE after the implementation of forest management in year 9 (blue) compared to the unmanaged scenario (orange). After 10 years, WUE seems to be the same, which indicates that a new management should be carried out if looking just to climatic resilience.

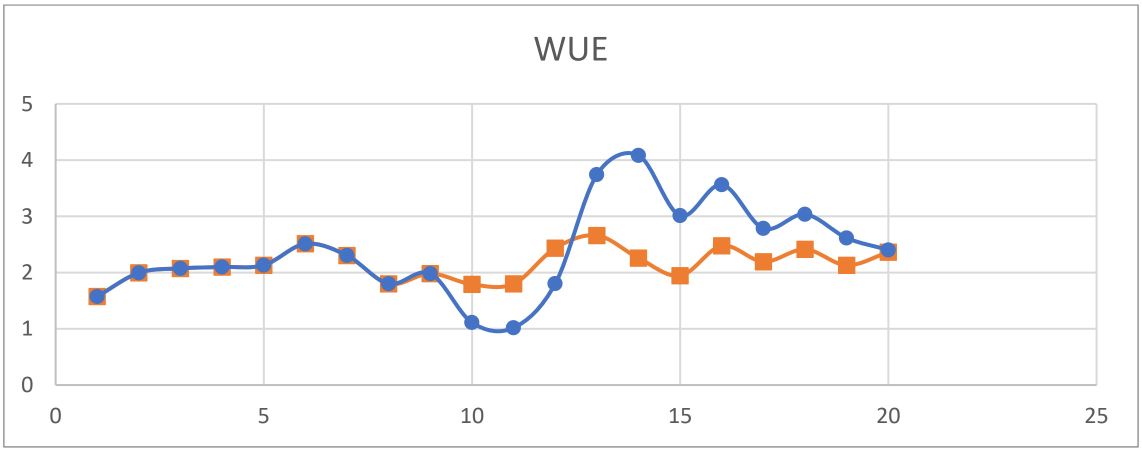

Figure 3: Comparison of WUE between managed (blue) and unmanaged (orange) forest. The management is applied in year 9.

Then, the recovery time was estimated by analyzing the same drought event but under a forest management scenario. The new recovery time obtained did not differ from the one obtained using NDVI, but no mortality was observed in any stand. Hence, it means, forest management increases WUE and reduces tree mortality under a severe drought event.

1.4.- Flood risk reduction:

The flood risk reduction is directly related to the fire risk and burned area decreasing. If a wildfire occurs within the study site, the flooding discharge after a precipitation event will increase, and with it, the flooding risk. Hence, when decreasing the fire risk, the project is also diminishing the flooding risk. To demonstrate this fact, the IBER model has been used to simulate a flash flood event (November 2015) after a wildfire with and without forest management (Figure 4). To represent the difference between both situations into the model, the output results from the simulations with FlamMap were used.

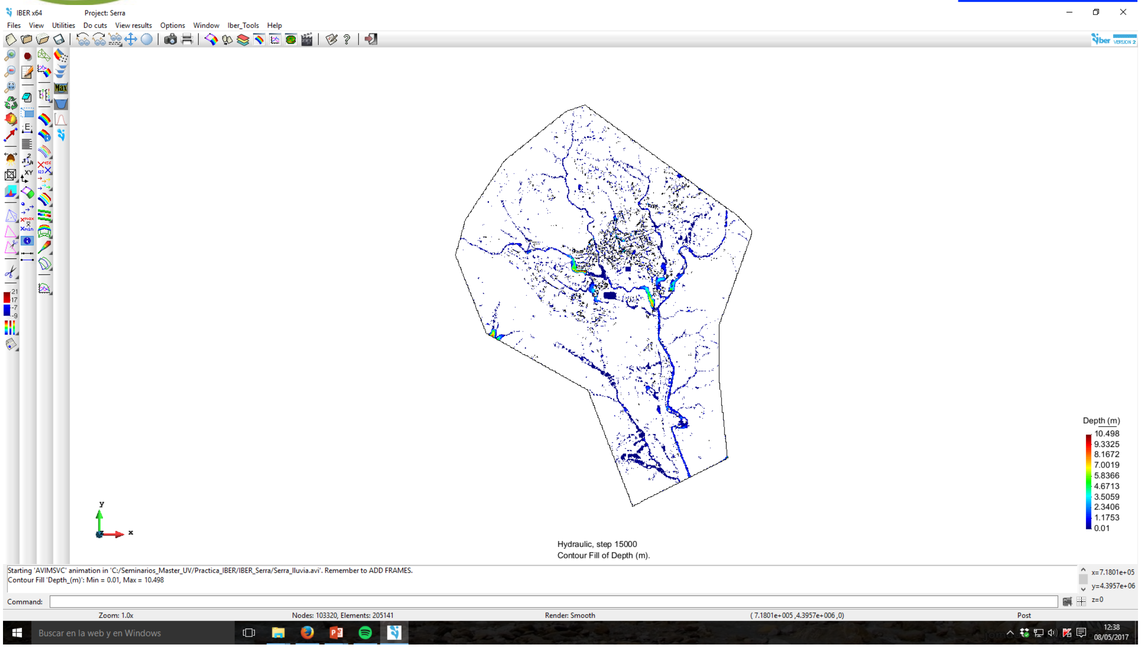

Figure 4: Image of study site simulation with the model IBER.

This precipitation event produced a river discharge of 5 m^3/s under a managed scenario, and 6.7 m^3/s under an unmanaged situation.

1.5.- Biodiversity

The impacts of forest management on biodiversity are mainly in two ways, the structural diversity and the species composition. In this sense, RESILIENT FORESTS has developed a field measurement of the impacts on species composition at stand scale, where the selected index to measure this impact was Margalef (see Table 2). The measurements have been carried out within the experimental plots that UPV has shared with RESILIENT FORESTS to accurately monitor some of the impacts of forest management. In this sense, the applied forest management increases the Margalef biodiversity index at the same time that modifies the physical forest structure.

Table 2: Experimental measurement of forest management impacts on biophysical forest structure and composition. PBI is the Potential Biodiversity Index.

Variable	Managed	Unmanaged
Forest cover (%)	33.8	75.1
Shrub & grass(%)	61.8	81.2
Shrub (%)	39.3	61.1
Bare soil(%)	24.4	2.5
Margalef biodiversity Index	3.1	2.8
PBI	4.75	2.75

Likewise, the Potential Biodiversity Index (PBI) developed by the LIFE BIORGEST has been calculated in the same experimental plots, but also in the three forest stands that have already been managed within the project. Regarding to the experimental plots, the forest management in this area doubles PBI as it generates a more diverse physical structure and allows the establishment of different habitats within the forest stand.

Figure 5: Managed forest stands in Serra.

The impacts of the forest management carried out in Serra within the project (Figure 5) have also been evaluated in terms of biophysical diversity. The PBI has been calculated in both stands before and after the forest management (see Table 3). In this case, forest management has barely modified the biophysical structure as the values are almost the same. The difference with the previous case remains in the applied forest management. The management is just sanitary thinning, while in the previous case a thinning of around 50 % of the trees/ha was carried out.

Table 3: Impacts of the implemented forest management in the biophysical structure. PBI is the Potential Biodiversity Index. LAI is the Leaf Area Index.

Variable	Initial 28b	Managed 28b	Initial 29a	Managed 29a	Initial 4a	Managed 4a
LAI	1.1	1.05	1.08	1.03	1.4	1.4
Forest cover (%)	75	75	80	80	51	51
PBI	7	7	7	7	10	10

2.- Related to forest management:

As stated in the proposal, these indicators are extracted from the forest management plan:

2.1.- Biomass management and pellet production:

The pellet production has increased from 60 Mg/year to 175 Mg/yr (see Table 4) thanks to the partial application of the improvement possibilities (Deliverable 3), to the project dissemination and also to the energetic situation. Furthermore, the biomass origin has partially changed with the initial Forest Management Plan application.

Table 4: Yearly pellet production and sales at Serra.

Year	Pellet production (t)	Sales (nº of pellet bags)
2019	150	664
2020	170	1199

2021	175	1101
2022	175	1081
2023 (until March)	Not available yet	372

2.2.- Grazing activities:

The Forest Management Plan that establishes a capability of 160 head of livestock. In this sense, a public tender for grazing in the area has been resolved with a livestock of 160 head. Right now, the corral is being prepared, and next winter the livestock (160 head) will be in Serra.

3.- Related to watershed services:

3.1.- Water supply reliability and population served:

The expected water income derived from forest management during the first year is 72847 m^3, where 58278 m^3 could be directly used by Serra's inhabitants, which implies water supply for 638 inhabitants in one year.

3.1.1. irrigated crops

There is an Irrigators community in Serra with a water concession from Jucar Hydrographic Confederation (CHJ). The water supply comes from four water sources in the municipality and is used in local orchards.

Table 5: Water use in the Serra's irrigators community

Indicator name	Indicator	2018	2021	Source
Irrigators community	No. Irrigators communities	1	1	irrigators Community
Members	No. Members	180	180	
No. Irrigated hectares	ha/año	22,15	22,15	
Consession by CHJ	M3/año	121.000	121.000	

4.- Related to recreation values:

4.1.- Wilderness recreation:

Serra's forest area is located within the Natural Park "Serra Calderona", which has around 17400 visitors/year. Besides being one of the natural areas closest to Valencia city, its nature value and mountainous landscape makes this place as one of the favorites to spend part of the weekend of people from Valencia and surrounding areas.

Table 6: Landscape metrics of Serra and "Serra Calderona" Natural Park.

Metric	Serra	Natural Park
aggregation index (%)	77.2	69.9
edge density	47.5	61.2
shannon entropy	2.4	3.4
shape index (mean)	0.7	0.6
shannon's diversity index	1.4	2.2

Landscape metrics have been calculated in Serra and the whole Natural Park by using SIOSE map (2014) and Fragstats RStudio package (see Table 5). In this sense, Calderona's landscape presents a Shannon diversity index of 2.2, while Serra's is 1.4. It means Serra's landscape is more homogeneous than that of the Park, probably as a result of the continuous land abandonment that has suffered during the last 60 years. Indeed, Serra is considered as one of the areas with higher rates of land abandonment in Spain (Perpiña Castillo et al. 2020), where despite its close position to Valencia city, is listed by the Regional Government (together with other surrounding villages such as Marines) as a vulnerable rural area, based on its land use distribution and socioeconomic factors such as population density and old-age dependency ratio (Albert et al., 2015). The forest management planned by RESILIENT FORESTS will increase the landscape heterogeneity to reach that of the Natural Park, and therefore not negatively affecting the landscape value nor the visits. Indeed, two patches have already been managed and no significant changes in visitors have been detected. However, this period might not be the best to estimate possible impacts on number of visits as the pandemic situation has completely modified this pattern.

4.1.1. Wilderness recreation activities.

In the local workshop, participants identified the natural landscape traits described above as the most influencing factor in developing socioeconomic activities in Serra municipality. These include nature tourism, recreational and sports activities such as trekking, racing circuits and mountain biking that considerably impact the number of visitors. The proposed indicators related to infrastructure and tourism are shown in Table 7.

Table 7. Visitors and infrastructure to wilderness recreational activities and tourism in Serra 2018 and 2021.

Indicator name	Indicator	2018	2021	Source
Trekking routes	No. Routes	8	5	PRUG 2006
Mountain Biking Trails	No. trails	1	1	
Visitors	No. visitors /year	1.651	4.785	Municipality
Tourism (infraestructure)				
Restaurants	No. Restaurants	8	9	pegv.gva.es/bdt
Pension	No. Pension	1	1	
capacity	No. Bedplaces	12	12	

Apartments	No. Apt.	6	11	
capacity	No. Bedplaces	31	78	
Rural houses	No. Houses	3	3	
capacity	No. Bedplaces	19	19	
Jobs	No. Jobs/year	69	64	

- Persons who are registered in the municipal tourist information office.

Hunting is another recreational activity identified that depends on the provision of the Forest ecosystem services in Serra. Table 6 shows some indicators that account for its importance.

Table 8. Indicator of Hunting in Serra 2018 and 2021.

Indicator name	Indicator	2018	2021	Source
Managed Hunting area	ha/year	2.700	2.700	Municipal Technical Hunting Plan
Small wild game	No. Pieces	579	962	
Large wild game	No. Pieces	38	62	
Hunting members	No. members	81	80	
Incomes	€/anual	8.616	8.454	
Expenses	€/anual	10.193,79	4.823,57	

4.2.- Non-timber commercial products:

Regarding to non-timber products, bee-keeping activity is one of the most common in Serra's forest, with 20 beehives installed, which implies an income of around 2000 €/year.

4.3. Cultural Passive Values

These indicators are proposed to measure the passive cultural values that could disappear in case of forest fire and could negatively impact the currently local socio-economic activities. Living preferences in a landscape and natural environment such as Serra's municipality could be measured by the number of inhabitants, which increased by 10 % from 2018 to 2022.

Table 9. Cultural passive values indicators in Serra.

Indicator name	Indicator	2018	2021	2022	Source
Aesthetic and passive values	View points	4	4	4	Municipal Forest Management Plan
Cultural heritage (4 towers, 1 castle, 1 monastery)	No. Protected Monuments	6	6	6	pegv.gva.es
Narutal heritage (2 covas, 4 floral microrreserve, 1 Natural Park)	No. Protected Places	7	7	7	
Preferences for living in a landscape or natural environment	No Inhabitants /year	3.091	3.326	3405	Argos.gva.es/Padron

Task D1.2.- Monitoring of the demonstration and replication activities (M9-M48).

1.2.1.- Stakeholders reached and involved in the process:

GVA, Divalterra, Centre Propietat Forestal Catalunya (CPFC), Basoa Fundacioa, Diputación Bizkaia, Asociación de Forestalistas, TRAGSA, VAERSA, Centre Tecnològic Forestal de Catalunya (CTFC), Nittua, Madrid Regional Government, Municipality of Lousã, Municipality of Gois, Municipality of Pampilhosa da Serra, Municipality of Arganil, Municipality of Miranda do Corvo, Lousã Comunity Land Association, Vila Nova Comunity 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), Forest owners from Finland, EIFFIEL National Park, EFI, ERIAF.

1.2.2.- Technical adjustment needed:

- Including both distributed and non-distributed simulation models.
- 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 optimize 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 programmed scripts to run in Google Earth Engine that can help with the modelling calibration and validation, improving data input for simulation.

1.2.3.- Reliability of the model at catchment scale:

The reliability of the model has been analyzed every time that the DSS has been applied by comparing simulated with observed eco-hydrological data.

Carraixet: The calibration and validation with the river discharge resulted in NSE indexes equal to 0.7 and 0.4, respectively. These results can be considered as satisfactory considering the difficulty of simulating intermittent rivers (Snelder et al., 2013; Ivkovic et al., 2014; Costigan et al., 2017). Likewise, the specific evaluation of transpiration and soil moisture dynamics within the experimental plots produced good results in both of them, control and treatment, indicating the good performance of the TETIS-VEG model in calculating the hydrological cycling of semiarid environments (Table 5). On the other hand, the spatial evaluation by comparing Land-surface temperature (derived from Landsat 8 OLI/TIRS Data) with simulated soil water content resulted in a significant negative relationship between both variables (Table 10). These results confirm the capability of the model in reproducing the natural correlation between temperature and soil water content under dry conditions (Redding et al., 2003), and therefore, its reliable performance in semiarid catchments.

Table 10: Calibration, validation and evaluation adjustment values. NSE represents the Nash-Sutcliffe coefficient. p represents the Pearson correlation coefficient. RMSE is the Root Mean Square Error.

Variable	Location	NSE	p	RMSE
Discharge (m^3/s)	Calibration	0.7	0.5	0.47
	Validation	0.4	0.5	0.47
Transpiration (mm)	Control	0.4	0.72	0.28
	Thinned	0.4	0.74	0.15
Soil moisture (cm/cm)	Control	-	0.44	-
	Thinned	-	0.43	-
Soil moisture vs Land-surface temperature	43 random points	-	0.60±0.11	-

<u>Ceira:</u> In this case the comparison was carried out between simulated and observed daily river discharge data form Ponte Cabouco gauging station (see Figure 6). Under these results, we can affirm that the reliability of the model allows its application on this catchment.

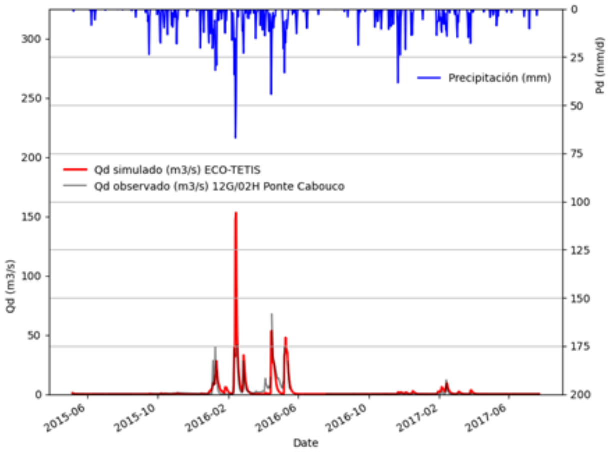

Figure 6: Comparison between simulated and observed river discharge of Ponte Cabouco.

Furthermore, satellite information of LAI, GPP and soil moisture has also been used to estimate the model reliability (see Figure 7).

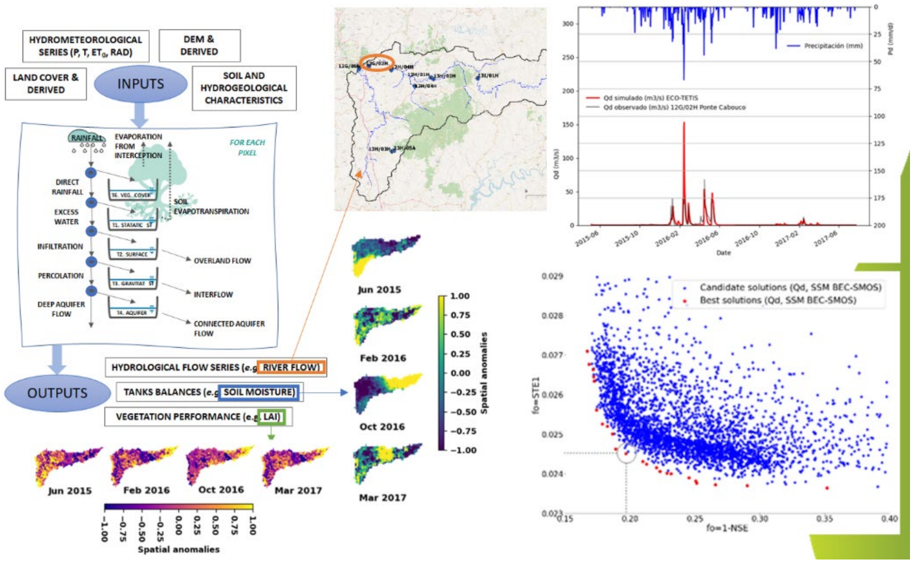

Figure 7: Scheme and information used to analyze the model reliability at the case study of Portugal.

Wüstebach: In this case soil moisture was chosen as the best indicator of model reliability, where it has been constated that performing data assimilation improves the simulation results and updating soil parameters during data assimilation improves them further (see Figure 8).

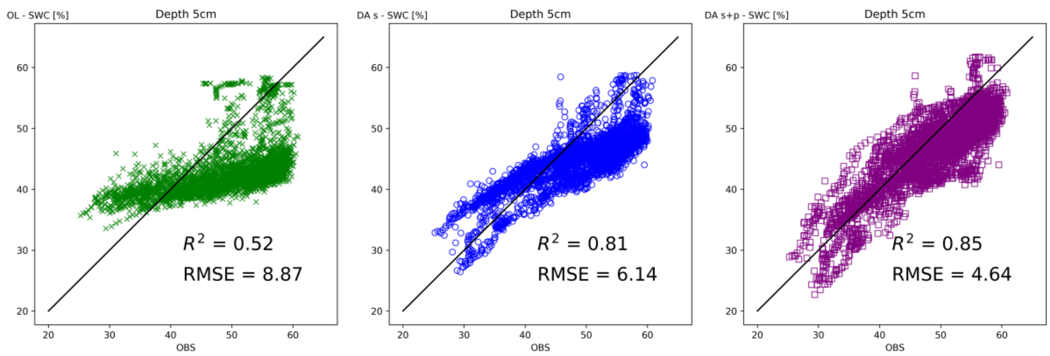

Figure 8: Comparison of in-situ measurements and simulation output of soil water content at 5 cm depth. Each marker represents one daily average in the simulation period of 2009 to 2018. Markers in the upper left triangle of each square imply that means observations are drier than simulation results, conversely markers in the lower right triangle of each square means observations are wetter than simulation, and markers on the diagonal means observation and simulation are the same. Left and green shows open-loop simulation, i.e., without data assimilation. Middle and violet shows simulation with data assimilation of the state variable (soil water content). Right and magenta shows simulation with data assimilation of state variable and update of soil parameters.

1.2.4.- Adaptation to the environmental and socio-economic needs of the upper catchment:

Since the models applied with the DSS tool are mechanistic, the environmental adaptation is implicit into the model philosophy. Regarding to the socio-economic adaptation, RESILIENT

FORESTS has on the one hand included economic metrics into the DSS tool, but not as a decision variable, just informative so the user can decide what is better for the socio-economy of the area. On the other hand, the DSS includes as many metrics as possible, and it is planned to keep on increasing the metrics according to the stakeholder's feedback.

1.2.5.- Comparison of management decisions provided by the tool and current management approaches developed:

In general, we have observed that the quantification of ecosystem services provisioning (metrics) is highly appreciated by the stakeholders, and the demanded accuracy level is high. On the contrary, when developing the management scheme, the level of demand accuracy in terms of percentage to be thinned is lower, as it is hard to distinguish in the field between for instance 25 and 30 %. In particular, in the three areas where the forest management has been applied, this is the collected information:

- Serra:
  - Management: interest on a wider range of proposed thinning.
  - Quantification: exactly what DSS provides.
- Catalunya (Collserola):
  - Management: interest on a wider range of proposed thinning.
  - Quantification: exactly what DSS provides, but mainly water.
- Basque Country:
  - Management: interest on rotation period and tree density.
  - Quantification: exactly what DSS provides, but mainly water.
- Portugal (afforestation)
  - Management: tree density.
  - Quantification: C sequestration, resilience and fire risk.

Task D1.3.- LCA assessment of the Forest management approach.

This activity has already produced a LCA calculation methodology that is provided as a separated document (LCA folder).

Action D.2.- LIFE KPIs monitoring.

The following table shows the state of the selected KPIs. KPIs related to blue water experienced no change because the aridity of the place needs a much larger managed area to experience some improvement. Regarding the Carbon capture and storage site, the figure is still based on modeling as we need to wait an entire growing period since the management.

CONTEXT	CODE	FIRST LEVEL DESCRIPTOR	SECOND LEVEL DESCRIPTOR	UNIT	START VALUE	END VALUE	BEYOND END VALUE	CURREN T VALUE
Manged area	1.5	Conservation or improvement of the status of an area or segment		ha	0	40	113	20
Manged area	1.6	Persons whose lives were directly, positively impacted by MAIN envir. actions of project - see Guide		Number of residents within or near the project area	0	3000	4200	2000
Flood risk	2.1	Terrestrial extent affected by the pressure or risk addressed		ha	1500	1450	1400	1480
Flood risk	2.3.4	Other		€	1400000	1350000	130000	1390000
Blue water	2.3.5.1	Drought risk/water scarcity risk		€	322368	314308	306249	322368
Clean energy produced	4.1.3	Biomass		kWh/year	294000	1274000	1470000	352800
Manged area	4.2.1	conifer		ha	0	40	108	20
CO2 saved from biomass	8.1.1	Buildings/ housing/domestic appliances		Tons of CO2 /year	4800	3840	3120	4700
CO2 saved from biomass	8.1.1	Buildings/ housing/domestic appliances		kg CO2/kwh (Energy production)	2.5	2	1.75	2.3
CO2	8.2	Carbon capture and storage site (CCS)		kg/ha/year	0	1300	1300	600
Manged area	9.1	Adaptation area		ha	0	40	113	20
Manged area	10.2	Public body/bodies		number of stakeholders involved due to the project	0	3	6	15
General public	11.1	No. of unique visits		No. of unique website visits	0	500	1000	3147

General public	11.2	Number of Hotline/information centers created	Number of outcomes (e.g. nr of reports, events, etc)	0	1	1	0
General public	11.2	Number of events/exhibitions organised	Number of outcomes (e.g. nr of reports, events, etc)	0	8	10	4
General public	11.2	Number of articles in print media (e.g. newspaper and magazine articles)	Number of outcomes (e.g. nr of reports, events, etc)	0	30	40	10
General public	11.2	Publications/reports	Number of outcomes (e.g. nr of reports, events, etc)	0	10	15	0
General public	11.2	Other distinct media products created (e.g. different videos/broadcast/leaflets)	Number of outcomes (e.g. nr of reports, events, etc)	0	10	12	8
General public	11.2	Number of different displayed information created (posters, information boards)	Number of outcomes (e.g. nr of reports, events, etc)	0	10	14	4
Stakeholder s	12.1	Professionals - experts in the field	No. of individuals	0	200	400	0
Stakeholder s	12.2	Professionals - experts in the field	No. of individuals	0	200	500	0
General public	12.2	Members of interest groups / lobby organisations	No. of individuals	0	200	300	0
Jobs	13	Jobs	No. of FTE	0	1.5	6	1.5
Manged area	14.1	Running cost/operating costs during the project and expected in case of continuation/replication/transfer after the project period	€	0	50000	50000	10000
Manged area	14.3	Beneficiary own contribution	€			50000	10000
Blue water	7.2	Ecosystem Service Condition		Poor/un fourabl e	Moderat e	Good/favo urable	Poor/unf ourable

Biomass production	7.2	Ecosystem Service Trend			Deterioration	Some improvement	Improving	Some improvement
Biomass production	7.2	Ecosystem Service Condition			Poor/unfourable	Good/favourable	Good/favourable	Good/favourable
Blue water	7.2	Ecosystem Service Trend			Deterioration	Some improvement	Improving	Deterioration

REFERENCES

Costanza, R., d'Arge, R., De Groot, R., Farber, S., Grasso, M., Hannon, B., ... & Raskin, R. G. (1997). The value of the world's ecosystem services and natural capital. nature, 387(6630), 253-260.

Costigan, K.H., Kennard, M.J., Leigh, C., Sauquet, E., Datry, T., Boulton, A.J., 2017. Flow regimes in intermittent rivers and ephemeral streams. In: Intermittent Rivers and Ephemeral Streams. Elsevier, pp. 51–78.

del Canvi Climàtic, O. C. (2013). Guía práctica para el cálculo de emisiones de gases de efecto invernadero (GEI). Oficina Catalana del Cambio Climático: Barcelona, Spain.

Garcia-Prats, A., Tarcísio, F. J., & Antonio, M. J. (2015). Development of a Keetch and Byram—based drought index sensitive to forest management in Mediterranean conditions. Agricultural and Forest Meteorology, 205, 40-50.

Ivkovic, K., Croke, B., Kelly, R., 2014. Overcoming the challenges of using a rainfall–runoff model to estimate the impacts of groundwater extraction on low flows in an ephemeral stream. Nord. Hydrol 45 (1), 58–72.

Snelder, T.H., Datry, T., Lamouroux, N., Larned, S.T., Sauquet, E., Pella, H., Catalogne, C., 2013. Regionalization of patterns of flow intermittence from gauging station records. Hydrol. Earth Syst. Sci. 17 (7), 2685–2699.

Van Der Werf, G. R., Randerson, J. T., Giglio, L., Van Leeuwen, T. T., Chen, Y., Rogers, B. M., ... & Yokelson, R. J. (2017). Global fire emissions estimates during 1997-2016. Earth System Science Data, 9(2), 697-720.