Deliverable Nº 32

REPORT ON IMPACT OF REPLICATION ACTIVITIES

ADIA

3/31/2023

This document presents the replication activities and its impacts.

REPORT ON IMPACT OF REPLICATION ACTIVITIES

ACTION D.1: Monitoring the impact of the project actions

INDEX

Deliverable 32; name: *Report on impact of replication activities*

Beneficiary responsible: ADAI

Action D.1: *Monitoring the impact of the project actions*

From month 9 – month 48

Name of the Deliverable	Number of associated action	Deadline
Report on impact of replication activities	D.1	03/2023

1. Introduction

Replication actions, within the context of LIFE projects, refer to the process of transferring and adopting successful outcomes, best practices, and lessons learned from a particular project to other relevant locations or sectors. These actions aim to amplify the impact of a successful initiative and foster a culture of knowledge sharing and collaboration. They hold several crucial benefits for the success and impact of LIFE projects. By promoting knowledge dissemination and cross-sector collaboration, replication actions allow for the optimization of resources and the acceleration of sustainable development efforts. Furthermore, they contribute to the creation of a supportive network that fosters continuous learning and improvement.

Assessing the impact of replication actions is crucial to understanding their effectiveness and identifying areas for improvement. Key performance indicators and monitoring frameworks are used to evaluate the replicated initiatives' achievements.

Under this context, this Deliverable analyses the performance of these replication actions and some others that have been triggered by the interest of the DSS tool of several stakeholders.

2. Background

Decision Support Systems for forest management offer invaluable assistance in addressing the intricate challenges of sustainable forest management. By integrating data, models, and stakeholder engagement, these tools empower decision-makers to make more informed and effective choices that balance ecological conservation, economic prosperity, and social welfare in forest ecosystems. In this sense, the background of the project did not go further than the pure knowledge of this concept and its application in other environments. Thus, this project has built, promoted and implemented a DSS tool from scratch. Along the way, the stakeholders have been active participants in all the process, and that's probably why the replication actions evaluated in this Deliverable have brought important outcomes, that aside from the foreseen activities and results, have reached important organisations such as FAO.

3. Objectives

The main goal of the action D.1 is to monitor the performance of the activities of the project. In this sense, this particular deliverable contributes to this action by analysing the impact of the replication activities established in Action C3.

4. Methodology

The impacts of the project replication action was analysed by considering:

- The adaptation of the DSS to the specific conditions (biophysical) in other areas
- The specific stakeholders and roles in each area
- Comparison of management schemes provided by the tool and current management approaches developed
- Adaptation to the environmental and social-economic needs of the upper catchment
- Other outcomes

5. Description of the activities

The replication actions were developed in 3 different catchments: Túria (Spain), Ceira (Portugal) and Wüstebach. In each site the DSS tool was shown and discussed, as well as the management options provided by it. To that end, previously, the DSS was calibrated, validated making sure the results were reliable.

Túria basin:

Since the project has already worked in several occasions with the stakeholders involved in this catchment, the replication here involved a meeting with the main catchment stakeholder, the River Basin Administration (CHJ), and a representation of social and ecological needs, the non-profit organisation Nitúa. During this meeting the final version of the DSS was shown, and its performance in Túria basin. Subsequently, an open and hybrid workshop was organized in CHJ's headquarters, where besides CHJ itself, other important stakeholders such as the Valencian Regional government attended and participated. During this workshop the DSS was shown in detail as well as its performance in the upper Túria basin, where the main forest part relies.

The model selected for this particular case was TETIS because of its good performance in Mediterranean environments. The calibration and validation of the model was developed by using 3 different gauging stations and also satellite information (soil moistures). The results (see Table 1) confirmed the model reliability, being therefore able to use with the DSS.

Table 1: Results of calibration and validation at 3 different gauging stations of the upper Túria basin (Spain).

NSE	Alfambra - Teruel	Turia- Teruel	Villalba Alta
Calibration	0.54	0.65	0.51
Validation	0.50	0.75	0.58

Ceira basin:

To replicate the project in Portugal the Strategy for replication was followed, and two activities were developed, an initial workshop and a DSS training session followed by a participatory workshop to gather their views on the usefulness of the DSS in enhancing their forest management activities.

The selected catchment was Ceira instead of Arouce as Ceira is a bigger catchment that includes Arouce, so the potential places to implement the DSS are increased. This catchment was

modeled using TETIS for the same reason than in the previous catchment, its performance in Mediterranean environments. The calibration and validation of the model was performed as in Túria basin, using gauging stations and remote sensing. A comparison between simulated and observed river discharge is shown in figure 1. The results once again, confirmed the model reliability, being therefore able to use with the DSS. Deliverable 31 shows more detail in the calibration and validation process.

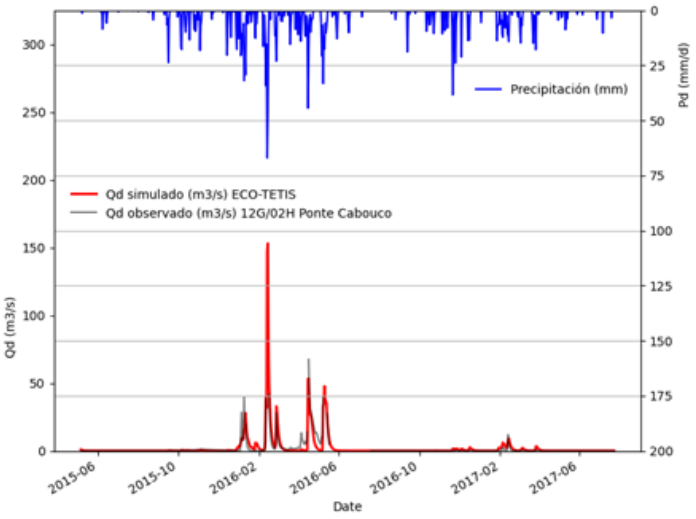

Figure 1: Comparison between simulated (grey) and observed (red) river discharge data in Ceira basin.

Wüstebach basin:

The replication in this catchment followed the replication strategy, where one workshop was performed.

In this case the selected model is CLM, as it has been mainly developed in Germany, and therefore could offer higher confidence to the stakeholders involved. The calibration and validation were performed using field data of soil moisture and streamflow (see figure 2). More information about the calibration and validation is shown in Deliverable 12 and Strebel *et al* 2022.

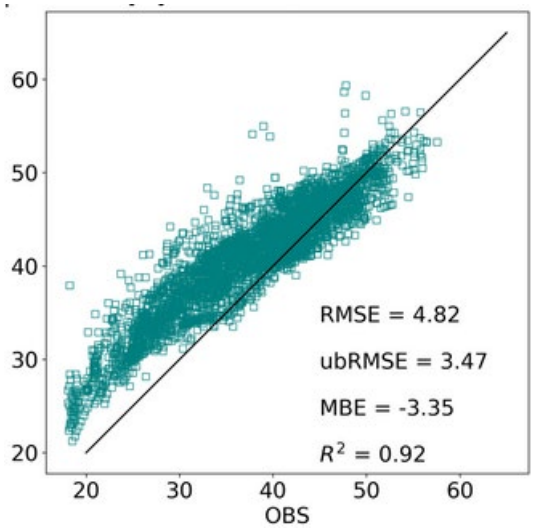

Figure 2: Comparison of in-situ measurements and simulation output of soil water content at 5 cm depth. The root mean square error (RMSE), the unbiased root mean square error (ubRMSE), the mean bias error (MBE), and the squared correlation coefficient (R2) are presented. (Figure from Strebel et al 2022)

6. Results and conclusions

The **capability of the DSS to adapt to the specific conditions** (biophysical) in other areas is very high as it has different eco-hydrological models capable of reproduce the dynamics of any forest environment. The proof of this is the DSS was successfully applied in these three different environments with good performance and reliable proposed solutions. Thus, the DSS can be applied to any forest ecosystem at any spatial scale form forest stand to basin.

The **stakeholders involved** in the replication actions are discussed in each catchment:

Túria: Here the main stakeholder was the River Basin Administration (CHJ), which is the administrative owner of the catchment. Aside form this stakeholder, the replication also included the Valencian Regional Government (GVA), as the stakeholder that has to approve the forest management and a non-profit organisation, Nitúa, as a representation of the social and ecological needs. Furthermore, since one of the replication events was an open and hybrid seminar in CHJ's headquarters, stakeholders from other fields did also participate in the debate.

Ceira: The participants in this replication represented the local, regional and national public administrations as well as private companies. Particularly, from the municipalities of the Ceira watershed were representatives of the civil protection services of the municipality of Góis, Coimbra and an association of Lousã (Lousitânea). The background of the participants was mostly in forestry engineering, environmental engineering, sociology and geography

Wüstebach: The stakeholders participating in this replication activity were from public local and regional administrations: Wald&Holz NRW, Zentrum Wald&Holzwirtschaft and Wald&Holz NRW, Regionalförstamt, and semi-public National company (Gaian Eco Assessment).

In general, in the three sites, the stakeholders involved in the replication include the main sectors that would make possible an implementation of the DSS tool, from public sectors to private ones.

When **comparing the management schemes** provided by the DSS tool to those usually applied by the stakeholders the following reactions where founded:

1.- The usual management practices where quite similar to those provided by the DSS tool, which means the results are realistic and applicable.

2.- The fact that all the management options are provided with the Ecosystem Services quantification makes its implementation easier in terms of administrative justifications.

3.- For the Wüstebach stakeholders, most of them wished a more detailed management schemes when they are focused on individual trees, even if it adds more complexity to the DSS use.

The **adaptation capability of the DSS to the environmental and social-economic needs of the upper catchment** comes from the selection of the ES to optimize. In this sense, the selected ES where different in each site, confirming the adaptability of CAFE to the different needs of the catchment. Table 2 shows the priorization of ES in each replication area, highlighting the differences among them. For instance, for Túria fire and water appears to be priority number 1, while for the german stakeholders none of them seem very important. The possibility of priorizing any management goal over the others states the flexibility of CAFE when dealing with different socio-ecological environments.

Table 2: Prioritization of the Ecosystem Services included in the tool (CAFE). 1 indicates very high importance, 2 high importance and 3 medium importance.

Ecosystem Services (C.A.F.E)	Túria	Ceira	Wüstebach
Biomass	2	0	1
Water	1	1	3
Fire risk	1	2	3
Biodiversity / Nature conservation	2	2	2
Climate Resilience	1	3	1
Carbon storage	-	-	1
Recreation	-	-	2
Erosion control	-	-	2/3

Aside from these results, there are other **outcomes** that have significantly increased the impact of the DSS tool. The interaction with the stakeholders has led to a replication of the DSS tool in other 2 areas. The first area, in Zambia, lead by FAO, is taking place right now, and they are using not just the DSS tool but also the whole CAFE concept to quantify the water provisioning of Kabompo upper basin (see Figure 2), and to design the best management scheme. It is being a two steps approach where the first one is the calculation of the baseline Ecosystem Services provisioning with CAFE in Kabompo upper basin. Then, on a second step, the whole CAFE methodology (see Tehcnical guide) will be applied. To that end, it is foreseen a training session of this methodology in September in Zambia by UPV.

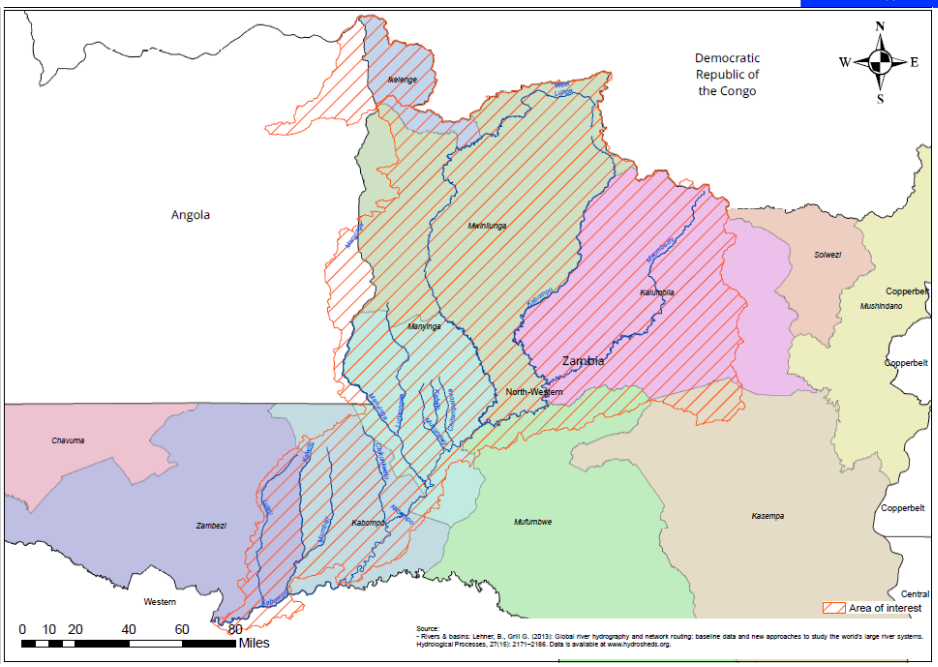

Figure 2: Region where the CAFE is being applied.

Likewise, Centre Tecnológic Forestal de Catalunya together with Agència Catalana de l'Aigua are applying CAFE to several catchments in Catalunya in order to design the best forest management schemes. In this case the implementation goes beyond a selection of an optimum management scheme as CTFC and ACA will adopt a modified version of CAFE as one of their tools to plan forest management. This replication has also brought new inputs in the DSS tool that will be included very soon.

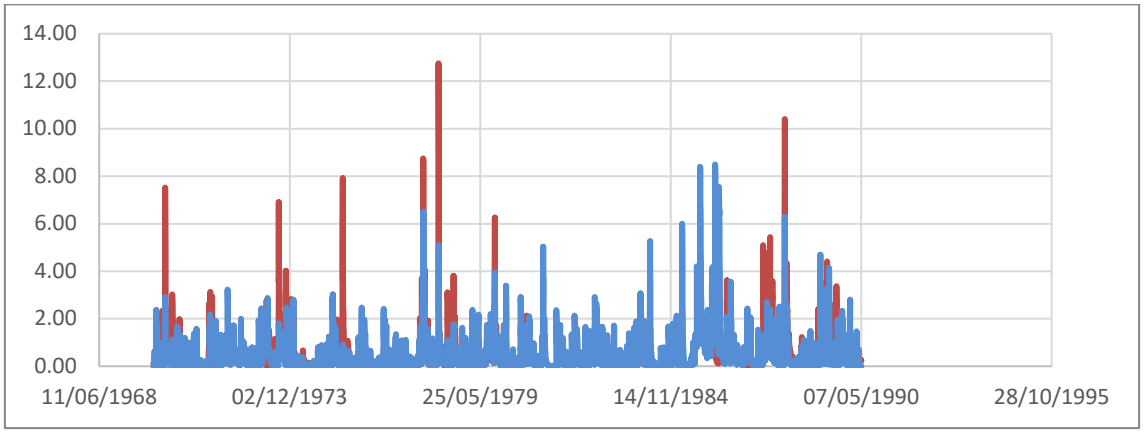

Figure 3: Comparison of simulated (blue) and observed (red) daily river discharge data (m^3/s) at Aigua D'Ora's catchment.

6. References

Strebel, L., Bogena, H. R., Vereecken, H., & Hendricks Franssen, H. J. (2022). Coupling the Community Land Model version 5.0 to the parallel data assimilation framework PDAF: description and applications. Geoscientific Model Development, 15(2), 395-411.