



GIS-based service platform - FAGESOS GIS

Deliverable 2.1

WP2 FAGESOS-GIS: Creation of a GIS-based service platform for disease impact and risk assessment

Summary:

The platform described in this Deliverable is one main outcome of Work Package 2. The GIS platform has been fully developed with open-source software and is accessible [at the following link](#). This document represents the initial platform release, describing briefly its accessibility, objectives, structure, current contents and next steps. Although already functional and ready-to-be-used, UCO will continuously improve FAGESOS-GIS over the duration of the project and integrate in more advanced stages the *Phytophthora cinnamomi* GIS-based risk maps developed in task 2.2. and the impact maps and remote sensing results developed in task 2.4.

Authors:

Adrián Cidre González; Pablo González Moreno; Francisco José Ruiz Gómez	Universidad de Córdoba (UCO)
Bruno Scanu, Gabriele Giuseppe Antonio Satta	Università degli Studi di Sassari (UNISS)
Andrea Vannini; Carmen Morales Rodríguez	Università degli Studi della Tuscia (UNITUS)
Simone Cali	Ente Parco Naturale Regionale Monti Ausoni e Lago di Fondi
José Carlos Esteves Gomes Laranjo	University of Tras-os-Montes and Alto Douro (UTAD)
Víctor Márquez Pantojo	La Almoraima

Project acronym: LIFE FAGESOS
 Project title: Phytophthora-induced decline of Fagaceae ecosystems in Southern Europe exacerbated by climate change: preserving ecosystem services through improved integrated pest management
 Grant Agreement number: 101074466
 Call identifier: LIFE-2021-SAP-CLIMA
 Start date of the project: 01/09/2022
 Duration: 60 months
 Website: www.lifefagesos.it & [EU Portal](#)



This report has been produced with financial support from the European Union's LIFE Programme under grant agreement No 101074466. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.



Document preparation sheet

<i>Responsible beneficiary:</i>	Universidad de Córdoba
<i>Due date:</i>	28/02/2023
<i>Nature:</i>	DEC
<i>Diffusion</i>	Public

<i>Revision history</i>	<i>Delivery date</i>	<i>Author</i>	<i>Summary of changes</i>
V1	15/05/2023	Adrián Cidre González et al.	Original version
V2	01/04/2025	Gertruud van Leijen	GIS Platform link update on request of CINEA. Cover-page update

<i>Approval status</i>			
<i>Function</i>	<i>Name</i>	<i>Date</i>	<i>Signature</i>
WP2 Leader	Pablo Gonzalez Moreno	15/05/2023	x

Table of content

Table of content	3
1. Executive Summary	3
2. Introduction	4
3. GIS-based service platform - FAGESOS-GIS: Initial platform release	4
4. Objectives of the platform and to-be offered contents	5
4.1 Structure of the page and rationale behind the set-up	7
4.1.1 About	7
4.1.2 Fagaceae distribution	8
4.1.3 Phytophthora database	9
4.1.4 Demonstrative areas	10
5. Conclusion and outlook on the next steps	12

1. Executive Summary

The platform described in this Deliverable is one main outcome of Work Package 2 (WP2): FAGESOS-GIS: Creation of a GIS-based platform for disease impact and risk assessment. The GIS platform has been fully developed with open-source software and is accessible at the following link. It currently consists of three maps containing information for Italy, Portugal and Spain:

- a) one map of the distribution of *Castanea sativa*, *Quercus ilex* and *Quercus suber* in the project regions of interest;
- b) one map in a grid format of 0.5 x 0.5° with the number of occurrences of *Phytophthora cinnamomi*
- c) one map with thematic cartography generated in the project for the demonstrative areas.

The FAGESOS-GIS platform in its current version is already functional and ready-to-be-used. Nevertheless, UCO will continuously improve FAGESOS-GIS over the duration of the project and Work Package 2, by improving resolution of some maps and adding additional data to enhance accuracy and comprehensiveness.

In more advanced stages of the project, UCO plans to integrate the *Phytophthora cinnamomi* GIS-based risk maps developed in task 2.2. and the impact maps and remote sensing results developed in task 2.4.

2. Introduction

The FAGESOS-GIS platform represents the primary output of Work Package 2 (WP2) within the LIFE-FAGESOS project. It is a sophisticated web platform that serves as a repository for the outcomes of WP2. Developed using the “Shiny applications” package in R software version 4.3.0, it will be updated throughout the project as new data and results become available. Our objective is to create an interactive platform that offers a range of services to stakeholders and project partners alike. The FAGESOS-GIS platform is expected to provide value to project stakeholders and project partners by offering relevant information and insights on various aspects of *Phytophthora* spread risk distribution and -impact, as well as environmental information on project areas. In the following paragraphs, we present the structure of the platform, the contents included in this first version and what will be the next steps in terms of development and improvement.

3. GIS-based service platform - FAGESOS-GIS: Initial platform release

The FAGESOS-GIS platform is publicly accessible [at the following link](#). While being currently in the early stages of development, it will be continuously improved during the duration of the project. At present, it consists of four sections that contain a wide range of information related to the project:

1. About
2. Fagaceae distribution
3. *Phytophthora* database
4. Demonstrative areas

A detailed description of each of these tabs is provided in the following sub-sections. While the platform in its current version is already usable, UCO, with input from all partners, anticipates adding additional features and expanding its capabilities as the project progresses. The goal is to create a highly informative and user-friendly service platform that provides stakeholders, such as policy makers of regional and local government level, public technical bodies, landowners, growers, land managers, as well as project partners with a comprehensive understanding of the project's insights on *Phytophthora cinnamomi* risk of introduction and current impact, guiding their work targeting Fagaceae ecosystems. Furthermore, we strive to support partners' assessment of treatment efficacy within the project.

4. Objectives of the platform and to-be offered contents

The FAGESOS-GIS platform pursues the following objectives:

1. To provide and make accessible through the FAGESOS-GIS:
 - a. Regional maps for *Phytophthora cinnamomi* risk of introduction based on already defined models that uses landscape and climatic variables.
 - b. Regional map of *Phytophthora cinnamomi* current impact based on trained model that uses remote sensing spectral images and ground truthing.
 - c. Maps of project's demonstrative areas, collecting important environmental information on project areas to support project activities such as treatments in WP4 and Monitoring of effectiveness of field campaigns in WP7.
2. To support different levels of stakeholders ranging from
 - a. Policy makers on regional, municipal, single-state and EU level, as well as local governments and municipalities for the development of new regulations, strategic intervention plans, environmental restoration plans, and supporting policies to the private sector: To give an example, we aim for having EU regulatory bodies (DG-ENV, AGRI, SANTE) use FAGESOS tools as a standard to set up protocols.
 - b. Public technical bodies (e.g. phytosanitary services, environmental agencies) will use the platform to support them in the application of existing regulations, directives, and guidelines: To give an example of regional activities: in Latium project region, ARSIAL, will rely on Regional Maps a) & b) for rural development. ARPA and phytosanitary services will consult the maps for environmental- and plant protection. On EU-level Plant Protection Organizations such as EPPO, technical organizations (e.g. EFSA) can use tools and platforms as a standard for phytosanitary measures. On single-state level FAGESOS-GIS tools provide valuable input for prevention and control strategies in the course of the update of the next National prevention regulation (such as e.g. "Normative Fitosanitaria" in IT, "Legislación de aplicación a los productos fitosanitarios" in ESP). Furthermore, monitoring systems and protocols will be worthwhile tools for monitoring publicly managed forest areas.

- c. Landowners, growers/managers will in both regional maps find support for prioritizing the application of Integrated Pest Management (IPM) or mitigation strategies. For landowners of project areas, map c) represents a valuable tool to guide their forest management.

3. To support project partners with the definition and update of IPM-intervention protocols:

To this end, the models on the service platform will be used for upscaled monitoring of entire treatment areas in WP7, being too time-consuming if done only by ground-monitoring. Finally, WP2 and WP7 are strongly interconnected, with WP7 improving WP2 tools which are in turn useful for monitoring.

The results achieved from pursuing these objectives are the outcomes described on the following pages.

4.1 Structure of the page and rationale behind the set-up

The first released version of the FAGESOS-GIS platform consists of four sections which are separated in tabs that are selectable at the top of the page (Fig. 1).

4.1.1 About

This section briefly describes the LIFE-FAGESOS project and its main objectives. In addition, the functioning of the website is explained in this section with a particular emphasis on how to use the maps. As the maps should be usable by a wide range of stakeholders, with different levels of education, we included some helpful screenshots to assist the users on this matter and kept the description as simple and accessible as possible (Fig. 2 and 3). During the project, feedback from stakeholders will be very useful to improve these aspects of the platform.



Figure 1 -Main page of the LIFE FAGESOS-GIS platform

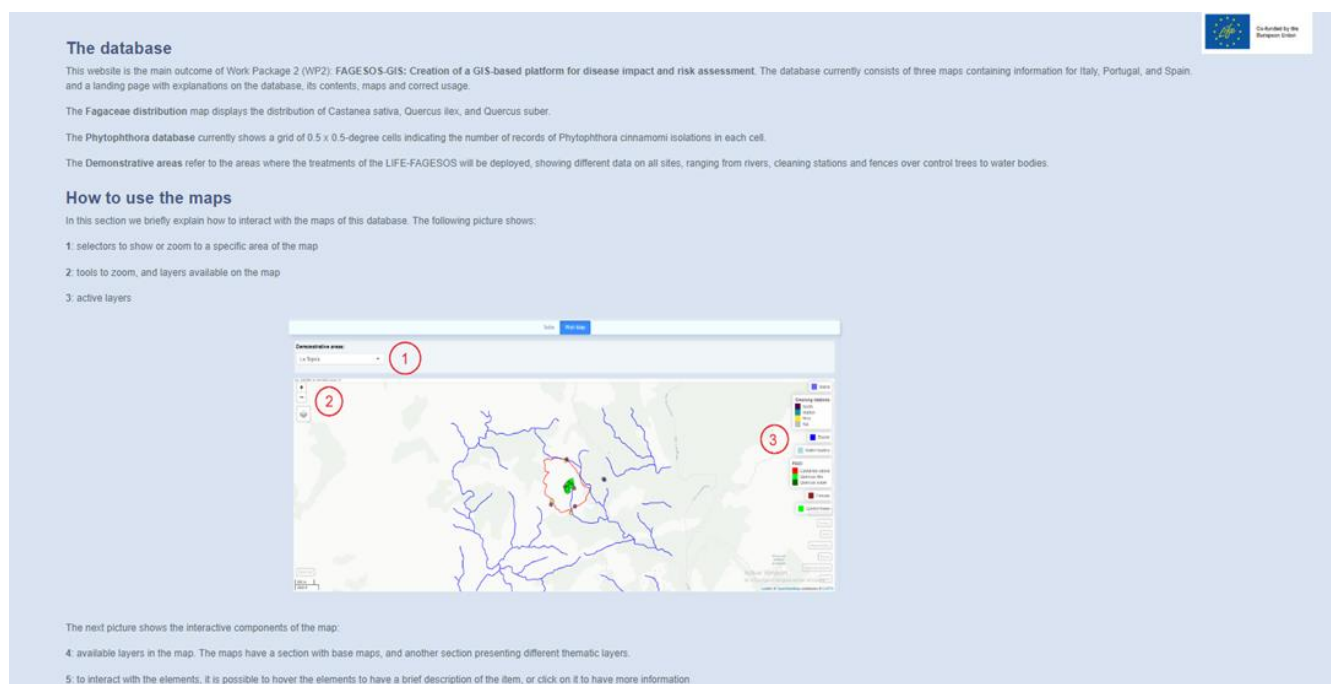


Figure 2 - Visual support to "How to use the maps"



Figure 3 - Visual support to "How to use the maps"

At the bottom of the webpage, users can find the general information about the project (topic, type of action, proposal number, proposal acronym and type of model grant agreement), in case they want to search for the project in EU databases. After successful set-up of the project webpages, we will insert the link to these pages here.

4.1.2 Fagaceae distribution

The Fagaceae distribution tab has been developed in task 2.1.1 by UCO, and reviewed by UNITUS, UNISS and UTAD and will serve as a basis for subsequent WP2 task (Fig. 4). Furthermore, it will feed into the different modelling approaches identifying *Phytophthora*'s habitat and distribution models (task 2.2), risk models at landscape level (task 2.3) and disease impact and forest health status models (task 2.4). At the top of the page a brief and clear description is presented. The primary content of this section is a map displaying the distribution of the tree species targeted by the project, specifically *Castanea sativa*, *Quercus ilex*, and *Quercus suber*.

The map has been created by conducting an extensive search in various state and regional resources, which have been homogenized to generate the distribution of these species in the regions of interest to the project. Firstly, we gathered the Spanish regional cartography of the "Mapa Forestal de España de máxima actualidad" (MFE) and aggregated it to create a homogeneous map of Spain including only the target species. The MFE (MITECO, 2022) consists of a national project representing the forest ecosystems, being the base of the Spanish National Forest Inventory. The cartography is mainly provided at scale 1:25,000 except four Autonomous Communities which are currently available at scale 1:50,000 (supplementary material for detailed information). The data from Portugal was collected from the "Carta de Uso e Ocupação do Solo para 2018" (DGT, 2022) which is available as a single layer for the entire country. The COS2018 cartography (DGT,

2022) was created from visual interpretation of orthorectified aerial images of high spatial resolution (0.25 m), and a minimum georeferenced unit of 1 ha. Next, data from Italy was collected and combined to generate the homogeneous assembled layer of the three tree species. Most of the data was acquired from the “Istituto Superiore per la Protezione e la Ricerca Ambientale” (ISPRA, 2022) except from the Regions of Calabria, Lombardy, Piedmont, and the provinces of Bolzano and Trento. Regarding Calabria, Bolzano and Trento no specific forestry cartography was found which had species-level differentiation. In the case of Lombardy, we used the “Uso e copertura del suolo 2018” which was obtained from photointerpretation of Aega aerial photos, colour aerial photos and satellite images from SPOT6 and SPOT7 from 2018 (Regione Lombardia, 2019). Lastly, for the region of Piedmont we used the “Carta forestale (edizione 2016)” which is based in photointerpretation of a referential aerial image (Camerano et al., 2016). All the compiled data from Italy was mixed to form a layer of the three tree species for the country.

The final map implemented in the platform has been built using the *leaflet* library and includes buttons that allow the user to select a base map and coordinates of interest. To ensure that the webpage meets its memory requirements, we have transformed the original map into a raster format and downscaled it to a 0.01×0.01° grid.

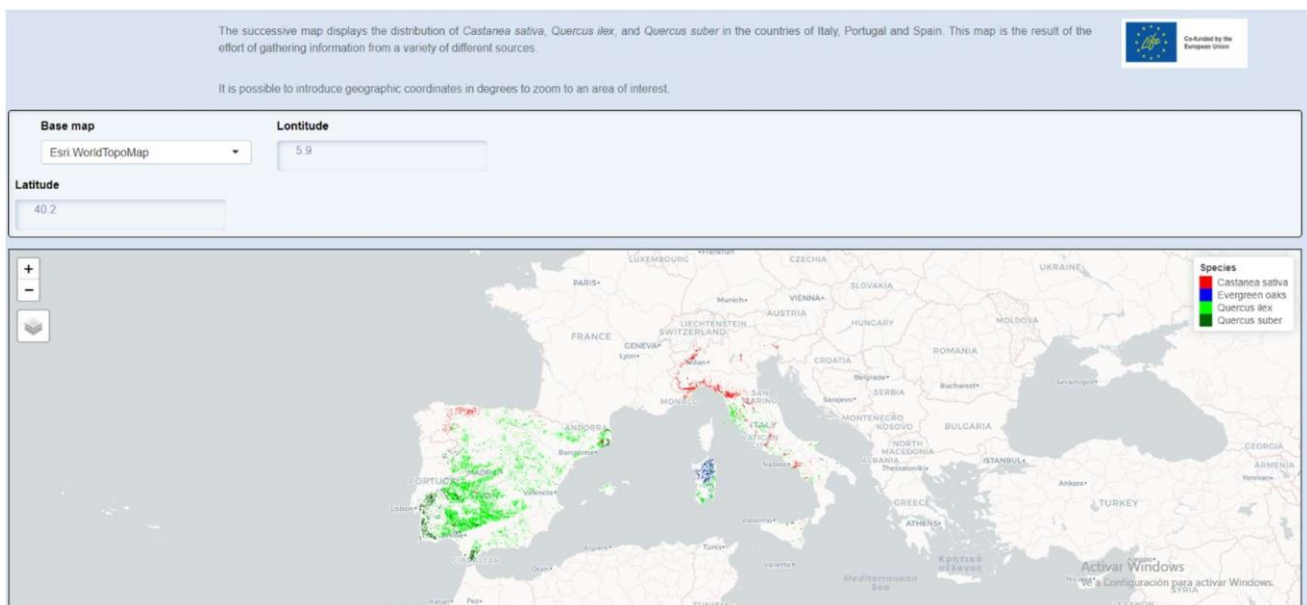


Figure 3 - Fagaceae distribution map

4.1.3 Phytophthora database

The third tab features a map that displays the distribution of *Phytophthora cinnamomi* within the regions of interest (Fig. 5.). This map has been developed in task 2.1.2, during which UCO performed an extensive bibliographic search with support from UNITUS and UNISS of *Phytophthora cinnamomi* surveys conducted over

the last few decades. The primary objective of this map is to provide users with an understanding of where *P. cinnamomi* has been most frequently found through field surveys.

The section begins with a brief description of the map, followed by a leaflet-based map display (leaflet is an open source Javascript-based library). In the current version, the map is shown as a $0.5 \times 0.5^\circ$ grid, where each cell represents the number of presences found in the analysed surveys. Users can interact with the map by zooming in and clicking on a cell to receive information about the number of isolations found in that area (Fig. 5).

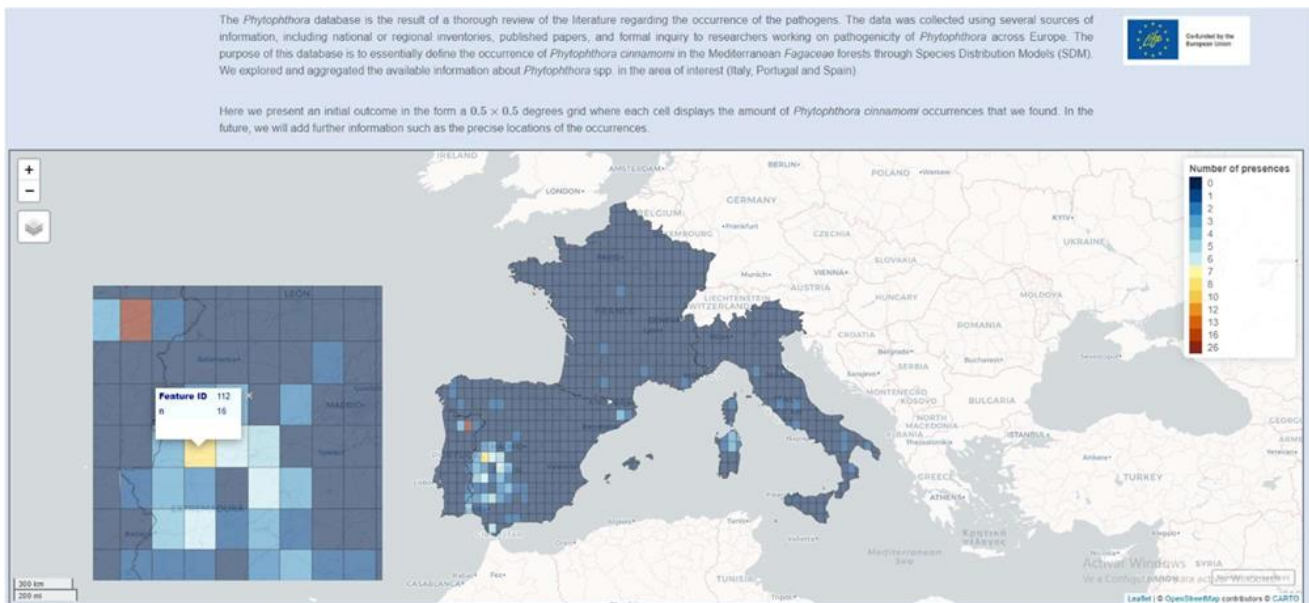


Figure 5 - Structure of the Phytophthora database tab. At the bottom-left is shown the emerging attributes that appear when clicking in a cell.

4.1.4 Demonstrative areas

The final tab in the first version of the FAGESOS-GIS platform displays a map that includes both basic and thematic cartography for the demonstrative areas of the LIFE-FAGESOS project. The data used in this map has been gathered in task 2.1.3 by UCO, UNITUS, UNISS, UTAD, La Almoraima and Ausoni Park for each demonstrative area. Each layer of the map is explained at the top of the page, providing the user with a clear understanding of the presented information.

Currently, the map includes the following layers:

- **Demonstrative area:** areas where the measures of the project will be implemented.
- **Road infrastructure:** linear elements representing the highways, roads, paths, and tracks of the demonstrative areas.
- **Cleaning stations:** point features representing the location of infrastructures used in LIFE-FAGESOS Work Package 4 (WP4) as Hygiene Measures against *Phytophthora cinnamomi*.

- **Rivers:** linear water elements.
- **Water bodies:** polygon water elements.
- **FOCI:** polygon features delimiting areas with symptoms and positive isolation of *Phytophthora cinnamomi*.
- **Fences:** linear elements representing closed areas in the demonstrative areas.
- **Control trees:** point features representing trees that will be treated/monitored. This layer has yet to be defined.
- **Other layers:** other layers such as vegetation maps, digital elevation models, etc., will be implemented in the future.

The current options of the map area are shown in Fig. 6. The user can select a table where the available data is shown by demonstrative area. Another option is that the user can choose the demonstrative area, thereby zooming automatically to the area of interest. Finally, users can modify the visible layers on the left pane and interact with these layers on the map to obtain additional information about the displayed features. As work proceeds, UCO will integrate optical and biophysical data obtained in monitoring field campaigns (in WP7), provided by IDAF.

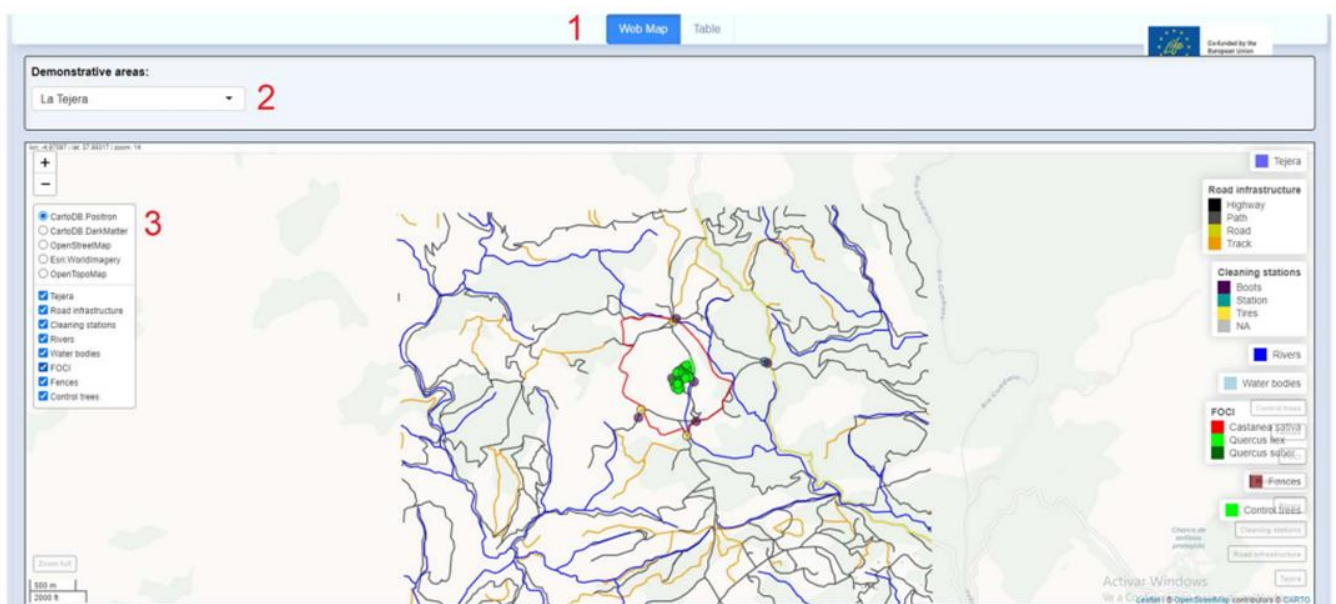


Figure 6 - Structure of the map of the Demonstrative Areas tab. (1) change from webmap to table; (2) choose the demonstrative area; (3) set the visible layers.

5. Conclusion and outlook on the next steps

In the present Deliverable we described content of the LIFE FAGESOS-GIS platform in its first version. The figures above display the main features of the platform, which currently are mostly informative maps. The structure of the platform has been completed successfully, first data has been inserted, so the platform is therewith launched and ready-for-use. The functionality of the maps will be improved in the future to serve as tools to project stakeholders and partners, as described. In addition, further information will be added. Specifically, we expect the following updates per section of the platform:

- *Fagaceae distribution*: optimize the resolution of the map to be more informative at local scales.
- *Phytophthora database*: in this map we show the occurrences of *P. cinnamomi* in a $0.5 \times 0.5^\circ$ grid. As we continue to gather more data, we anticipate adding additional occurrences to the resulting map. Further metadata will be included in the emergent attribute table.
- *Demonstrative areas*: the table shows the available information by demonstrative area. Some information is currently not available because the partners are working on the cartography. We will add this information to the database as we receive it.

Furthermore, new maps or functionalities will be added in the future. We plan to add the following data to the platform:

- *Phytophthora cinnamomi* risk maps: in the context of task 2.2, we plan to add the results of the work on risk maps in the platform. These maps will be at least: species distribution model, risk of surviving to winter temperatures, risk of surviving to summer temperatures, risk of spring growth, and a combined model of the suitability of the territory for *P. cinnamomi*, represented in a GIS-based risk map.
- *Impact maps and remote sensing results*: the outputs of task 2.4 including impact maps extended at regional scale with accurate information on Phytophthora impacts and tree condition for the FAGESOS target ecosystems based on the upscaling of the Remote-Sensing based products produced in task 7.2 for monitoring changes at landscape level. The results will be presented in a GIS-based collection of cartographic products for chestnut, holm oak and cork oak.