Interreg Euro-MED

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Germ of Life

Interreg Euro-MED Project GERM OF LIFE

"Digital Drought Risk Management enabling the drought mitigation and adaptation strategies for the restoration of the ecosystem equilibrium in Mediterranean European Countries".

Test Project (Thematic Project)
Mission: NATURAL HERITAGE

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Report presenting the common methodology of the Test protocol and technical details of the pilot sites to ensure a smooth implementation of the in-situ monitoring environment.

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1 Executive Summary

The Germ of Life project aims to enhance drought resilience in the Mediterranean through the development, testing, and adoption of innovative Nature-based and technological solutions. This report outlines the common test protocol and methodology that will guide real-life implementation in four Pilot Test Areas (PTAs) across Greece, Italy, Portugal, and Spain.

The purpose of this protocol is to ensure harmonized deployment and evaluation of in-situ drought monitoring systems, allowing for consistent data collection and cross-border comparability. It is grounded in previous project activities that assessed vulnerabilities and defined site-specific goals.

Key elements of the protocol include:

- A standardized set of drought indicators to be monitored, including soil moisture, precipitation, temperature, humidity, solar radiation, wind, and vegetation indices.
- A coordinated procurement process, selecting common suppliers and agreeing on shared terms of service and delivery to comply with national regulations.
- A shared methodology for installing and operating monitoring equipment, with technical support provided across PTAs.
- A unified data management approach using standardized logging intervals and open data formats for integration into the project's central platform.
- A maintenance and sustainability plan to ensure continued use and impact of the systems beyond the project's lifetime.

1.1 Role of deliverable

This report presents the common methodology of the Test protocol and technical details of the pilot sites to ensure a smooth implementation of the in-situ monitoring environment.

1.2 Relationship to other GERM OF LIFE deliverables

The activity capitalizes the outcomes of the preliminary study (A1.1) and the definition of goals and objectives, the solutions, including their design and implementation carried out in A1.3-A1.6.

1.3 Structure of the document

This deliverable is organized in a logical sequence that guides the reader from the overall context of the project to the detailed methodologies applied at the pilot sites. The structure begins with introductory and objective-setting sections, followed by the definition of the common test protocol. It then describes the methodologies applied in each pilot country, before concluding with the long-term maintenance and sustainability approach. The final section synthesizes the key outcomes of the document.

The main sections are:

- **Introduction** – Presents the context, background, and relevance of the Germ of Life project.
- **Objectives** – Defines the aims and expected results of the test protocol and methodology.
- **Common Test Protocol** – Details the general monitoring scope, equipment and suppliers, and the data management strategy.
    - Monitoring Scope
    - Equipment and Suppliers
    - Data Management
- **Methodology for Pilot Sites** – Provides site-specific protocols and implementation strategies.
    - Pilot Greece
    - Pilot Italy
    - Pilot Portugal
    - Pilot Spain
- **Maintenance and Sustainability Plan** – Explains measures to ensure the long-term viability of monitoring systems.
- **Conclusions** – Summarizes key findings and highlights the relevance of the harmonized protocol.

2 Introduction

The Germ of Life project addresses drought risk management in the Mediterranean region through the testing and evaluation of Nature-based and technological solutions across four Pilot Test Areas (PTAs) in Greece, Italy, Portugal and Spain. This report outlines the common test protocol and methodologies to be implemented across the pilot sites, aiming to ensure consistency in data collection, monitoring, and evaluation of the solutions deployed.

This deliverable supports the execution of real-life test activities under the project's Work Package "Test activities and Evaluation of Solutions". It is based on the preliminary findings (Activity A1.1) and the design and implementation planning (Activities A1.3–A1.6).

3 Objectives

The objectives of this deliverable focus on preparing and guiding the implementation of the Germ of Life project's drought monitoring and mitigation activities across the four Pilot Test Areas (PTAs). They aim to ensure a harmonized, reliable, and sustainable approach that can be replicated beyond the project's timeframe.

- To prepare the PTAs for the deployment of drought monitoring and mitigation solutions.
- To establish a shared methodology and test protocol.
- To ensure that procurement, installation, and data handling procedures are harmonized across pilot sites.
- To define the technical setup for each site, ensuring comparability and replicability of results.
- To establish a maintenance and sustainability plan post-project.

These objectives collectively provide the foundation for consistent implementation across diverse Mediterranean environments. By aligning technical procedures, procurement, and data management, the project ensures that the solutions tested are not only site-specific but also comparable across countries. This framework enhances cross-border learning, facilitates knowledge transfer, and strengthens the long-term impact of the Germ of Life initiative in promoting drought resilience.

4 Common Test Protocol

4.1 Monitoring Scope

Each pilot site will monitor drought-related variables through in-situ equipment, according to local needs and climatic/agricultural context. The core set of measurements includes:

- Air temperature and humidity
- Wind speed and direction
- Precipitation
- Photosynthetic Active Radiation (PAR)
- Normalised Difference Vegetation Index (NDVI)
- Ground temperature and relative humidity at three depths (25 cm, 45 cm, 60 cm).

4.2 Equipment and suppliers

- The procurement strategy adopted has been based on bids, following respective national public procurement regulations.

- All suppliers should provide calibration certificates for each sensor.

4.3 Data Management

- All sensors are interrogated every 1 minute; the outputs and stored data are 10-minute and 24-hour averages.
- Outputs are fed into the Germ of Life Vulnerability Assessment Platform using open data formats (e.g. CSV, JSON).
- Calibration and quality control protocols will be jointly defined.

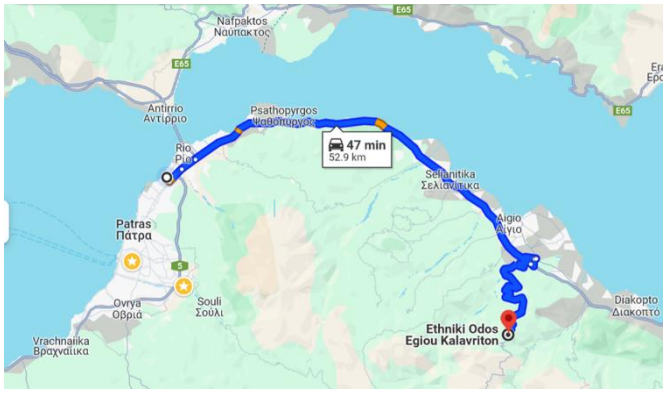
5 Methodology for Pilot Sites

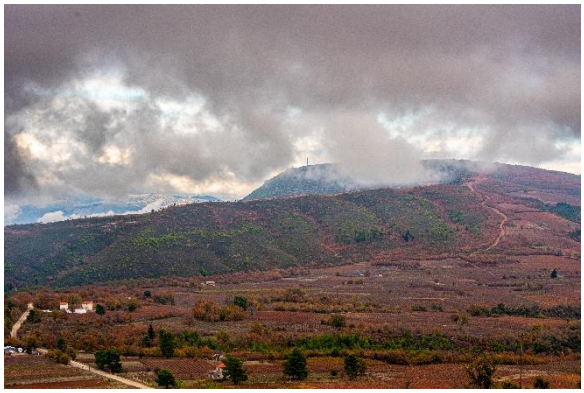
5.1 Greece

5.1.1 Pilot Site Description

- **Location**: Aigion, Peloponnese, Greece, Coordinates: North: 38° 10' 14.7" East: 22° 04' 49.4" Google maps: https://maps.app.goo.gl/hHApnXu8iBMCeYqUA
- **Main Land Use**: Vineyards (mainly traditional and unirrigated).
- **Climatic Characteristics**: Mediterranean, hot dry summers with mild, wet winters.
- **Vulnerability Factors**: High exposure to prolonged summer droughts; water resource limitations.
- **Stakeholders**: Local vineyard cooperatives, agricultural extension services, municipal authorities

Figure 1. Hellenic Pilot Site





5.1.2 Equipment Deployment Plan

Weather station equipped with temperature / humidity sensor, wind speed and direction sensor, three soil temperature and humidity sensors at 25, 45, and 60 cm depth, a Photosynthetic Active Radiation (PAR) sensor and a Normalised Difference Vegetation Index (NDVI) sensor.

The weather station is powered by the mains and transmits data via a land internet line.

Figure 2. Hellenic Pilot Weather Station

5.1.3 Procurement Status

- Tender procedure launched following Greek national guidelines.
- Supplier selected for soil moisture sensors and weather stations.
- Delivered November 2024.

5.1.4 Deployment Plan

- Installation supervised by technical partner University of Patras, GR.
- Calibrated and tested prior to delivery.
- Data transmission Germ of Life Vulnerability Assessment Tool platform, successfully tested in February 2025.

5.2 Italy

5.2.1 Pilot Site Description

- **Location**: Parco "Le Vallere" Corso Trieste, 98, 10024 Moncalieri (Torino), Italy. Coordinates: 45°00'44.0"N 7°40'19.5"E Google maps
The installation site is the urban park "Le Vallere", located at the confluence of the Sangone stream with the Po River, between the municipalities of Moncalieri and Turin (Piedmont region). The area lies within the boundaries of the Po River Protected Area in Piedmont and is open to the public during specific hours. The sensors will be installed within the Phenological Garden, which was created to study the seasonal cycles of plants and their relationship with climate.
Unlike other urban parks, Le Vallere is characterized by the coexistence of agricultural landscape and public parkland, featuring a mosaic of forage meadows and predominantly native tree species such as hornbeams, maples, lindens, poplars, and willows—typical of riparian vegetation.
- **Main Land Use**: Meadows.

Figure 3. Perimeter delimitation of the Phenological Garden, Sensor installation area

- **Climatic Characteristics**: Le Vallere Park has a typical climate of the western Po Valley, influenced by the presence of the river and the proximity to the surrounding hills. The park's climate supports a mixed vegetation, including hay meadows, small woodland patches, and native tree species. The proximity to the Po River contributes to a humid microclimate, which is ideal for local biodiversity.
- **Vulnerability Factors**: The area is subject to prolonged periods of drought, but also to extreme weather events such as cloudbursts and hailstorms, which can significantly impact the local vegetation and soil conditions.
- **Stakeholders**: Management Authority of the Piedmont Po Regional Park, municipalities, Park users for recreational and educational activities, Research Institutes and Universities.

5.2.2 Equipment Deployment Plan

- An integrated environmental monitoring system was acquired, consisting of: a data acquisition station, environmental and meteorological sensors, soil sensors, and vegetation sensors. Supervision by CMCC.
-The equipment consists of: Data acquisition station for meteorological, environmental, hydrological, and geotechnical sensors; temperature and humidity sensor; PAR sensor; tipping-bucket rain gauge; TDR soil moisture sensor; Analog sensor for NDVI (Normalized Difference Vegetation Index) monitoring.

5.2.3 Procurement Status

- Acquisition of sensors carried out by the LAMORO Development Agency. Supervision by CMCC.
- Delivered in May 2025.

5.2.4 Deployment Plan

The installation will take place in June/July 2025 at the selected site within the Phenological Garden. All administrative matters involving the LAMORO Development Agency and the Po River Park are currently being addressed.

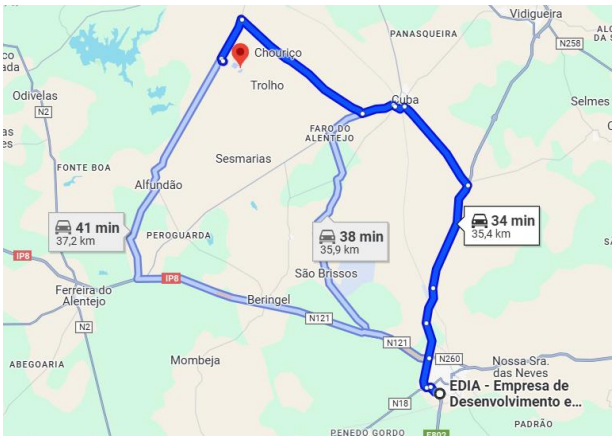
Figure 4. Installation site

5.3 Portugal

5.3.1 Pilot Site Description

- **Case Study:** Mediterranean Temporary Pond Habitat (Listed as a priority habitat (3170*) for conservation in Annex I of the EU Habitats Directive).
- **Location**: civil parish of Alvito, municipality of Alvito, district of Beja, Portugal. Coordinates: Latitude: 38.181809°; Longitude: -8.005738°. Google maps: https://maps.app.goo.gl/dfu7UjqYrCvg2sYG7
- **Main Land Use**: Extensive livestock farming on pastures for cattle. In the surrounding areas there are super-intensive olive groves.
- **Climatic Characteristics**: Mediterranean, hot dry summers with mild, wet winters.

Figure 5. Portuguese Pilot Site



13th May 2024

19th December 2023

- **Vulnerability Factors**: High exposure to prolonged summer droughts; water resource limitations, dependence on precipitation, short periods of flooding, high temperatures and evaporation, changes in land use (agricultural intensification), hydrographic isolation and small size, dependence on synchronised biological cycles and low ecological resilience.
- **Stakeholders**: Farm owners and managers, nature conservation organisations, local and regional authorities, local workers, the educational public and research and education organisations.

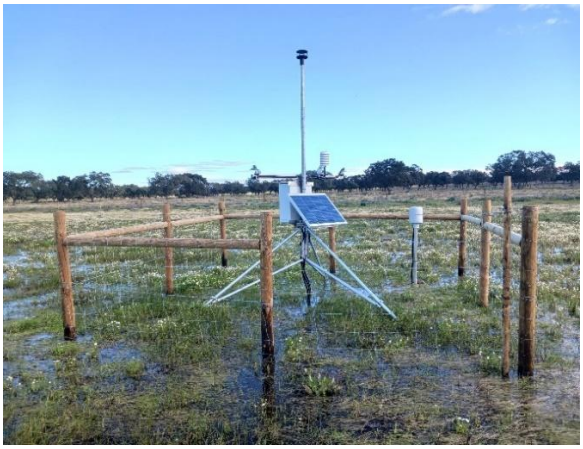
5.3.2 Equipment Procurement Plan

Meteorological station equipped with the following sensors:

- Precipitation Sensor (LAMBRECHT meteo GmbH – Model 15189)
- Air Temperature and Relative Humidity Sensor (Campbell Scientific – Model EE181-L)
- Wind Speed and Direction Sensor (Gill Instruments – Model WindSonic)
- Two Soil Moisture and Temperature Sensors (Campbell Scientific – Model CS655)
- Quantum (PAR) Sensor (Campbell Scientific – Model CS310)
- 4-component net radiometer (Hukseflux – Model NR01)
- Normalized Difference Vegetation Index (NDVI) Sensor (Apogee Instruments – Models S2-411 and S2-412)

The soil humidity and temperature sensors were installed at a depth of 20 and 40cm.

Figure 6. Portuguese Pilot Meteorological Station



The meteorological station is powered by a photovoltaic panel that converts sunlight into electricity, meeting the station's energy needs.
The data is recorded on a datalogger (Campbell Scientific - CR1000X) which is then transmitted through the mobile network (SIM card - 4G) via a 4G Cellular Module (Campbell Scientific - CELL215).
A protective fence was also installed around the weather station, as there are cattle in the area that could compromise the physical integrity of the equipment.

5.3.3 Procurement Status

- Tender procedure launched following Portuguese national guidelines.
- Supplier selected for the purchase of the complete meteorological station, as well as all installation and programming work.
- Supplier selected for the purchase and installation of fencing to protect the weather station, due to the presence of livestock in the pilot area.
- All the work and equipment were delivered and completed by December 2024.

Figure 7. Portuguese Pilot Meteorological Station - Installation Works

5th December 2024

5.3.4 Deployment Plan

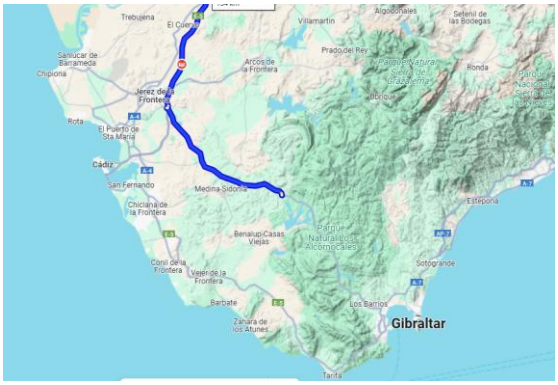
- Installation supervised by EDIA technicians.
- All the equipment and programming work was tested by the supplier before delivery and installation to guarantee the quality of the work.
- Final configurations are still pending to test data transmission to Germ of Life Vulnerability Assessment Tool platform.

5.4 Spain

5.4.1 Pilot Site Description

- **Location**: Forest Fire Defense Center (CEDEFO) of Alcalá de los Gazules, Andalucía, Spain. Coordinates: North 36° 26' 41.50" West 5° 44' 53.62"
Google maps: https://maps.app.goo.gl/K3oR3dWxciXR4bcP6
- **Main Land Use**: Grassland
- **Climatic Characteristics**: Mediterranean, hot dry summers with mild, wet winters.
- **Vulnerability Factors**: Medium exposure to prolonged summer droughts.
- **Stakeholders**: Forest Fire Defense Center, regional and municipal authorities.

Figure 8. Spanish Pilot Site



5.4.2 Equipment Procurement Plan

Weather station will be equipped with precipitation, temperature / humidity sensor, wind speed and direction sensor, two soil temperature and humidity sensors at different depth, a Photosynthetic Active Radiation (PAR) sensor and a Normalised Difference Vegetation Index (NDVI) sensor at 1 and 2 m. above vegetation.

The weather station will be powered by a solar panel, a charge regulator and a battery. It will transmit data via a land internet line.

Figure 9. Weather Station Instruments

5.4.3 Procurement Status

- Tender procedure launched following Spanish national guidelines.
- Expected to be installed October 2025.

5.4.4 Deployment Plan

- Installation will be supervised by Regional Ministry of Sustainability and Environment technicians.
- Calibrated and tested prior to delivery.
-Data transmission Germ of Life Vulnerability Assessment Tool platform is scheduled to be tested in November 2025.

6 Maintenance and Sustainability Plan

- Each Pilot will define a local protocol for equipment maintenance, data validation, and long-term operation beyond the project's duration.

- Local capacity building activities will be conducted to train technical staff on equipment upkeep and data interpretation.

7 Conclusion

This test protocol ensures a harmonized approach to monitoring drought conditions across diverse Mediterranean settings. The pilot sites will not only generate actionable data for local drought mitigation but also serve as demonstrators for scalable, cross-border solutions.