LIFE Project Number
LIFE17 CCA/ES/000030

Final Report
Covering the project activities from 01/07/2018 to 30/06/2022

Reporting Date[1]
30/09/2022

LIFE PROJECT NAME or Acronym
LIFE RESILIENCE

Data Project

Project location:	Italy: Tuscany Portugal: Alentejo Spain: Andalucía, Extremadura, Murcia
Project start date:	01/07/2018
Project end date:	30/06/2022 **Extension date**.-no
Total budget:	€ 2.968.675
EU contribution:	€ 1.723.567
(%) of eligible costs:	60%

Data Coordinating Beneficiary

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1

This table comprises an essential part of the report and should be filled in before submission

Package completeness and correctness check	
Obligatory elements	**✓ or N/A**
Technical report	
The correct latest template for the type of project (e.g. traditional) has been followed and allsections have been filled in, in English *In electronic version only*	✓
Index of deliverables with short description annexed, in English *In electronic version only*	✓
Mid-term report: Deliverables due in the reporting period (from project start) annexed Final report: Deliverables not already submitted with the MTR annexed including the Layman'sreport and after-LIFE plan Deliverables in language(s) other than English include a summary in English *In electronic version only*	✓
Financial report	
The reporting period in the financial report (consolidated financial statement **and** financial statement of each Individual Beneficiary) is the same as in the technical report with the exceptionof any terminated beneficiary for which the end period should be the date of the termination.	✓
Consolidated Financial Statement with all 5 forms duly filled in and signed and dated *Electronically Q-signed or if paper submission signed and dated originals* and in electronic version (pdfs ofsigned sheets + full Excel file)*	✓
Financial Statement(s) of the Coordinating Beneficiary, of each Associated Beneficiary and of each affiliate (if involved), with all forms duly filled in (signed and dated). The Financial Statement(s) of Beneficiaries with affiliate(s) include the total cost of each affiliate in 1 line per cost category. *In electronic version (pdfs of signed sheets + full Excel files) + in the case of the Final report the overallsummary forms of each beneficiary electronically Q-signed or if paper submission, signed and dated originals**	✓
Amounts, names and other data (e.g. bank account) are correct and consistent with the Grant Agreement / across the different forms (e.g. figures from the individual statements are the sameas those reported in the consolidated statement)	✓
Mid-term report (for all projects except IPs): the threshold for the second pre-financing payment has been reached	
Beneficiary's certificate for Durable Goods included (if required, i.e. beneficiaries claiming 100% cost for durable goods) *Electronically Q-signed or if paper submission signed and dated originals* and in electronic version (pdfs of signed sheets)*	
Certificate on financial statements (if required, i.e. for beneficiaries with EU contribution ≥750,000 € in the budget) *Electronically Q-signed or if paper submission signed original and in electronic version (pdf)*	n/a
Other checks	
Additional information / clarifications and supporting documents requested in previous lettersfrom the Agency (unless already submitted or not yet due) *In electronic version only*	✓
This table, page 2 of the Mid-term / Final report, is completed - each tick box is filled in *In electronic version only*	✓

**signature by a legal or statutory representative of the beneficiary / affiliate concerned*

1. Table of contents

2. List of key-words and abbreviations

BALAM Agriculture, S.L. (BALAM)	*Xylella fastidiosa* (XF)
Greenfield Technologies (Greenfield)	Olive Quick Decline Syndrome (OQDS)
Asociación Agraria de Jóvenes Agricultores. (ASAJA)	Climate Change (CC)
Agrifood Sector Communication, S.L. (AGRIFOOD)	Available water capacity (AWC)
NUTRIPRADO, LDA. (NUTRIPRADO)	Map2Soil (M2S)
Sociedade Agricola Herdade Do Charqueirao, LDA. (SAHC)	Electric conductivity (Eca)
Universidad de Córdoba (UCO)	Rapid Biodiversity Assessment (RBA)
Societa' Agricola Villa Filippo Berio, S.S. (VILLAFILIPPO BERIO)	Normalised Difference Vegetation Index (NDVI)
Consiglio Nazionale Delle Richerche - L'Istitutoper la BioEconomia. (IBE-CNR)	World Olive Germoplasm Bank of Cordoba (WOGB-UCO)
Partnership Agreement (PA)	Hydraulic Conductivity (HCS)
Grant Agreement (GA)	Organic Matter (O.M)
Steering Committee meeting (SCM)	Project director (PD)
	Compliance Manager (CM)
	Steering Committee (SC)
	Legal Entity Form (LEF)
	Financial Identification form (IF)

3. Executive Summary

Project objectives, Key deliverables and outputs

Life RESILIENCE is intended to prevent and mitigate the spread of XF in almond and olive production systems with Mediterranean climate. During the project, all activities have been focused on achieving this goal through two main strategies: 1) create disease- resistant varieties trough evaluation and crossbreed pathogen-resistant olive varieties, and 2) developa "best sustainable production practice model" focused on improving soil and plant health and the resilience towards pathogens as XF. The specific **activities performed and major achievements** to reach these objectives are detailed below:

A1 Selection and design of demonstration trials: the design of land management plans for each demonstration trial was determined within the identified areas plots. PT- Heredade de Charqueirao, Alandroal (50 ha), Évora; SP- El Valenciano, Carmona (150 ha); IT- La Traversagna (since January 2020 the name changed to Villa Filippo Berio), Pisa (50 ha). For the base line different test were performed in each farm: identification of soils type; identification of plants species, irrigation, and soil nutrition needs. Cover crops were selected and sown. The biodiversity assessment started with the inventory of presence of potential vector of XF. Also, insect + nest /bird boxes were installed in each demo farm for a total of 163. This baseline has determined the starting point in each farm and facilitated the impact analysis achieved at the end of the project.

A2 Training sessions and design of materials for demonstration trials: Training material has been developed on different basic aspects related to XF and on the methodologies required to implement the good practices on the selected farms. The material has been used in five project stafftraining events performed. The first was in Madrid on January 22nd and 23rd 2019 (18 attendees). Thesecond was in Italy led by VF BERIO & CNR in February 27th 2019 (13 attendees). The 3rd was in Portugal led by SACH in March 13th 2019 (4 attendees). The 4th was in Spain led by BALAM in March 13th (10 attendees) and the 5th in Pisa on June 18th 2019 (25 attendees). In Pisa, Portugal and Spain field training was done in

order to establish how to apply the monitoring protocols. Furthermore, all the materials were published in June on the website.

C1 Development of disease-resistant olive varieties: in the experimental field El Valenciano (SP) UCO and BALAM have planted in total 1.000 seedlings. Of those, 500 seedlings(pre-selected genotypes crosses from 2017) were planted in December 2018 and other 500 seedlings(from 2018) were planted in August 2019. As a result, a selection of 18 genotypes was made according to their agronomic characteristic which were clonally propagated and 533 plants reaching 70 cm height were shipped to Italy in order to implement 3 XF evaluation trials. First, a test the adaptability of the selected genotypes to the Tuscan climate and edaphological condition at VF FERIO. Second, an evaluation to XF in controlled condition by IPSP in Bari. Finally, two experimented field to test the selected genotypes under natural infection condition to XF has been made, collaborating with the company "Giovanni Presicce". In addition, the selected genotypes have been planted in El Valenciano to evaluate in detail the agronomic performance of this new cultivars in a different environment.

C2 Demonstration in trial areas: the implementation of best practices in 250 ha has started in all 3 demo areas: with olive (in Spain and Italy) and almond production (in Portugal). Five treatments were established including bioestimulants, deficit irrigation, biological pest control, cover crops and implementation of sustainable cultural practices (including prune and installation of nest boxes). Furthermore, a web viewer compatible with all types of smartphones, tablets and personal computers operating systems was developed in order to upload and share several agronomic parameters that being monitoringconstantly in the three demo areas.

C3 Natural vector control measures: Sustainable cultural methods were implanted in all demo areas to prevent and or control vector presence. Firstly, mapping of vector distribution was performed. Secondly, after the implementation of cover crops, CNR (Italy) and NUTRIPRADO (Spain and Portugal) have evaluated the auxiliary flora and border plants. In Italy trap plants in olive orchards evaluated adults' density population of *P. spumarius.* In addition, more than 7 different trials were studied by CNR to find eco-friendly methods for evaluating alternative natural vector control, such as sulphur, soap, *Beauveria bassiana* and pyrethrum under laboratory condition, 3 trials on farm to determinate the behaviour and distribution of XF vectors. Finally, a soil biological fertility trials was done in Spain and Italy to demonstrate that the increase in soil biodiversity can improve plant growth and health.

C4 Replication activities:13 replication farms signed the letter of accession on time covering a total of 1.861,6 ha. First, GREENFIELD characterized with satellite images the sites and a management plan was designed for each one. Second, management plans were implemented, and subsequent technical advice was carried out by the partners until the end of the crop season. At the same time, training sessions were developed. Significant environmental and economic impact was estimated for these farms. Besides, in Italy, CNR evaluated 4 new replication farms that were set up in Tuscany and Sicily covering 40 ha, using the original data set of NDVI provided by GREENFIELD through the innovative methodology developed in this project. As an additional effort to guarantee future uptake and part of the After Life Activities, ASAJA achieved new 30 farms (2.194 has) that were committed to implementing the model during the afterlife period (2022-2026). At the end, we can say that we have achieved 4.346 ha that were likely to apply the Life Resilience model.

D1 Monitoring & project performance indicators: 18 monitoring parameters were measured and evaluated. First data was done to determinate the initial state of the farms, then monitoring activities have required field visits, in situ sampling and laboratory analysis. Results have been focussed on Tree Health, Soil quality, Disease prevalence, Weather, Quality, Water Use, Carbon Footprint, Biodiversity, Production Value and XF Resilience.

D2 Conclusions and recommendations: A conclusions and recommendation report is presented as a stand-alone document that comprises, socio-economic and environmental impact, replicability and transferability potential and the business plan including new genotypes resistant to XF generated in the project.

D3 Monitoring KPI´s: The impact that the measures implemented were analysed through indicator which have been updated in different phases of the project until the end. All KPI´s have been archived at 100% least 4 of them, such as the reduction of CO2 (19%), AWC (48%), reduction of costs of phytosanitary and fertilizers cost reduction (33%) and quality of olive oil (50%).

E1 & E2 General Dissemination: The communication strategy was focused on raising awareness and engagement of a wide variety of stakeholder groups i.e. farmers, cooperatives, private companies,

foundations and governmental organisations and citizens involved in the olive and almond sector, which were interested in learning about sustainable practices for the prevention or control of XF disease in Mediterranean region, mainly Spain, Italy and Portugal. In total, **50 information** and awareness-raising activities were carried out during the project, having reached more than 1,140,200 people. Beyond the technical seminars, workshops, and training courses, also communication with MEP were established to inform about the achievements in this project on the important of water management and soil health to increase resilience of the orchards. Lastly, a white paper and 4 scientific papers with technical and practical knowledge were published.

Few deviations and problems have arisen during the project that include technical, organizational and financial issues which are explained in detail in section 6.2.

4. Introduction

Background, problems and objectives

Xylella fastidiosa (XF) is a bacterium with pathogenic potential that has led to diseases in a variety of woody crops and trees. It has set alarms across Europe since its detection in 2013 in olive groves surrendering over 1 million olive trees to Olive Quick Decline Syndrome (OQDS). Detected in France, Germany and Spain the disease has the potential to spread across other climate-similar countries and other species such as almonds. The EU considers this quarantine organism "one of the most dangerous plant bacteria worldwide [due to its] causing of a variety of diseases, with huge economic impact for agriculture". Spain, Italy and Greece, the world's main producers of olives and olive oil are currently at risk of losing millions of Euros.

Given the high risk of XF spreading across important agricultural areas of the EU, LIFE RESILIENCE proposes **to develop pathogen-resistant and productive plant genotypes, apply sustainable practices and innovate on natural vector control methods to demonstrate their efficacy in preventing the negative effects of XF**. Once infected by the pathogen, elimination and containment is difficult to achieve. Current measures address the eradication of infected and surrounding vegetation, leading to huge economic and ecological losses. Preliminary research shows that climates with temperate winters are especially vulnerable to pathogen proliferation, and climate change (CC) will only exacerbate this effect.

In order to reach the objectives, the project has performed the following main actions:

- Evaluate and crossbreed pathogen-resistant olive varieties as resilient options for olive producers in potentially infected areas, minimizing the risk of losses due to XF and other pathogens. These new olive varieties can create different olive oils with new organoleptic qualities, increasing the competitiveness in the sector.
- Demonstrate sustainable best practices and technologies for intensive Mediterranean olive and almond production systems, on 250 ha in Spain, Italy and Portugal, that lower their water consumption and carbon footprint, increase biodiversity and resistance to pests/pathogens without compromising yield.
- Provide a replicable model of best practices for olive, almond, and other woody crops such as citrus and grapevine production systems in Europe, increasing their capacity to adapt to CC and future epidemics to be replicated ten-fold (2.500 ha) during the project.
- Involve multidisciplinary actors in transnational collaboration to provide new prevention strategies and EU policies for uptake.

Final results (*see table 6.4.8. Comparison of results achieved against the objectives*)

In terms of Resilience & Sustainability:

- 18 potentially resistant new genotypes were selected, which are derived from resistant cultivars to XF ('Leccino' and 'Fs-17').
- Demonstrate sustainable best practices and apply cutting-edge technologies that increase resilience of 150ha in Spain, 50 ha in Italy and 50 ha in Portugal (olive and almond).

- Increase in biodiversity by introducing auxiliary flora, and fauna via insect hotels and nest boxes.
- Reduction in GHG emissions in the demo farms were of 3.557 tns of CO2 eq. The GHG estimated in replication sites was 6.580,02 tns of CO2 eq. These is equivalent through reduced phytosanitary applications; decrease in water usage and tillage, and implementation of cover crops.
- Reduction of vector insect population via natural vector control measures
- Trees become healthier as phenolic compounds increase; low intensity water stress forces plants to become more vigorous, increasing resilience.
- A Handbook of Best-Practices and a white paper including natural vector control measures was created for replication and transfer of knowledge.

In terms of Quality:
- Due to the application of sustainable practices such as the use of biostimulants increased phenolic compounds in olives (quality increase) around 15%. Particularly the quality of olive oil increased by 50%.
- The reduction of AWC by 48%, and reduction of costs of phytosanitary and fertilizers cost reduction by 33%.

In terms of Socio-economic benefits:
- It was expected to reach 10 farms preserved from XF infection, and finally we reached 47 farms covering 4.346 ha that were likely to apply the Life Resilience model.
- Decrease of production costs from savings on expensive inputs
- The consortium´s network has a direct line of communication with 1,140,200 farmers through the project.

5. Administrative part

Partnership and its added value

The general management structure of the consortium as well as the responsibilities and duties of the partners were recorded in detail in the Partnership Agreement (PA), in conformity with the Grant Agreement of the LIFE Regulation, that was signed by everybody within 22/06/2018.

Project director (PD) was Teresa Carrillo-Cobo, assisted in day-to-day technical tasks by a subcontracted specialised agronomic company as a Technical Management Support (IDEAGRO). As well, NUTRIPRADO and SAHC, after a previous selection procedure, agreed to subcontract the same company to provide technical support during actions A1, C2 and C4. This was necessary and foreseen in the proposal due to their lack of expertise in specific areas of plant pathology, soil health and pest control. In action A1, the subcontracted expert supported the design of necessary protocols and experimental methods to analyse each demonstration plot and coordinate the final design of the management plans. In action C2, the agronomic company supported the setup of trials of all demo areas, they also reinforced the monitoring tasks and will help in the reporting of analysis of results in order to demonstrate that the practices can increase ecosystem resilience against foreign pathogens and climate change. In C4, they support the pre-evaluation of the replication farms and in the design and implementation of the new task according to the proposed plan.

For the day-to-day administrative and financial issues, the PD and all partners were assisted by an external compliance manager (CM) (TRANSFER). This was necessary and foreseen in the proposal due to the complexity of the project and multilingual management made up of 9 partners, some of whom have no LIFE experience. All partners contributed financially to CM in action F1 also agreed in the PA.

The PD chaired the steering committee (SC) which was composed of:
Teresa Carrillo-Cobo (BALAM) as Project director (PD) and assisted by CM (TRANSFER),
Diego Barranco (UCO) for the technical management of plant genetic improvement,
Manuel Barrera (SAHC) for the technical management of the field in Portugal,
Claudio Cantini (IBE-CNR) for the technical management of the field in Italy

Andrea Villarino (AGRIFOOD) for the manager of communication and she was replaced by Ricardo Miguelañez,
José Carlos Caballero (ASAJA) in the management of replication activities.

The SC met for steering committee meetings (SCMs), of which 14 were held in total, averaging 3/year. Besides these meetings, smaller meetings and conference calls were regularly organised in sub-teams to discuss ongoing activities. Email exchanges occurred when project-wide issues were at stake and were efficiently managed by BALAM. Partners have frequent telephone contact to discuss collaborations regarding the technical actions, or with the CM regarding financial or administrative issues.
1. MR Annex 01_ Deliverable F1_Signed Partnership Agreement (BALAM)

Communication with the CINEA and Monitoring team
A positive flow of communication was established between PD and the external monitor Cristóbal Ginés (NEEMO), who assisted us in four monitoring meetings (19/03/2019 in Carmona SP; 26/11/2020 online meeting together with the project officer Claudia Guerrini; 14/07/2021 online; the last meeting was divided in two, having the field visit in Portugal on the 19/04/2022 and the technical and financial part in Madrid on the 17/05/2022).

Responses to the commission letter upon a monitoring visit or after a reporting period:
There were five letters received and answered, the last one is included in this report.
Furthermore, two notifications were presented announcing the shift of cost category incurred in IBE-CNR and UCO, one in July 2021 and the other in August 2021. Both were accepted by the project adviser in September 2021. 3.FR Annex 02: Responses of Commission Letters

Changes due to amendments to the Grant Agreement
There have been two amendments of the Grand Agreement:

13/10/2020. It was entered into force in October 2020. Five administrative changes were presented: 1) Change of the ownership of GALPAGRO changed from multiple shareholders to one shareholder; 2) Change of the beneficiary's name from AGRODRONE, SL to GREENFIELD TECHNOLOGIES SL, and new legal representative; 3) Change of the beneficiary's name IVALSA-CNR Consiglio Nazionale Delle Richerche, Istituto per la Valorizzazione del Legno e delle Specie Arboree to IBE-CNR Consiglio Nazionale Delle Richerche, L'Istituto per la BioEconomia, and new legal representative; 4) Change of the beneficiary's name from Societá Agricola F.Lli Fontana, S.S. to Societá Agricola Villa Fillipo Berio S.S (V.F. BERIO); 5) inclusion of the company SALOV SPA as an AFFILIATE.

01/03/2022: It was entered into force in March 2020. The legal name, the legal status and a new address were presented. New legal name: BALAM AGRICULTURE SL.

6. Technical part

Expected results per action can be consulted in section 6.3.2

6.1. Technical progress, per Action

6.1.1 Action A1 Selection and design of demonstration trials

Foreseen start date:	*01/07/2018*	*Actual start date:*	*01/07/2018*
Foreseen end date:	*31/12/2018*	*Actual (or anticipated) end date:*	*28/02/2019*

Activities undertaken and achievements

In this first action, the 3 demo farms were characterized and the design of each trial were established including a broad menu of sustainable and integral management adapted to each circumstance. These are the activities that were developed:

A.1.1) Soil inventory (base line study) and zoning of crop soil by sensors of Geophysical Magnetism;

A.1.2) Inventory of presence of potential vectors of *Xf*; and A.1.3) Selection of measures to improve system productivity and sustainability.

The results revealed the elaboration of **zoning maps** that were the basis to obtain the soil control points and decide the type of treatment applied. In particular, Charqueirao (PT-50ha) and El Valenciano (SP-150 ha) found a soil classified as type 4 and 5, very hard to manage soils because they are very weight soils, high clay content, high water retention but compaction problems. It was very important to consider soil variability when establishing adequate management to increase the resilience of the system against pathogens such as XF as well as when applying treatments and irrigation. On the contrary, at Villa Filippo Berio (IT- 50 ha) has found 4 types of soil, these were quite similar to each other, which facilitate soil management and treatments design. Regarding the **inventory of potential vectors** was established and Nutriprado was responsible of monitoring four times a year by vacuuming hedgerows in 4 locations in each demonstration site: samplings was done in hedgerows, canopy, cover crops, shrubs and aromatics plants. Samplings was done in springtime every 4 or 6 weeks depending on the weather conditions. Furthermore, IBE CNR monitored the presence of *Philaenus spumarius* main vector of XF within the main demo farm in Pisa belonging to V.F. BERIO. Since it is important to enlarge the information CNR also monitored the population of *Philaenus* in three different orchards located in two other sites: Follonica and Marina di Grosseto, both along the coast of central Italy. Insect population in these sites has been monitored from spring until summer counting the spittles on the green coverage and then by captures ofadults. The latter activity has been conducted using an entomological net and by yellow sticky trapspositioned within the orchards. Lastly, the **selection of measures to improve system productivity and sustainability** consisted in the treatments described below:

1) **Control** plot using conventional methods: Each orchard will recreate their current management methods.
2) **T1**: According to the soil analyses and evaluations of the Map2Soil system, in each plot will be implemented the combination designed in A.1, in order to increase the plant resilience and also minimize carbon/water footprint. The biostimulant Procrop ISR and soil bacteria as Contribute IBNP will be applied. This biofertilizers/biostimulants will improve soil quality and health.
Contribute IBNP: It is a combination of amino acids, selected nutrients and growth- promoting bacteria to optimize the soil microbiome and improve the availability of nitrogen and phosphorus.
Procrop ISR: Based on Alltech research studies in the field of nutrigenomics about *Saccharomyces cerevisiae* SP.1026, it has been designed as a biorational solution for crop production.
3) **T2**: **Deficit irrigation:** Deficit irrigation techniques tailored to each site will be applied to reduce water consumption. Plant, soil and weather parameters (soil moisture, stem water potential, evapotranspiration, etc.) will be measured weekly to determinate the irrigation scheduling. In addition, tree evolution will be monitored monthly through different parameters (trunk diameter, canopy development, inflorescence and fruits size) to evaluate the impact of the deficit irrigation techniques.

- **T3: cover crops**: These species that serve as natural enhancers of biodiversity and restore balance to intensive production ecosystems were sown and maintained at a height of 40 cm in these plots, and were monitored heavily for vector presence.
- **T 3.1 Cover Crop Mixture.** Four mixtures with different species were prepared with its corresponding dose: M1. 15 kg/ha, M2. 25 kg/ha; M3. 20 kg/ha, M4. 30 kg/ha. There were maintained throughout the project. The mixture was composed of: *Phacelia tanacetifolia, Sinapis alba Matricaria Chamomila Calendula officinalis, Lupinus Luteus Raphanus sativus,* among others (9. FR Annex 03: A1_Cover Crop Mixtures Nutriprado)
- **T 3.2 Farm cover crop:** the vegetable cover of the farm was maintained.
- **T 3.3 Without cover and tilling:** 5 streets were filled. The tilling was performed in Sep 2020.

T4: A combination of **T1, T2 and T3:** this treatment aim is to showcase the beneficial and complementary nature of the measures to increase sustainability against climate change and resilience of the system. Each campaign the measures was fine-tuned providing optimal methods by the end ofthe project. Also, installation of nest boxes was considered. In the absence of suitable places to nest or pass winter, nest boxes have become one of the possible solutions to promote populations of bird species that are in serious decline. Special attention has been given to the installation of the boxes with adequate standards in each of the demo farms using an appropriate model to encourage the increase of biodiversity. At the time of its installation, the orientation, placement height and measures to avoid

predation must be taken into account, as it is one of the main drawbacks of the nest boxes. Regarding the nest boxes + insect hotels – BALAM has externalized a company to produce 138 next boxes which ware installed in the 3 demo farms following the project designs by the company. The occupation of these boxes was evaluated throughout the project.

Deviation in the action: A website property of GREENFIELD was created to show the progress indicators of the data gathered in the demonstration farms by Greenfield. The consortium agreed in using this website instead of the ZERYA APP that were foreseen due to practical used among partners where they can shared knowledge and can rapidly update data on irrigation, vector population, disease control, removal of vegetation, among others. The website can be consulted on the following link (it is necessary user and password credentials; User: viewer; Password: 7NsQtDnJ): **https://informes.greenfield.com.es/life_resilience/**

Along the duration of the LIFE project, this website was a real-time query web to get the information of several parameters and indicators of the project as they are measured or determined. Also, Maps of the orchards have been produced and the intervention in each subplot has been organized planned and started in the different treatments. All this information is compiled in the Deliverable A1.

Performance indicators

Indicators	**Achievements**
Design Land Management plan for each demo site. (31/12/2018)	Design plans were completed in 12/2018 as due, but a few corrections to the deliverable were thereafter applied after the meeting in January (Madrid). The final publishable version was delivered in 15/02/19.
Vector population distribution in each demo site	Achieved in 12/18. Design plans were completed in 12/2018 as due, but a few corrections to the deliverable were thereafter applied after the meeting in January (Madrid). The final publishable versionwas delivered in 15/02/19.
List of cover crops for each demo site	Achieved in 12/18. Design plans were completed in 12/2018 as due, but a few corrections to the deliverable were thereafter applied after the meeting in January (Madrid). The final publishable versionwas delivered in 15/02/19 in A1
Number of insect/bird hotel for each demo site	25 Achieved in 12/18;+ 138 achieved in 2020

Complementary actions and future perspectives

Once the design of treatments was established, there were implementing at the demo farms. The orchards have been divided in to plots and subplots to have a repetition of each thesis included in thetrial to achieve a higher significance and representative results from different study areas. For example,in Pisa the V.F. BERIO orchard has been divided to host just 4 different thesis with 4 repetitions were traditional management will be compared with other practices since it is impossible to apply regulated deficit irrigation treatment. The reason is V.F. BERIO farm is located under sea level, in consequence is not irrigated. Regarding the introduction of cover crops, there were 3 sowings: first season in Charqueirao 2/12/2019, VF BERIO 27/9/2019, El Valenciano 22/10/2019. Second season in Charqueirao 21/02/2020, VF BERIO not possible; El Valenciano 18/11/2020. in Charqueirao 2/12/219, VF BERIO 27/9/219, El Valenciano 22/10/219. Third season in Charqueirao 02/12/2021, VF BERIO not possible; El Valenciano 18/11/2021.

Deliverables

Deliverable name	**Expected date**	**Actual date**
Report "Demonstration areas:Inventory & Design plans" (BALAM)	31/12/2018	31/12/2018 reviewed 15/02/2019

Justification: The training materials were ready to be shared internally in time and used during the training course, but the Consortium decided to improve its editing in order to share it with a wider public (project website news/download section).

Milestones

Milestone name	Expected date	Actual date
Baseline data gathered foreach demonstration site (Greenfield)	31/10/2018	31/10/2018

Attachments

4.MR Annex 05: **Deliverable A1_** "Demonstration areas: Inventory & Design plans Report"
5.MR Annex 06: A1 Baseline data El Valenciano farm, Spain
6.MR Annex 07: A1 Baseline data Charqueirao farm, Portugal
7.MR Annex 08: A1 Baseline data La Traversagna farm – Villa Filippo Berio, Italy
8.MR Annex 09: A1 Technical monitoring report part 1
9. FR Annex 03: A1_Cover Crop Mixtures Nutriprado
10. FR Annex 04: A1_Nest boxes and insect hotels. Design

6.1.2 Action A2 Training sessions and design of materials for demonstration trials

Foreseen start date: *01/07/2018* *Actual start date:* *01/07/2018*
Foreseen end date: *31/12/2018* *Actual (or anticipated) end date:* *30/06/2019*

Activities undertaken and achievements

This action has achieved two main goals: A.2.1) Development of the training materials to get to know the problems of XF, identify the symptoms, established the best practice to increase resilience in olive and almond orchards and how to monitor and prevent the entry of the bacteria; and A.2.2) Development of training session to all the staff members.

The document **"Training Course Material**" was developed considering people who may not have previous knowledge about the XF pathogen and that can be shared through different public but also put into place and teach the staff of this Consortium to make sure the experimental methodology would be properly implemented and evaluated after that. Consequently, the document consists of 3 main chapters: 1) Introduction to *Xylella fastidiosa,* 2) Best practices to increase resilience, and 3) Monitoring Activities. This last chapter considered a fundamental aspect to evaluate the impact that these measures in the field. For that, a protocol for monitoring and control procedures, sampling methodologies and data gathering was included.

Once the material was developed, the implementation of **five training courses** was done. **The first training session was in Madrid on January 22 - 23, combined with an SMC (18** attendees). After that, the practical part was performed in the **three** demo farms (Spain, Italy and Portugal).
Training in Italy – V.F. BERIO & CNR organized the event on February 27, 2019, in which 13 people attended, among personnel, technicians, workers of the subcontractors and some neighbour farmers.
Training in Spain – BALAM organized the event on March 13, 2019, 10 participants attended among technicians, and field workers of the Finca El Valenciano. Some doubts arose about the strategies established to increase system resilience, especially by less qualified personnel. This gave rise to a discussion space that enriched the journey. On the other hand, part of the staff provided specific data of the farm that were subsequently considered when implementing the treatments.
Training in Portugal – SAHC organized the event on March 13, 2019, 4 attendees among filed workers and technicians of the farm participated to the meeting. Again, farm workers pointed out some specific information about almond cultivars and the suitability of the treatments. In this case, a second control treatment was designed to solve that problem.
Training in Pisa – V.F. BERIO & CNR organized the event on June 18, 2019, combined with an SMC (25 attendees). At this time, we had the opportunity to review with the Consortium staff the protocols to be carried out.

Performance indicators

Indicators	Achievements
Training course materials	Achieved. Materials were prepared before the meeting in Madrid, but the documentation was edited into a final publishable version after the meeting. 15/02/2019
Delivery of training course (theoretical and practical part) to staff and partners	5 Training courses given.

Complementary actions and future perspectives

The training course materials have been published on the project website and are available for use by any other interested entity. During the implementation of the different treatments established was required additional training courses to the staff directly involved in the activity to ensure that the activity was carried out according to the established protocol. The partners contributed to the translation in Italian, English, Portuguese and Spanish of some documentsthat were used for training and education.

Deliverables

Deliverable name	Expected date	Actual date
Training course materials(BALAM)	30/11/2018	15/02/2019
Signed Attendance list of all training courses (BALAM)	31/12/2018	13/03/2019
Justification: The training materials were ready to be shared internally and used during the training course, but the Consortium decided to improve its editing in order to share it with a wider public (project website news/download section).		

Milestones

Milestone name	Expected date	Actual date
First training course given in Spain (BALAM)	30/11/2018	22/01/2019
All training courses complete(BALAM)	31/12/2018	13/03/2019

Attachments

11.MR Annex 10: Deliverable A2_Training course material
12.MR Annex 11. Deliverable A2_Signed Attendance List of Training Courses
13.MR Annex 12: A2 Leaflets Training Course (English, Spanish, Portuguese, Italian)

6.1.3 Action C1 Development of disease-resistant olive varieties

Foreseen start date: *01/07/2018* *Actual start date:* *01/07/2018*
Foreseen end date: *30/06/2022* *Actual (or anticipated) end date:* *30/06/2022*

Activities undertaken and achievements

The novelty of this action is that this is the **first genetic improvement programs put in place at EU level** with the aim of obtaining **new varieties resistant to the bacteria Xf**. This big achievement entailed the following subtasks:

C.1.1 Selection of olive parents with good agronomical characteristics and evaluate XF resistance. Final selection and controlled cross-breeding. The selection of the olive cultivars acting as parents (genitors) in the breeding program was accomplished as first step of the project. The cultivars were selected according to their resistance to XF and positive agronomical characteristics. Among these latter, we selected cultivars with outstanding productivity, oil content and moderate-reduced vigor. The following directed crosses (female x male) were performed in spring 2017 'Leccino' x 'Fs-17', 'Leccino' x 'Carolea', 'Oglariola Salentina' x 'Leccino' and 'Leccino' x 'Picual'. The crosses 'Leccino' x 'Arbequina', 'Leccino' x 'Arbosana', 'Fs-17' x 'Arbequina', 'Fs-17' x 'Arbosana' and 'Fs-17' x 'Picual' were conducted in the spring 2018.. (14.MR Annex 13)

C.1.2 Fruit harvest, seed preparation and disinfestation, stratification and seed germination. In September of 2017 and 2018 we harvested the fruits and germinated the seeds derived from the directed

crosses. After collecting ~6.000 fruits and germinating the seeds in controlled conditions (see attached protocol), more than 2.500 seedlings (1.080 and 1.401 seedlings from the 2017 and 2018, respectively) were successfully grown. (14.MR Annex 13).

Figure 1. Protocol of olive seed germination followed in the project.

C.1.3. Forced growth of the seedlings. When the seedlings had at least 2 pairs of leaves (in January 2018 - 2019) were transplanted to 1.5 litres pots and placed into a greenhouse under forced growth conditions (24 hours of light and 24 ºC) during at least 6 months. During forced growth, we need that our genotypes acquire the maximum height to become adults as soon as possible. **The experimental management and evaluation of agronomic characteristics** has been according to the integrated production protocols with drip irrigation. The genotypes have been guided up to 1.25 meters high and all branches have been pruned up to 60 cm high. Regarding the agronomic characteristics evaluated, they are being monitored for the height, width, and diameter of the trunk to assess the vigour of the plants. (15.PR Annex 01)

C.1.4. Growth in field, selection, and evaluation to XF disease (S.1.). The selected seedlings from the 2017 and 2018 crossings (501 and 550 genotypes, respectively) were transported by truck to the experimental field located in the olive orchard "El Valenciano", Carmona, Seville, owned by the company BALAM. The goal of this trial was to characterize the agronomical traits (early bearing, oil content, vigour etc.) meanwhile their resistance to XF is tested. The seedlings were planted with 5 meters between rows and 2 meters between trees, following a randomized block design, with the cultivars 'Picual', 'Frantoio', 'Arbequina', 'Arbosana' and 'Fs-17' as controls.

C.1.5. Field trials. Agronomic characteristic evaluation and genotypes selection. The most promising olive genotypes were selected according to their agronomical traits, which were evaluated in the experimental field "El Valenciano" (16.FR Annex 02). The agronomic characteristic evaluated were: **Tree vigor** (height, width, and diameter of the trunk), **early bearing** (A new olive cultivar must produce fruits as soon as possible) **olive oil characteristic** (Maturity index, olive oil and basic characterization of olive oil quality). **and fruit characteristic** (fruits shape, dimensions, fruit weight, endocarp weight and fruit load).

A selection of the most promising genotypes was made according to their agronomic characteristics. Specifically, 15 and 3 genotypes from the 2017 and 2018 crosses were selected. The resistant cultivars to XF 'Leccino' and 'FS-17' were genitors of all but one of the selections. In the case of the characterization of olive oil, the following analyses have been carried out per genotype: Fatty acid composition and olive oil stability. **Paternity tests** by SSR DNA markers were carried out to validate the identity of the genitors in the selected genotypes. These analyses also corroborated the compatibility or incompatibility between the varieties used as genitors in the project. According to these results the crosses 'Fs-17' x 'Arbosana', 'Fs-17' x 'Picual', 'Leccino' x 'Arbequina' are incompatible, so they do not produce fruit set. Thus, the seedlings derived from these crosses were considered as siblings of the mother cultivar in open pollination.

C.1.6. Clonal propagation, forced growth, pre-commercial trials establishment and XF evaluation. The 18 selected genotypes were clonally propagated by soft cuttings to generate plants to establish new trials with replicates and to be able to evaluate them in different environments in pre-commercial

conditions. Approximately 100 soft cuttings per genotype were planted to obtained 50 rooted plants. (16.FR Annex 02)

C.1.7. Xylella fastidiosa evaluation trial. Rooted cuttings from the selected genotypes were transplanted into 1 L pots and subjected to forced growth with light for 24 h in the greenhouses of the University of Córdoba for 6 months until reaching a height of approximately 70 cm. In April 2022, 533 plants reaching 70 cm height were shipped to Italy by road transportation. The plants were delivered in three locations for their evaluation.

First in the experimental farm "La Traversagna-VF BERIO" (Lucca, Tuscany) to establish an experimental trial to test the adaptability of the selected genotypes to the Tuscan climate and edaphological conditions. (16.FR Annex 02)

Second, in the Instituto per la Protezione Sostenibile delle Piante – IPSP in Bari, where the researchers Donato Boscia and María Saponari received the plants. The selected genotypes are being evaluated to XF in controlled conditions in this institution. To do so, the researchers of this group are proceeding with the: 1) Preparation of the bacterial inoculum (maintenance and growth of the bacterial strain); 2) Mechanical inoculation of 9 replicates per genotype (6 with the bacterium and 3 mocks inoculated); 3) Maintenance of the plants for at least 1 year under controlled conditions; 4) Testing the plants by qPCR and qRT-PCR at least 4 times, to monitor bacterial population and host colonization; 5) Visual monitoring, growth evaluation, and symptom scoring (at least 6 times).

Finally, in Scorrano (Lecce), where the collaborating company "Giovanni Presicce" (contract signed - 17.FR Annex 05) has provided two experimental fields to test the selected genotypes under natural infection conditions to XF. These two experimental fields are located at the core of the XF outbreak. At the same time the agronomic characteristic of the selected genotypes are being evaluated in these experimental fields. In addition to these three experimental fields in Italy, the selected genotypes have been planted in the experimental farm "El Valenciano" owned by BALAM with the aim of evaluating in detail the agronomic performance of this new cultivars in a different environment. The three experimental fields have been planted following an experimental design with blocks and replicates.

Figure 2.Plantation of the selected genotypes from Life Resilience in Scorrano, Lecce, Italy and Plantation of the selected genotypes in "El Valenciano", Sevilla, Spain (right).

Performance indicators

Indicators	Achievements
10-20 resistant olive varieties created and evaluated (UCO)	Done. 18 potentially resistant new genotypes, which are derived from resistant cultivars to XF ('Leccino' and 'Fs-17'), have been selected by UCO
Contract signed with external company for shipment trials in Italy	Done. 17.FR Annex 05
Market Study New cultivars resistant to Xylella fastidiosa	Done. 18.FR Annex 06

Complementary actions: The UCO has selected 18 potentially resistant new genotypes, which are derived from resistant cultivars to XF ('Leccino' and 'Fs-17'). These genotypes are still under evaluation because the methods to test olive cultivars to XF have not experimented a significant improvement in terms of time since the project started in 2018. The UCO relied on the availability of faster tests during the final years of the project to complete the evaluations. However, monitoring the inoculated plants during at least a year is still necessary to perform a reliable testing. Because of this reason, some extra

time (months) are necessary to validate the resistance to XF of the selected genotypes in controlled conditions. To overcome this drawback the UCO has implemented several complementary actions, which were not foreseen in the original proposal, to complete the evaluation of the selected genotypes: 1) Two field trials in Scorrano (Lecce, Italy) where the genotypes are being evaluated in natural infection conditions; 2) A field trial in Lucca (Tuscany, Italy), where the agronomical adaptation of the selected genotypes is being evaluated; 3) A field trial in Carmona (Sevilla, Spain), where the agronomical adaptation of the selected genotypes is being evaluated; 4) These field trials were planted according to a statistical design with blocks, replicates, and control cultivars in order to generate reliable and measurable results. To guarantee the final evaluation of the selected genotypes, their registration as new cultivars and the continuity of the XF breeding line, UCO and BALAM (19.FR Annex 07) signed an agreement, where BALAM committed to economically support these processes during 10 years after Life-Resilience finishes. This commitment guarantees the registration and availability of new cultivars resistant to XF in a near future after being thoroughly evaluated.

Futures perspectives: The 18 potential cultivars generated by the UCO will be completely evaluated to XF in the next months. These new cultivars will have a broad market in and out of the XF affected areas. A **market study** (18.FR Annex 06) showed that, in the least favourable scenario, approximately 24 million of plants for superhigh density orchards and 3,6 million of plants for intensive orchards would be sold generating a profit of 55,2 million €, while in the best-case scenario the profit could reach more than 138 million € only counting the cost of the plants in Italy. These new cultivars will be the perfect option to substitute the olive orchards affected by XF in Italy but also for new plantations in areas susceptible to be affected by this pathogen worldwide.

The three field trials stablished by Life-Resilience will be monitored in collaboration with the host companies during at least 10 years generating priceless data about the adaptation and performance of these new cultivars in different countries and environments. Besides, extra genotypes will be selected from the 2018 progenies and evaluated following the same methodology described in this document in the frame of the BALAM-UCO agreement.

These new cultivars open a new avenue for olive breeding, being a tangible solution for those olive areas already affected by XF and others in danger. In the next months, these new cultivars will be a real alternative contributing to maintain the olive growing areas and related stakeholders, despite the daunting XF thread.

Deliverables

Deliverable name	**Expected date**	**Actual date**
Report on the selection ofparent plants and seed germination (UCO)	31/07/2019	31/07/2019
Report on results of forced growth in environmental chamber (UCO)	31/12/2019	31/01/2020
Report on field trials new genotypes	30/06/2022	30/06/2022

Milestones

Milestone name	**Expected date**	**Actual date**
Contract signed with external company for shipment trials in Italy	31/12/2019	15/02/2019
10-20 resistant olive varieties created and evaluated (UCO)	30/06/2022	30/06/2022

Attachments

14.MR Annex 13: **Deliverable C1**_Report on the selection of parent plants and seed germination
15.PR Annex 01: **Deliverable C1**_Report on results of forced growth in environmental chamber
16.FR Annex 02: **Deliverable C1**_ Report on field trials new genotypes
17.FR Annex 05: Contract signed with external company for shipment trials in Italy
18.FR Annex 06: Market Study New cultivars resistant to Xylella fastidiosa
19. FR Annex 07: UCO and BALAM agreement 10 years after Life-Resilience

6.1.1 Action C2 Demonstration in trial areas

Foreseen start date: 01/10/2018 Actual start date: 01/10/2018

Foreseen end date: 30/06/2022 Actual (or anticipated) end date: 30/06/2022

Activities undertaken and achievements

The aim of this actions was to demonstrate that the innovated practices model applied in this project can increase ecosystem resilience in olive and almond production systems against pests, diseases and others threats of climate change. The **best practices model** was implemented in 250 ha thought 3 demo areas during the three seasons: with olive (in Spain and Italy) and almond production (in Portugal). Daily activities related to optimal crop management such as pest and disease control, nutrition, pruning, harvest, soil management and irrigation have been carried out throughout the farm. As was mentioned in Action A1, **five treatments were established in different subplots, including the control (T0), bioestimulants (T1), deficit irrigation (T2), cover crop (T3) and the combination of all of them (T5).** Furthermore, biological pest control by cover crop, traps, nest boxes, insect hotel and the implementation of sustainable cultural practices as including prune were carried out. The distribution of

the treatments has been made based on results of physicochemical soil analysis and results of soil enzymatic activity, carried out in action A.1. Figure Distribution of the treatments in El Valenciano Farm, Herdade do Charqueirão and La Traversagna – VF BERIO farm.

Results of the sustainable practices implemented in different plots have indicated in general an improvement in diverse parameters which are detailed explained by demo site in the yearly deliverables of this action, also their final analysis is compiled in action D1.

The **web viewer** developed in Action A1 was updated with several agronomic parameters obtained from samplings carried out in situs and satellite images to monitoring constantly in the three demo areas during every year of the project. This information is very valuable for the agronomic management of each farm, as well as to record the necessary information for the monitoring and impact carried out in action D1.
The 3 yearly reports explained the general activities performed in each demo area including a detailed description of the treatments, doses and date of application. The impact of these 5 treatments are evaluated with the specific project indicators, measured, calculated, analysed and described in the 3 yearly reports which are in line with the summary table of the deliverable of action D1.

Table below summarizes the treatments in term of dose, timing, and mode of application. Due to different climate conditions treatments were implemented on different dates in each demo farm. However, individual tables for each demonstration site were presented in annexes (19.FR Annex 05).

Table 1. Summarizing the regular Crop Management and Treatments applied in the demonstration areas

Action C2	**T0 - control**	**T1**	**T2 - Deficit irrigation**	**T3- Cover crops**	**T4 (combination T1-T2-T3)**
Demo site	**Traditional management**	**T1 – IBNP +ISR**	(*except VF BERIO)		
1. El Valenciano – SP **2. H.Charqueirao -PT** **3. VF BERIO - IT**	**1.Soil:** tillage (3 times/year) and herbicide (3 times/year). **2.Irrigation**: on demand (March-November; 2-3 days/week) (*except VF BERIO) **3.Pests:** Differs in each location * **4.Diseases:** Differs in each location * **5.Nutrition:** Soil (17-19-/year) and Foliar (8-18/year). * **6.Pruning:** Formation pruning (1/year) and Top and bottom pruning (2 times/year) **7.Harvest:** 1/year SP Nov/Dec PT Aug/Sep, IT Nov/Dec	**1.Soil**: tillage (3 times/year), herbicide (3 times/year) IBNP (1 kg/ha) +ISR (0.5L/ha) IBNP (1/year) 12/06/2019 and ISR (4/year) 24/07/2019; 07/08/2019; 21/08/2019 and 11/09/2019.. *Differs in each location **2.Irrigation:** on demand (March-November; 2-3 days/week) (*except VF BERIO) **3.Pests:** Differs in each location **4.Diseases**: Differs in each location. **5.Nutrition:** Soil (17-19-/year) and Foliar (8-18/year).* **6.Pruning**: Formation pruning (1 time/year) and Top and bottom pruning (2 times/year) **7.Harvest:** 1/year SP Nov/Dec PT Aug/Sep, IT Nov/Dec	**1.Soil:** Tillage (3 times/year) and herbicide (3 times/year). **2.Irrigation**: On demand (March-June)-(September-November) and deficit irrigation (July-August). (*except VF BERIO) **3.Pests:** Differs in each location **4.Diseases:** Differs in each location **5.Nutrition:** Soil (17-19-/year) and Foliar (8-18/year). * **6.Pruning:** Formation pruning (1/year) and Top and bottom pruning (2 times/year) **7.Harvest:** 1/year SP Nov/Dec PT Aug/Sep, IT Nov/Dec	**1.Soil:** tillage (1/year), herbicide (2/year), 4 mixtures were sown in 3 season 2019,2020 and 2021 **2.Irrigation:** on demand (March-November) (*except VF BERIO) **3.Pests**: Differs in each location **4.Diseases:** Differs in each location **5.Nutrition**: Soil (17-19-/year) and Foliar (8-18/year). * **6.Pruning:** Formation pruning (1/year) and Top and bottom pruning (2/year) **7.Harvest**: 1/year SP Nov/Dec PT Aug/Sep, IT Nov/Dec	**1.Soil:** tillage (1/year), herbicide (2/year), cover crop: sow (1/year), weed (1/year), IBNP (1/year) 12/06/2019 and ISR (4/year) 24/07/2019; 07/08/2019; 21/08/2019 and 11/09/2019.. *Differs in each location **2.Irrigation**: On demand (March-June)-(September-November) and deficit irrigation (July-August). (*except VF BERIO) **3.Pests:** Differs in each location **4.Diseases**: Differs in each location **5.Nutrition:** Soil (17-19-/year) and Foliar (8-18/year). * **6.Pruning:** Formation pruning (1/year) and Top and bottom pruning (2/year) **7.Harvest**: 1/year SP Nov/Dec PT Aug/Sep, IT Nov/Dec

Performance indicators

Indicators	Achievements
Experimental design applied in 5 plots per demoarea	Done - (150 ha in Spain - 50 ha in Italy - 50 ha Portugal)
Biostimulants applied	Done
Regulated deficit irrigation	Done
Biological pest control applied	Done
Cover crops applied	Done - 9. FR Annex 03
Solar and wind powered irrigation applied	Not possible. Currently studying the environmental impacts of the solar and wind powered installation to adapt them to the regulations in force in Spain (RD-2019/5098)
Monitoring WEB TOOL	A web viewer compatible with all types of smartphones, tablets and operating systems of personal computers were put on line. In addition, it supposes, on the one hand, an advantage when introducing a greater amount of parameters determined in the LIFE Project, and not restricting only those considered in the technical report and, on the other hand, a greater facility for the implementation of Internal changes in the data visualization application

Deliverables

Deliverable name	Expected date	Actual date
Yearly report on activities in demo sites Year 1	31/12/2019	30/07/2019
Yearly report on activities in demon sites Year 2	31/12/2020	08/12/2020
Yearly report on activities in demo sites Year 3	31/12/2021	01/05/2022

Milestones

Milestone name	Expected date	Actual date
First cover crops sown(Nutriprado)	30/12/2019	30/12/2019
Solar/wind-powered irrigationsystems installed (BALAM)	30/12/2018	Not possible

Attachments

20.MR Annex 14: C2 Wind power regulation in Spain
21.PR Annex 02**Deliverable C2** Yearly report on activities in demonstration sites Year 1
22.PR Annex 03 **Deliverable C2** Yearly report on activities in demonstration sites Year 2
23.FR Annex 05**Deliverable C2** Yearly report on activities in demonstration sites Year 3

6.1.2 Action C3 Natural vector control measures

Foreseen start date: *01/01/2019* *Actual start date:* *01/01/2019*
Foreseen end date: *30/06/2022* *Actual (or anticipated) end date:* *30/06/2022*

Activities undertaken and achievements

Controlling insect vectors is the only effective strategy to prevent XF spread. This action has focused the attention on the management of natural vector control measures including use of natural based products, biological control with natural predators, mapping, and identifying the vector presence, cover crops and increase in biodiversity. To this end several subtasks have been developed:

C.3.1. Identification and trial of alternative measures. Different products have been tested to control nymphs of Philaenus: Sulfur, soft soap, Beauveria bassiana, sulfur plus B. bassiana, and pyrethrum. B. bassiana proved to be effective in significantly reducing both the number of spittles and nymphs of P.

spumarius. To a lesser extent, also soft soap significantly reduced the overall number of nymphs in comparison to the control. These results suggested to **evaluate the role of froth in protecting nymphs against sustainable control products. This evaluation consists of three trials under laboratory conditions:**

1) Testing two commercially available entomopathogens: B. bassiana (strain ATCC74040, commercial product Naturalis®) and the nematode Steinernema feltiae (Nemaplus®). 2) Biodea BIO Wood Distillate as sustainable control product instead of Nemaplus®. The mortality caused by B. bassiana and S. feltiae and the wood distillate is only slightly higher than mortality caused by the tap water. These findings suggest that the froth protect nymphs against the tested entomopathogens. 3) Some bioassays were carried out using a generalist predator (the spider Synema globosum) to evaluate the role of the foam in the protection of the nymph from predation. Results suggest that the foam could protect the insect from predators both as physical and chemical barrier. These results have been shared in two posters during the 3rd European conference on Xf 04/2021 ("Atrractiveness of different colored sticky traps for spittlebug vectors of Xf" and "Response of Philaenus spumarius and Neophilaenus campestris to potential semiochemicals". (24.PR Annex 04).

C.3.2. Mapping of vector behaviour and distribution. Several activities were carried out at the experimental farm "VF Berio" in order to collect data on the ecology and population dynamics of spittlebug vectors of Xf in an olive grove agroecosystem. *P spumarius*, was the main studied species. At the same time, information on *Neophilaenus campestris,* were also collected.

1) The abundance and distribution of spittlebug vectors within four olive orchards were investigatedalong the coastal Tuscany. Observationsof the juvenile instars were conducted following EFSA supporting publication 2019.EN1628. Adult insects sampling was performed by both entomological sweep net and by unbaited yellow sticky traps. Results of the first year was published in a poster presented during the second International conference on Xf that were held in Ajaccio in October 2019 (see copy of the poster 25.MR Annex 15).

2) Evaluation of different color sticky traps. In 2020, several field trials has been carried out in three olive groves in order to evaluate the attraction of different color sticky traps towards spittlebug adults. In each olive grove seven traps were tested (transparent, white, yellow, green, brown, red and blue). Results were presented at the 3rd European Conference on X. fastidiosa and Xf-ACTORS final meeting. (24.PR Annex 04).

3) Evaluation of the possible role of froth in protecting nymphs against generalist predators. Regarding the exploration of the defensive strategies of P. spumarius nymphs could help in planning sustainable and efficient control strategies, as well as in the assessment of biological control feasibility, using natural enemies and/or entomopathogens. To evaluate the role of P. spumarius froth in protecting nymphs from arthropod generalist predators, two model species were used in this study: i) the ant *Crematogaster scutellaris* and ii) the crab spider *Synema globosum* which are commonly found in Mediterranean olive groves together with P. spumarius. Two types of experiments were conducted under laboratory conditions: (a) assessment of spittlebugs mortality when challenged with predators and (b) assessment of spittlebug foam deterrence. First results obtained from our experiments should be taken cautiously, because the low survival of nymphs probably depended more to their behaviour than to the predators' effectiveness. However, these results could suggest that spittlebug's froth did not show a deterrent effect *sensu stricto* towards predators, but rather masked the odour (or the view) of the prey in addition to the protection offered by its physical state. Results obtained in these experiments will be the subject of a paper in preparation that will be submitted to a peer reviewed journal. (Details in 26.FR Annex 06).

C.3.3. Functional biodiversity assessment and management. The aims of this sampling were: 1) to investigate the composition of soil generalist predator fauna. 2) to assess some eventual difference between areas where different soil management are applied. Pitfall traps were positioned in two replicates (total 6 traps). Three taxonomic group of generalist predator have been considered to compare different sol strategies, ground beetles, rove beetles and spiders.

Nest hotels, insect boxes and bat boxes. Occupancy rate was very low but the VF Berio experimental olive grove is characterized by the presence of an almost perennial soil coverage, wild trees and shrubs that offer suitable sites for the wild fauna. Several bird species were observed feeding and or stationing on soil coverage or on olive trees:.*Parus major, Cyanistes caeruleus, Jynx torquilla, Certhia brachydactyla, Upupa epops, Serinus serinus, Coracias garrulus, Falco tinnunculus, Buteo buteo, Tyto* alba were recorded in the olive grove. (details in 26.FR Annex 06).

C.3.4. Development of audio technology

During the II international conference on Xylella (2019) a relation on the use of vibrational or audio technology (see book of abstract) pointed out that for the moment it is impossible to use this approach. It became clear that the machinery to be imported from Brazil –which is focussing on a much larger type of cicadae will not be useful in the light of present knowledge since it will take several years of novel research to have a deeper understanding of the male/female or male/male communication of the specific vectors ofXF.

Summarizing, **the results obtained in this action are**:

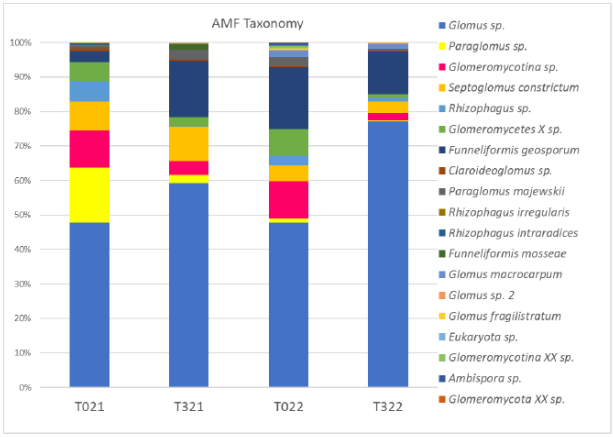
- **Identification of the vector: *P. spumarius*** is the most abundant spittlebug species occurring in the olive orchard.
- **How to monitor vectors' presence:** the **monitoring of spittlebugs** presence and development in the olive orchard is crucial in order to effectively manage these insects. To accomplish this aim, yellow sticky traps could help in the monitoring of spittlebug adults.
- **Main problem associated to vector control:** the froth is the main cause that could impede the action of several type of natural control agents, such as generalist predators or entomopathogens. Indeed, some commercial sustainable products (Naturalis and Nemaplus), tested in our experiments, have shown a low efficacy against P. spumarius nymphs.
- **Role of the Associated flora:** it is important to evaluate the role of cover crops before sowing them, because they could favour the presence of spittlebug in the olive orchard.

Performance indicators

Indicators	**Achievements**
Mapping of vectors in each area	Done
Cultural technics applied	Done. During May 2019 has been tested the possibility to lower the population of the vector by chopping the plants coverage within the olive orchard. Publishing of the results in preparation. Pruning of the plants in February 2020
Develop of audio technology	Not possible
Scientific publications	4

Complementary actions and future perspectives and deviation of this action:

IBE-CNR identify the importance **of soil biological fertility for improving plant growth and health** (deviation in this action communicated to CINEA on 09/2021, being approved, both the technical tasks and the shift of the budget). *Soil mycorrhizal potential and microbial biodiversity* showed that soil microbial communities differed in the two experimental years, with a higher abundance of bacterial species (S) and of dominant bacteria (H1 and H2) in cover crops samples than in control ones. Soil fungal communities showed instead a higher richness in control soil samples, compared to those with cover crops. As to AMF soil communities, metagenomics data related to MIP bioassay data. Both a higher richness of species and a higher variability of AMF propagules activity were found in control than in cover crops samples. The results of *soil mapping of the activity of AMF propagules* section showed a high MIP variability within the experimental fields (in Spain and Italy) while the variable occurrence of intraradical vescicles and extraradical spores suggested the occurrence of diverse AMF taxa across the fields. (27.FR Annex 07).



Graph. Distribution of AMF taxa in olive orchard soils in the two treatments (T0 e T3), and in the two experimental years (2021/2022).

Deliverables

Deliverable name	**Expected date**	**Actual date**
Best practices Handbook turned in with Final Report	30/09/2022	15/09/2022

Milestones

Milestone name	**Expected date**	**Actual date**
Audio technology developed and first tested	30/09/2021	Not possible

Attachments

24.PR Annex 04C3 2 posters 3rd European conference on Xylella fastidiosa 04/2021 ("Atrractiveness of different colored sticky traps for spittlebug vectors of Xylella fastidiosa" and "Response of Philaenus spumarius and Neophilaenus campestris to potential semiochemicals".
25.MR Annex 15: C3 Poster international conference (Italy) & book of abstract
26.FR Annex 06: C3 Sub-trials with alternative natural vector control measures
27.FR Annex 07: C3 Collaboration-IBE-UNIPI

6.1.3 Action C4 Replication activities

Foreseen start date: *01/07/2020* *Actual start date:* *01/07/2020*
Foreseen end date: *28/06/2022* *Actual (or anticipated) end date:* *28/06/2022*

Activities undertaken and achievements

This action entails the replication in situ of the best practices with third parties. For this purpose, first a selection of the replication areas was made, seconded by the pre-analysis of the land by sentinel satellite data, then the design of the management strategy, training sessions and implementation of the best practices on land.

C.4.1. Selection of replication farms

This action started as scheduled, in July 2020. However, when contacting again with the representatives of the 10 farms which had previously signed commitment letters during the proposal, they have changed their mind. This situation together with the pandemic condition, resulted in the resignation of their commitments. In that sense, in order to bring together new replications sites a great effort from the team members were assumed for performing new dissemination activities informing about the sustainable farming practices demonstrated in the project. These new events were done from Nov. 2020 to March. 2021. As a result**, 13 signed letters were obtained on time covering a total of 1.861,9 ha** (29.PR Annex 06) for the implementation of the activities during season 2021-2022. These sites were characterized with satellite images by GREENGIELD, and a management plan was designed for each one. The management plans were implemented in these farms and subsequent advice was carried out by the partners until the end of the crop season. Training sessions were developed and throughout the implementation of the measures, the farmers have had technical assistance from Life Resilience partners.

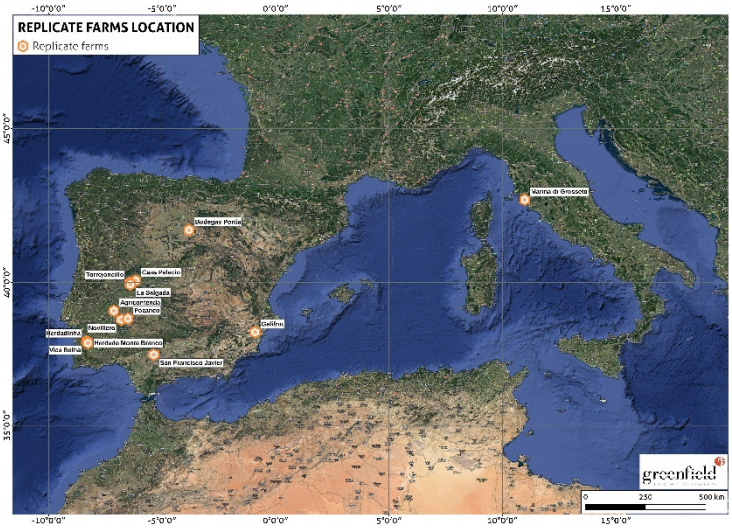


Figure 3Location of the replication farms

Table 2. Replication farms of Life RESILIENCE

COD	Farm	Location	Country	Crop	Area (ha)
1	Herdadinha Farm	Beja	Portugal	Olive	442,0
2	Vica Belha Farm	Beja	Portugal	Almond	78,0
3	Herdade do Monte Branco Farm	Aljustrel	Portugal	Olive	162,0
4	Contanda Farm	Concelho de Campo Maior	Portugal	Almond	264,0
5	Novillero Farm	Albuera	Spain	Grapes	45,0
				Pistachio	42,0
				Almond	35,0
6	Pozanco Farm	Mérida	Spain	Grapes	120,0
				Pistachio	36,0
				Almond	59,0
7	Torrejoncillo Farm	Extremadura	Spain	Almond	100,0
8	Casa Palacios Farm	Plasencia	Spain	Almond	20,5
9	La Salgada Farm	Riolobos	Spain	Almond	100,3
10	San Francisco Javier Farm	La Campana	Spain	Olive	150,1
11	Portia Winery	Gumiel de izan,Roa, Sotillo, Gumiel de Mercado y Villanueva de Gumiel (Burgos)	Spain	Grapes	156,0
12	Galifrut Farm	Hondón de los Frailes (Alicante).	Spain	Grapes	13,6
				Almond	9,8
				Pomegranate	14,5
				Apricot	6,1
13	Marina di Grosseto Farm	Marina di Grosseto	Italy	Olive	8,0

C.4.2. Satellite Imaging

GREENFIELD pre-analysed the sentinel satellite data of each individual **replication sites (13)**. The objective of this pre-analysis was to obtain a recommendation of the possible location of the specific treatments to be established. A similar analysis was done previously in demo farms in seasons 2018, 2019 and 2020. In this sense, the degree of average vegetative development obtained in previous seasons in demo farms, allowed determining homogeneous zones of vegetative behavior. In turn, the temporal variation throughout the cultivation campaigns in each pixel of 10 x 10 meters that make up the images offered by the Sentinel 2 satellites, provided a visualization of how these homogeneous areas vary over time.

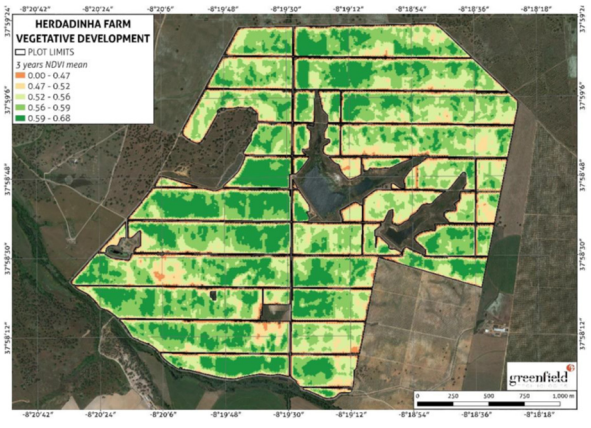
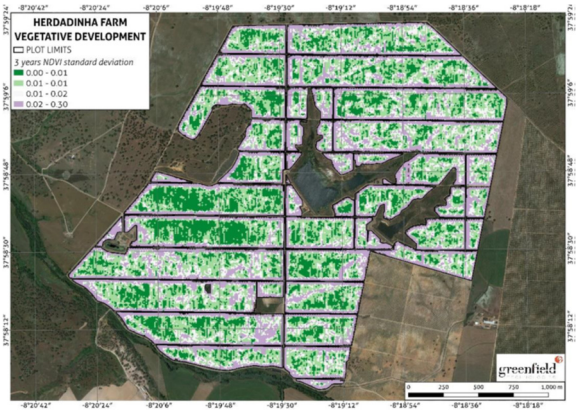


Figure Sentinel satellite data analysis



In general terms, through these two analyses, it can be established which areas reach higher vegetative development, which would explain a lower incidence of stress-causing agents in the plant and, furthermore, if these areas have a lot or little variation in their development over time. Throughout the campaigns, which would indicate stable areas of growth and development, which tend to more stable productions.

C.4.3. Design of Management Plan

Based on the results obtained with the satellite data, the recommendation to establish the project's treatments is marked according to the variability of the parameters, where, in a preliminary way, it is proposed to follow the following action:

- Zone of low values of vegetative development, the T1 treatment of application of biostimulants and biofertilizers is implanted.
- Zone of average values of vegetative development, the T3 treatment of application of covers crop is implanted.
- Zone of high values of vegetative development, the T2 treatment of irrigation dose optimization through deficit irrigation is implanted. For its part, the temporal variability in the vegetative development shown in each farm will mark the specific selection of treatments. Advising that, for a first year of treatment application results, those areas with low variability be selected.

The Management Plan (C.4.2.) of the 13 replication farms along with satellite information (C.4.1) are compiled in the 30. FR Annex 10.

C.4.4. Training sessions form replication partners

There were organized different events to give visibility to the project and expand the replica farms. In addition, training courses took place, where different stakeholders (NGOs, associations, landowners, government bodies, private companies, a.o.) got involved. A summary of these events are compiled in the Annex 31.FR Annex 11

C.4.5. Technical Assistance

In addition, technical assistance sessions, throughout the implementation of the designed plan, were done with each replication agent. IBE-CNR oversaw the training in replication farms in Italy. SAHC, IDEAGRO (Technical Manager) and BALAM provided technical advice to the replicas in Portugal. BALAM and IDEAGRO were responsible for the advice and technical monitoring of the replica farms in Spain. Much more than the two estimated technical visits for advice and supervision were necessary to ensure the implementation of the designed plan.

C.4.6. Discounted Materials

The replication cost of implementing the measures were borne by the replicating agent. However, the advice was provided by each partner, ensuring that the costs of the products used were reduced by 25% by the distributor.

C.4.7. Replication and transfer plan for future uptake

Considering future replications, all material generated by the project is available on the project website to continuous transfer the ideas for future replications (Annexes E1). As an additional effort to guarantee future uptake and part of the After Life Activities, ASAJA achieved **new 30 farms (2.194 has)** that were committed to implementing the model during the afterlife period (2022-2026). The 30 signed replication contracts AFTER LIFE are attached in 32.FR Annex 12. In addition, a preliminary characterization of each site was done (33.FR Annex 13).

Table 3. 30 Replication farm after life.

COD	Farmer	Location	Total ha	Crop
1	JOSE JOAQUIN SANCHEZ	HELLÍN -ALBACETE	245	ALMOND
2	MIGUEL ANGEL GONZALEZ HERNANDEZ	HELLÍN -ALBACETE	45	ALMOND
3	MIGUEL ANGEL GONZALEZ HERNANDEZ	HELLÍN -ALBACETE	60	OLIVE
4	JOSE ANGEL INIESTA	ALBACETE	44	ALMOND
5	JOSE ANTONIO GARCIA ESPINOSA (SAT ISSO FRUIT)	HELLÍN -ALBACETE	435	OLIVE
6	PEDRO JAVIER LOPEZ GARCÍA	ALBATANA-ALBACETE	59	OLIVE
7	PEDRO JAVIER LOPEZ GARCÍA	TOBARRA-ALBACETE	21	ALMOND
8	AGUSTIN GOMEZ MORENO	HERENCIA-CIUDAD REAL	62	ALMOND
9	LUIS ANTONIO CAÑETE NIETO	LAS CASAS- CIUDAD REAL	43	ALMOND
10	MIGUEL ANGEL CASTRO RUBIO	DAIMIEL-CIUDAD REAL	300	ALMOND
11	AGUSTIN GOMEZ LOBO	HERENCIA-CIUDAD REAL	45	OLIVE
12	RODRIGO GOMEZ LOBO	ALMAGRO-CIUDAD REAL	47	OLIVE
13	FRANCISCO MENAYO	BOLAÑOS DE CALATRABA - CIUDAD REAL	72	ALMOND
14	TRINIDAD SAN ANDRES	DAIMIEL-CIUDAD REAL	33	ALMOND
15	DAVID CAMACHO	BOLAÑOS DE CALATRABA - CIUDAD REAL	30	OLIVE
16	ANTONIO GOMEZ DEL VALLE	ALMAGRO-CIUDAD REAL	70	OLIVE
17	JOSE UGARRIO	LILLO-TOLEDO	15	ALMOND
18	JOSE UGARRIO	CORRAL DE ALMAGUER-TOLEDO	20	OLIVE
19	JESUS TRIGUERO	CORRAL DE ALMAGUER-TOLEDO	13	OLIVE
20	JESUS TRIGUERO	LILLO-TOLEDO	44	ALMOND
21	VICENTE ORTIZ ALAMEDA	NAVAHERMOSA-TOLEDO	186	OLIVE
22	VICENTE ORTIZ ALAMEDA	MENANSALBAS-TOLEDO	81	ALMOND
23	JUAN CARLOS CATALAN MONTAÑANA	TARBENA-ALICANTE	15	OLIVE
24	TOMAS MASCARO	TARBENA-ALICANTE	12	ALMOND
25	JUAN MIGUEL MARCO	TARBENA-ALICANTE	20	ALMOND
26	CARLOS GUALLAR	ANDORRA-TERUEL	50	OLIVE
27	CARLOS GUALLAR	ANDORRA-TERUEL	18	ALMOND
28	MARTIN COMIN	ALLOZA-TERUEL	23	OLIVE
29	OSCAR BETMANTE	VALDEARGORZA-TERUEL	62	OLIVE
30	OSCAR BETMANTE	VALDEARGORZA-TERUEL	24	ALMOND
			2194	

Complementary actions and future perspectives and deviation of this action:

Technical assistance from BALAM, SAHC, CNR, NUTRIPRADO, ASAJA, GREENFIELD is offered

to the 43 (13 + 30) replication farms for at least 5 more seasons. Replicators and beneficiaries are committed to share progress obtained in those campaigns so it can be published through the communication channels of the project.

Additionally, the replication activities **within Italy** were set up both in Tuscany and Sicily. CNR evaluated **4 new replication farms (40has),** using the original data set of NDVI provided by GREENFIELD through the innovative methodology developed in the LIFE RESILIENCED project. The farmers followed the advice of the technicians mainly about the managing of the cover crops and good farming and the satellite data were used by the owner to follow the vegetation indices to improve the management. Two scientific papers were realized as results of these studies. First (published in the journal "Remote Sensing 2022) was about mapping of hedgerow olive orchards by NDVI data from satellite images. Second (summited Sep. 2022) was about the direct and indirect ground estimation of leaf area index to support interpretation of NDVI data from satellite images in hedgerow olive orchards. (34. FR Annex 14).

Table 4. 4 Replication Farm NDVI methodology treatments

COD	Location		Area	Crop
1	Bonfiglio	Italy	3,59 ha	Olive
2	Brazzaventre	Italy	12 ha	Olive
3	Catania	Italy	1,13 ha	Olive
4	Giardinelli	Italy	23,28 ha	Olive

Performance indicators

Indicators	Achievements
10 replication farms	Done. **13 replication farms** were included in the project. More than 1.862 has were management with sustainable practices model in order to increase the resilience and sustainability. In addition, **4 replication farms** in Italy (40ha) were evaluated 30 replication farms (2.194 has) are committed to implement sustainable management plans after-life. In total 47 replication farms were achieved with 4.095,90 ha
Training session for replicators	Done. 9 training sessions and technical visits

Deliverables

Deliverable name	Expected date	Actual date
Manual for replication training (ASAJA)	31/12/2020	15/04/21
Design of replication site management plans	31/01/2021	30/05/2021_v1 15/06/2022_v2

Milestones

Milestone name	Expected date	Actual date
10 Signed Replication Contracts	31/12/2020	Done, 13 signed replication contracts. Last 2/2022 30 replication farms for after life (5/2022)
Training for Replicators realized in each country (ASAJA)	31/03/2021	Jun 2020-End of project

Attachments

28.PR Annex 05: C4 **Deliverable C4**. Manuals for replication training

29.PR Annex 06: C4 13 Signed Replication Contracts
30.FR Annex 10: C4 **Deliverables C4** Design of replication site management plans
31.FR Annex 11: C4 Training for replication (ASAJA)
32.FR Annex 12: C4 30 Signed replication contracts AFTER LIFE
33.FR Annex 13: C4 Preliminary characterization of AFTER LIFE replication farms
34. FR Annex 14: 2 papers_Cantini et al. Vegetative mapping remote sensing

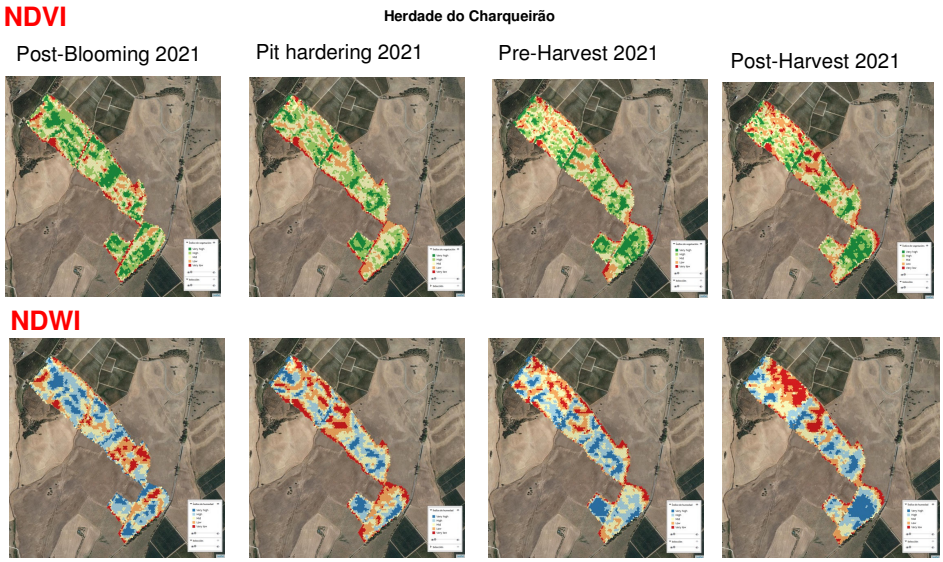
6.1.4 Action D1 Project performance indicators

Foreseen start date: *01/07/2018* *Actual start date:* *01/07/2018*
Foreseen end date: *30/06/2022* *Actual (or anticipated) end date:* *30/06/2022*

Activities undertaken and achievements

The impact during the project was evaluated through the constant technical monitoring of project Activities. Different parameters are being measured by specific methodologies (compilated in deliverable of A2, MR Annex 10:) to calculate the project specific indicator (18) included in ten specific groups Tree Health, Soil quality, Disease prevalence, Weather, Quality, Water Use, Carbon Footprint, Biodiversity, Production Value and XF Resilience.

The general results shows that it would be possible to achieve the objective of increasing the resilience of differentcrops against pathogens such as XF in the Mediterranean basin. The impact of the treatments on each of the indicators are described in the FR Annex 12, small headline is given below:

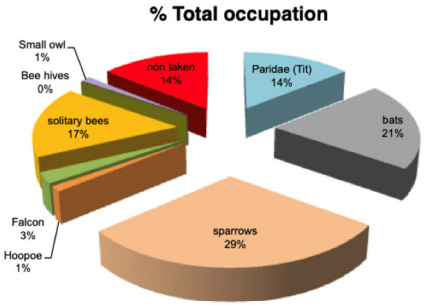
Factor / Parameter	El Valenciano (SP) Olives	Herdade de Charqueirao (PT) Almonds	VF BERIO (IT) Olives
Tree health D.1 Nutritional state	Improved Nitrogen, Potassium and Phosphorus content	Improved Calcium, Magnesium and Boron content	Improved Nitrogen, Magnesium and Cooper content and microelements
Tree health D.2 Tree Temperature.	No variations in temperature were identified with risk of Xf No areas of anomalous behavior were observed (high Tº)	No variations in temperature were identified with risk of Xf No areas of anomalous behavior were observed (high Tº)	2019 Italian operator, weather cold and rainy data could not be processed to differentiate trees from vegetation. 2020 and 2021 flights pandemic situation impossible to carry out
Tree health D.3 Vegetative Development	Physiopathies and diseases were not detected	Physiopathies and diseases were not detected	Physiopathies and diseases were not detected
			
Soil quality D.4 Soil	Improvement of microbiota and soil fertility	Improvement of microbiota and soil fertility	Improvement of microbiota and soil fertility

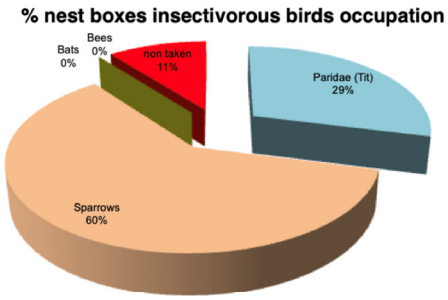
microbiological activity			
Soil quality D.5 Available Water Content	an improvement of 7% in AWC that was observed in general in this project is very important not only for soil health but also for crop productivity. The water availability for plant growth and important soil processes are governed by a range of soil properties including porosity, field capacity, lower limit of plant available water (thus excluding osmotic potential), micro pore flow and texture		
Soil quality D.6 Soil Physico-chemical analyses	the nitrogen content, all the treatments showed very similar values. On the contrary, as far as NO3 is concerned, a much higher value was observed in T2 with respect to the remaining treatments. The phosphorus content in the soil was much higher in the T4 treatment, the same was observed for the potassium content. Very similar values were observed between treatments regarding the content of calcium, magnesium and sulfur. About micronutrients, a slightly higher content of Fe and Mn was observed in T1 treatment.		
Disease prevalence D.7 Xylella fastidiosa disease control data	Insect vector had not been detected in Spain and Portugal.	Insect vector had not been detected in Spain and Portugal.	All the collected samples of plant and vector collected in Italy were tested negative to X. fastidiosa in both years 2020 and 2021
Disease prevalence D.8 Insect vector trap	auxiliary fauna was increased, and insect vector was not detected in Portugal and Spain.	auxiliary fauna was increased, and insect vector was not detected in Portugal and Spain.	auxiliary fauna was increased but insect vector was detected
Weather D.9 Climatic and atmospheric data	The Weather was monitored every year of the project because the closest relation between warm temperatures and XF incidence. In this sense, in low latitudes higher values of average temperature are favorable conditions to XF spreading. However, XF was not detected during the project.		
Quality D.10 Olive Oil D.11 Almond	**D.10 Olive Oil** treatments did not have a negative effect on the profile of fatty acids in which, in all the samples, the majority acid was **oleic acid**, with values higher than 60%. The second most important acid in olive oil is **palmitic acid**, which appeared in the highest concentration in T2. total **polyphenol content** in T1 presenting the highest content. **Bioestimualnt treatment** increased antioxidant olive oil capacity. The **volatile compounds** are responsible for the aroma of the extra virgin olive oil. In all samples, the compound related to fruity aromas, whose highest concentration was found in treatments T1 and T4. About **sensory profile** attributes "fruity (olive)" was observed in T2 and T4 and "bitter" attribute, being higher in the T2 sample, while in the pungency of the oil, the T1 sample stands out Pesticides in oil were also analysed but none of the treatments had pesticide content.	**D.11 Almond** no twins kernels was detected. increments in specific almond weight have been detected, especially in the treatments where biostimulants were applied. Regarding **crude fat,** an increase was observed in general in all the seasons in treatments subjected to deficit irrigation. Respect to mycotoxins, in most of the treatments they were below the detection limit (<LD). In the cases in which mycotoxins were detected, all were below the limit allowed for nuts. This was a robust result of this project as none of the years in which it has been carried out has mycotoxins been detected above the permitted levels in the almond crop. Mycotoxins are a very important quality parameter because they are one of the health hazards that can affect cereals and nuts and their by-products	**D.10 Olive Oil** treatments did not have a negative effect on the profile of fatty acids in which, in all the samples, the majority acid was oleic acid, with values higher than 60%. The second most important acid in olive oil is palmitic acid, which appeared in the highest concentration in T2. Regarding the groups of fatty acids, the majority were monounsaturated fatty acids, oleic acid being the most important, with values greater than 75%. At all the treatments increased phenolic content in comparison T0. Bioestimualnt treatment increased antioxidant olive oil capacity. The volatile compounds are responsible for the aroma of the extra virgin olive oil. In all samples, the compound related to fruity aromas, whose highest concentration was found in treatments T1 and T4. About sensory profile attributes "fruity (olive)" was observed in T2 and T4 and "bitter" attribute, being higher in the T2 sample, while in the pungency of the oil,

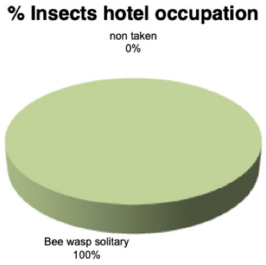
			the T1 sample stands out. Respect to bitterness and fruity taste, all the treatments increased oil fruity and bitterness in comparison to T0. Pesticides in oil were also analyzed but none of the treatments had pesticide content.
Water Use D.12 Water Use Efficiency (WUE)	The WUE is the relation between water consumed (m3) by the crop and irrigation water applied (m3). Both values were calculated each year in the demo farms in Italy and Spain where RDI strategies was applied. WUE in T2 and T4 treatments, where deficit irrigation was applied, increased as expected respect to T0 and T1 where the need water requirements were applied. In T0 and T1 had the same irrigation and WUE. The WUE is 1 when the irrigation consumed by the crop and irrigation applied are equal. Then, WUE in T2 and T4 treatments deficit irrigation was increased as expected.		
Water Use D.13 Irrigation Water Productivity (IWP)	The IWP is the relation between annual yield (kg) and water applied (m3). Both values were measured each year and IWP was calculated every year in the demo farms in Italy and Spain where RDI strategies was applied. T2 and T4 treatment had major IWP. This means that these treatments (RDI) required less water consumption to produce 1kg of yield therefore they were more efficient in the use of water.		
Water Use D.14 Stem Water Potential (SWP)	the measurement of SWP allows us to establish the water state of the plant and, in relation to that value, determine the necessary irrigation hours (Hydrosustainbale protocol). When the water requirement demand is satisfied 100%, this value, despite being important, is not critical. However, when we are applying a RDC strategy, the SWP value is crucial to determine the hours of irrigation in a much more precise way, achieving reductions in water consumption but without affecting production. During the project (3 years), we could apply RDI strategy in El Valenciano Farm, reducing water consumption and without yield reduction.		
Carbon Footprint D.15 CO2 emitted	Annual CO2 emitted in each farm was analysed at the end of the project. To do that, annual CO2 emitted in each farm was estimated by Carbon Footprint Assessment ISO/TS 14067:2013. The total carbon reduction associated with the activities of the project that took place at the demonstration sites was: 3.568,7 tons of CO2 eq.		

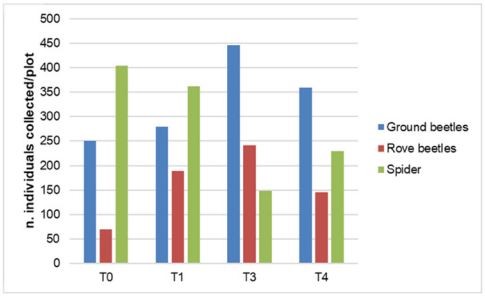
Spain	BE1	12858,30	BE2	784329,00	BE3	1237,06	BE4	0,00	**Total per year**	**Total**
	PE1	3673,80	PE2	627463,20	PE3	0,00	PE4	-234000,00		
	RE1	9184,50	RE2	156865,80	RE3	1237,06	RE4	234000,00	401287,4	1404505,8
Portugal	BE1	9666,80	BE2	584766,00	BE3	930,02	BE4	0,00		
	PE1	2761,94	PE2	467812,80	PE3	0,00	PE4	-175920,00	**Total per year**	**Total**
	RE1	6904,86	RE2	116953,20	RE3	930,02	RE4	175920,00	300708,1	1052478,3
Italy	BE1	11710,94	BE2	475167,00	BE3	1126,68	BE4	0,00		
	PE1	3345,98	PE2	380133,60	PE3	0,00	PE4	-213120,00	**Total per year**	**Total**
	RE1	8364,96	RE2	95033,40	RE3	1126,68	RE4	213120,00	317645,0	1111757,6
									RE (tonCo2 eq)	3568,7

Biodiversity D.16 Auxiliary fauna	Most of the boxes were used by Geckos (Tarentola maurtanica) to spend the winter. In fact, wintering bats had not been detected in the bird boxes, but were detected in the bat shelters. Of the three locations for kestrels, 2 of them have been occupied, twice as many as in the previous review. No domestic honeybee swarm has been found, which means less competitive pressure for native wild bees. The occupation by sparrows, probably Passer montanus in all cases, has increased from 22% to 30%. Occupancy by tits, probably Parus major in all cases, has remained stable at 14%. In Italy, spiders appear to be more abundant in plots characterized by most grasses in the herbaceous soil coverage, while ground beetles seem to be the more abundant group in plots characterized by a greater presence of dicotyledonous









species.

Production Value
D.17 Money saved

A total saving of around €40,500/year were calculated based on 3 parameters. Considering the 4 years of the project, a total saving of 180,000 € was achieved.

Parameter	Reduction	€/ha	Reduction €/ha	Valenciano	Charqueirao	VF BERIO	Total €
Herbicide	4 application and soil preparation	9,9	9,9	1742	1599	1562	4903
Fertilizer	-30%	1.400	420	5085	6344	4419	15849
Diesel	4 application and soil preparation	32	160	7038	6460	6312	19811
						Total	40563

Disease prevalence D.18 Xylella fastidiosa disease control data	18 potentially resistant new genotypes. These genotypes are still under evaluation (see action C1)		18 potentially resistant new genotypes. These genotypes are still under evaluation (see action C1)

Performance indicators

Indicators	Achievements
Methodology for measurement of key indicators defined	Consensus reached
Report on technical meetings	Done. Yearly update

Deliverables

Deliverable name	Expected date	Actual date
LIFE Project Specific IndicatorsTable sent in with Mid-Term Report (BALAM)	22/11/2019	09/2019
LIFE Project Specific Indicators Table sent in with Progress Report (BALAM)	21/05/2021	01/05/2021
LIFE Project Specific Indicators Table sent in with Final Report (BALAM)	22/07/2022	20/07/2022

Milestones

Milestone name	Expected date	Actual date

Protocol for measuring indicators established (BALAM)	12/2018	03/2019

Attachments

8. MR Annex 09: A1 Technical monitoring report part 1

35. MR Annex 16: **Deliverable D1**_LIFE Project Specific Indicators Table sent in with Mid-Term Report(BALAM)
36. MR Annex 17: D1 Protocol for measuring indicators established (Part of Annex 5_Training Materials-Chapter III+Annexes)
37. MR Annex 18: D1 Report on technical meetings
38. PR Annex 07: **Deliverable D1**. Life Project Specific Indicators Table sent in with Progress Report
39. FR Annex 15: **Deliverable D1** Life Project Spedific Indicator Table sent in with FR

6.1.5 Action D2 Conclusions and recommendations

Foreseen start date:	*01/07/2018*	*Actual start date:*	*01/07/2018*
Foreseen end date:	*28/06/2022*	*Actual (or anticipated) end date:*	*28/06/2022*

Activities undertaken and achievements

Based on all the results obtained, a **Conclusions and recommendations report**) has been elaborated under coordination of BALAM (44. FR Annex 18). It has been conceived as a stand-alone document that includes 3 chapters presenting the socio-economic and environmental impact and the contribution to the adaptation to climate change, as well as the main conclusions and recommendations to ensure the replicability and transferability of the project concept and its market potential.

Main conclusions and recommendations:

1. ***Socio-economic impact***:
   - ***1.1. Social perception:*** The analysis of the 72 surveys conducted at the beginning of the project showed the lack of knowledge at that time, observing that there were basic aspects of XF, since what are the problems caused or how to prevent it. However, the Italians already lived with the bacterium and therefore showed a much deeper and more critical knowledge of the environmental, social, and economic impacts of this disease. Soon before the project ends, the surveys were done again and analysed this is described in 41. FR Annex 39. In general, the surveys show a greater understanding about XF of technicians versus farmers. In addition, Italian technicians and farmers stand out with greater knowledge about the disease in all aspects for which it has been asked. The main observations are:
     - There is a disparity of profiles within the associates of ASAJA about the perception of the impacts on XF.
     - A small part of the respondents considered that plant material controls that are carried out in customs controls, as well as good agronomic and nursery practices as a control method are fundamental to avoid the propagation.
     - Communication and Dissemination Plan are essential for transfer of knowledge. Thanks to the communication channels this project has reached about 1,140,200 people.
     - Reduction in management costs is mainly due to the reduction of herbicides and pesticides use, which in most cases were abandoned and more attention has been put in the agrobiodiversity maintenance and development.
     - Jobs have been created for the implementation of the model within the demo and the replication areas.
     - This project facilitates the transfer to precision agricultural practices by integrating the use of new technologies in the field
     - There is an acceptance for integrate new plant material in different regions.

   - ***1.2. Sustainable best practice model:*** The LIFE RESILIECE model has been accepted by the farmers and it is demonstrated that is an economically and technically feasible option to enhance the sustainability and increase resilience of intensive olive and almond production in

the Mediterranean. The 3 main practices implemented (Cover crop, Bioestimulant and Regulated Deficit Irrigation) have important impact:

- Impact **cover crops** strategy: 1) improve the stability and structure of the soil, protecting the soil against erosion, improve infiltration. 2) improve the water balance, improving the storage of water in the soil by increasing infiltration and reducing the evaporation of the water found under the roof in the hottest seasons, 3) improve soil heath, increasing organic matter in the soil by the contribution of plant mass 4) greater biodiversity of microorganisms that allows increasing the content of organic matter in the most superficial layer of the soil. 5) greater availability of macro and micronutrients for the crop 6) control of pests and diseases, since the increase in plant biodiversity leads to a greater diversity of food and microhabitats that favor the increase of natural enemies.7) Nitrogen fixation, forming symbiosis with bacteria of the Rhizobium genus.8) Fix atmospheric carbon dioxide (CO_2). About 8 tons of CO_2 per hectare of plant cover, 9) reduction Nutrition, fertilizer and fuel cost and 10) reduction CO_2 emission due to reduce tractor passes
- Impact **Bioestimulants** use strategy: 1) Increment of soil microbiological activity due to an increment in soil enzimes as ß-Glucosidasa and DHA , 2) Increasing soil nitrogen fixing and potassium and phosphate solubilizing bacteria which improves in soil fertility, 3) Soil microbiological activity activates plant defenses increasing soil-plant resiliency. 4) Reduction of 30% of NPK fertilizers reducing soil and environment pollution with nitrogen and phosphorus leaching, 5) Money saved with 30% of NPK reduction incrementing crop rentability, 6) Application of soil microorganism improves plant diseases management through induced disease resistances, 7) stimulation of plant's nutrient assimilation incrementing nitrogen, phosphorus and potassium plant content.
- Impact **Regulated deficit Irrigation** strategy: 1) increase olive oil quality (phenolic compounds in olives) 2) reduction Water footprint and Carbon Footprint. 3) energy and water cost reduction.

This best practical model are key strategies to increase the **biodiversity** in the soil and in farms. Introducing auxiliar flora and fauna with cover crop, bioestimulant, microorganism, nest boxes, insect hotels, hedgerows we achieved this goal, in addition it is improved the soil and plant health and minimize the use of chemical phytosanitary products.

1.3. Environmental impact: the water footprint and the carbon footprint assessment were calculated at the beginning and at the end of the project to determine the impact on both resources. Both indicators have been calculated on the demonstration farms and estimated on the replica farms, which are developed in detail in the reports 42. FR Annex16 and 43. FR Annex 13.

- In the Water footprint assessment report was determined that the total water consumption **reduction** achieved thus far as a result of the project's implementation is: **1.261.301,50 m^3**. In the demo farm the water reduction was 105.096,16 m^3 and in the 13 replication farms was estimated as a reduction of 1.156.205,34 m^3.
- In term of **GHG emission reduction**, considering all the areas in which the measures were applied, at the demonstration sites (3.568,7 tn CO2 eq removed) and the replication sites (6.580,02 tn CO2 eq removed), a total of **10.148,72 tn CO2 q** was removed from the atmosphere up to this moment. Clearly demonstrates the project's significance in terms of reducing carbon emissions.

In that sense, it is reasonable to consider the project's potential to have a positive impact on the environment if its scope of action is expanded. For example, just considering the countries where the activities took place, Spain, Italy, and Portugal, they have a total of 19.526.432 ha of arable land. If we assume that 1% of this land will replicate this project's activities, we can estimate the average reduction in CO2 emissions as follows:

- The aforementioned information demonstrates how the LIFE RESILIENCE project's actions had a positive impact on the environment. It is also advised to replicate it in all the regions and crops where it can be used successfully.

1.4. Innovation in the use of technologies in the agro sector. The ***use of technology*** in this project, such as drones or satellites, has allowed us to implement **precision agriculture on farms**. This

allows us to be more efficient in the use of resources (water, energy, soil, fertilizers, nutritional, etc.) and improves all farm management activities (design of pruning strategies, irrigation, nutrition and pest control, sampling, etc.). This has had a great positive impact on the environment, social and economic. LIFE RESILIENCE has made an effort to make available to the farmer the most innovative technology that we have used in the project.

1.5. New XF resistant varieties have an important environmental impact. 1) greater resilience of new varieties to climate change 2) greater resistance to diseases. The economic and social impacts are very remarkable and summarized below in the business plan

2. Replicability and transferability.

2.1. Transfer of knowledge: LIFE RESILIENCE has made a significant effort to transfer all the learning and results of the project to our target audience, farmers in Mediterranean areas with a high risk of XF spread. The scope of the project has been important, since we have reached different regions and crops, to which we have provided the tools, management plans and technical advice to implement the model of sustainable practices and the socioeconomic and environmental impacts that it generates. See Action C4. A total of 4.065 ha was advised on the use of innovative methodologies and tools to develop precision agriculture on their farms. It is expected that the impact will increase with the continuation of the communication and dissemination efforts by AGRIFOOD and mainly due to the transfer of results that ASAJA will continue to carry out at a national and European level through COPA-COGECA.

- Recommendation to ensure replicability and transferability: focusing on communication and dissemination, training and environmental education efforts.
- Commitment or replication in the After-Life period.

3. **Business plan.** The variety in site conditions and trials laid out in the Resilience project, warrants a comprehensive comparison of trees established and managed by sustainable management versus those managed with conventional practices. The diverse data collected during the project allow us to assess not only the environmental and climate change impact but also the market potential. (46. FR Annex 20) This chapter entails 2 strategies:

3.1. Contracting of services: This strategy are mainly for BALAM, GREENFIELD and NUTRIPRADO, that already provides specialized agricultural advisory services, but now can offer an innovative platform for monitoring data and remote sensing analysis, and support on cover crop management. The potential of the partners to offer services and advice is significant, almost being able to reach a **replication area of 200.000 has**, considering only 1% of the arable land in these three countries based on the project's findings. It is also important to emphasize **ASAJA's** contribution to reaching more farmers, **AGRIFOOD** Comunicación will continue to carry out the project's dissemination and communication activities for the following five years after the project has ended**. SAHC** and **V.F. BERIO** will continue their studies in the coming years. Likewise, **V.F. BERIO** together with **CNR** will work on a program of **best agricultural practices for precision agriculture in olive**. The economic impact of implementing the best practices model will be important, but even more so the environmental benefits that will be achieved, which will be proportional to the impact of resilience, biodiversity, sustainability and social, achieved in this project LIFE RESILIENCE.

3.2. Sale of resistant olive varieties: In the economic aspect, the commercialization of these new varieties of olive trees, It could generate -being conservative- a sales volume of 88.5 million euros, introducing them in three different markets: in the Apulia area, areas with the potential to be infected by the bacterium and in the world olive market. However, the economic impact would be greater, since the significant increase in jobs in the olive sector would imply, in turn, a greater spending capacity of the citizens of the area. To estimate the income from sales of the new resistant varieties, we established the following assumption: of the total sales, 60% of them will be of variety A (intended for intensive cultivation of 200 trees per ha) and the remaining 40% it will be of variety B (intended for super-intensive plantation systems of 2,000 trees per hectare). In social benefits, that make clear the importance of developing these varieties, were significant, such as, the provision of a range of varieties with different agronomic characteristics

that will allow farmers in the infected area to generate new oils and enter new markets. the generation of a large number of jobs, nurseries and plantation management, as well as indirectly in service companies, phytosanitary products, oil mills, packaging companies, those in charge of materials for the implementation, the revitalization of social motivation, since olive growing in Puglia is a way of life that had been lost in recent years or tourism in this area.

Performance indicators

Indicators	**Achievements**
Interviews and consultations with the stakeholders involved	72 surveys perfomed in IT, SP and PT. 7 in Italy by VILLA FILLIPO BERIO-CNR 9 in Spain by BALAM, 7 in Portugal by SHAC 49 in Spain by ASAJA

Deliverables

Deliverable name	**Expected date**	**Actual date**
Carbon FootprintAssessment	31/05/2022	31/05/2022
Water Footprint Assessment	21/05/2022	31/05/2022
Conclusions and recommendations report (incl. socio-economic impactassessment) handed in with the Final Report	30/09/2022	20/09/2022

Milestones

Milestone name	**Expected date**	**Actual date**
Notes from interviews with relevant stakeholders - start ofproject (BALAM)	11/2018	30/09/2019 update spring 2020
Business Plan Developed	30/06/2022	30/06/2022
Notes from interviews with relevant stakeholders end ofproject	30/06/2022	31/05/2022

Attachments

40.FR Annex 38: D2 Surveys IT-SP-PT-ASAJA-Life Resilience
41 FR Annex 39: D2 Survey Analysis
42. FR Annex 16: **Deliverable D2** Carbon Footprint Assessment
43. FR Annex 17: **Deliverable D2** Water Footprint Assessment
46. FR Annex 20: Business Plan Developed
44. FR Annex 18: **Deliverable D2** Conclusions and Recommendations report

6.1.8 Action D3 Monitoring KPI's

Foreseen start date: *01/07/2018* *Actual start date:* *01/07/2018*
Foreseen end date: *28/06/2022* *Actual (or anticipated) end date:* *30/09/2019*

Activities undertaken and achievements

BALAM has synthesized the monitoring of project indicators and uploaded it in a timely manner intothe KPI webtool before the Midterm Report, Progress Report and Final Report. 3 KPI analysis reports were sent throughout the project analysing the achievements and the deviations found during its development Also, an analysis focusing on the results achieved and/or deviations experienced/expected as compared to the original estimates is presented below in section 7.

Performance indicators

Indicators	**Achievements**
LIFE KPI webtool updated	Consensus reached

Deliverables

Deliverable name	Expected date	Actual date
KPI Analysis sent in with Midterm Report (BALAM)	20/12/2019	30/09/2019
KPI Analysis sent in with Progress Report (BALAM)	18/06/2021	17/06/2021
KPI Analysis sent in with Final Report (BALAM)	30/09/2022	01/09/2022

Attachments
45. MR Annex 21: **Deliverable** D3_KPI Analysis (Table)
46. PR Annex 09: **Deliverable** D3. KPI Analysis Table sent in with Progress Report
47. FR Annex 21: **Deliverable** D3. KPI Analysis Table sent in with Final Report

6.1.9 Action E1 General Dissemination

Foreseen start date: 01/07/2018 *Actual start date: 01/07/2018*
Foreseen end date: 28/06/2022 *Actual (or anticipated) end date: 30/06/2022*

Activities undertaken and achievements
From the beginning of the project, all partners carried out dissemination activities in Spain, Italy and Portugal. These activities served to disseminate the project objectives and results to different stakeholder groups (i.e. researchers, NGOs, private companies, foundations and governmental organisations, citizens, etc.). The main target groups of stakeholders were olive and almond producers, as well as other audiences (agri-food companies, plant protection producers, research groups, farmers' associations and cooperatives) who were able to obtain information about the project through different media, both online, offline and off-line.
The dissemination events also helped partners to get in touch with key stakeholders, while creating opportunities for networking and synergies with other LIFE projects. Dissemination materials were produced and distributed during these events, and the materials were regularly published on the projects' communication channels.
The methodologies and the main results of the project reach a particularly high interest of the following stakeholders, among which we find at least 4 research groups; 9 national - regional and local authorities in agriculture; 12 university departments of forestry, agriculture, environmental sciences, phytopathology and entomology; 47 farmers corresponding to the replica farms and 700 farmers who have attended the different seminars and workshops organised, 45 farmers associations and cooperatives; 5 NGOs and international organisations for agriculture, food security; 4 policy makers and members of the European Parliament. Some of the stakeholders who have taken an interest in the project are described in 54. FR Annex 25.

E.1.1. Networking with other projects
In particular, Agrifood coordinated the mapping of other relevant projects, those promoting the reduction of the impact of chemicals on the environment or human health, those promoting improved cultivation practices, those working towards climate change resilient or pest resistant agriculture, or those promoting biodiversity and the integration of agricultural ecosystems, among others.
The partners established meetings with other interesting projects and made contact with relevant actors, which resulted not only in joint events and reciprocal visits, but also in replication activities. The consortium has participated in **10 networking activities** and has contacted **with 17 other LIFE projects**. During the events, the project partners introduced the project to different representatives also creating synergies and sharing experiences with research projects such as the Life AGRIADAPT project or the Life AGROMITIGA, LIFE BIOVEXO, LIFE VIDA FOR CITRUS projects. In total, the project partners were visited by 7 representatives of 2 LIFE projects in the demonstration areas and/or project events. Networking report can be found in the annex 55. FR Annex 26, also full list of activities can be found on the projects' Networking webpage.

Collaboration with European Climate Adaptation Platform (ADAPT): We sent the Climate ADAPT platform emails for the publication of several information, including description of the project and videos about the ongoing of the LIFE Resilience project and the SDGs. However, the platform only presents basic information and it did not report the extra communication information that was sent. This can be found in the 56. FR Annex 27.

E.1.2. Design and diffusion of dissemination and communication pack

Notice boards, brochures and a Layman's report were designed, printed and distributed during the events to reach out to key stakeholders. In addition, a website, social media pages on Facebook, Twitter and LinkedIn and a YouTube channel were created to disseminate the project information and results to a wider audience.

Website: The website (http//www.liferesilience.eu) was created by Agrifood in cooperation with SENTIDO COMUN. It was launched on June 12, 2018 in Spanish, English, Italian and Portuguese. Since then, the website was monitored and regularly updated with news, usually on a weekly basis, on regular activities and tasks performed during the project execution, networking events with other projects and lastly the results. The website includes a total number of 779 articles of all kinds (i.e., project dissemination, networking, awareness raising, etc.): 254 in SP, 233 in ENG, 144 in IT and 148 in PORT.

Website traffic: The traffic has increased significantly during the implementation of this project (1/07/2018-30/06/2022), reaching 61,583 visits and 11,787 different users have visited our website.

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Social media. The project's social networks were permanently updated with partners' activities, as well as with publications on relevant topics related to Xylella fastidiosa and other Life projects.

The project has created the following accounts:

- Facebook (27/04/2018): 346 publications, 406 followers, 668 likes and 18,1 K people reach. (https://www.facebook.com/pg/LifeResilience/about/?ref=page_internal)
- Twitter (27/04/2018): 907 publications, 1.086 followers, 1.619 likes and 90.591 people reach. (https://twitter.com/Life_Resilience)
- YouTube (27/04/2018): 74 videos, 101 followers, 0 likes and 17K people reach. (https://www.youtube.com/channel/UCJuyVJ3Bz1lHPFl1ioxSUNQ/featured)
- LinkedIn (27/04/2018): 1308 publications, 366 followers, 2.000 likes and 890 K people reach. (https://www.linkedin.com/company/18611895/admin/)

LIFE information boards, Project leaflets, and Layman's report

Notice boards: The notice boards were created by Agrifood in collaboration with the external company Materialising Ideas. These boards contain the URL of the project website, the LIFE logo, as well as project and partner logos and general information about the project. Therefore, two designs were created, a smaller A3-size notice board and a large information board. The smaller A3-size information boards were placed in the entrances or meeting rooms of the partners' offices. All project partners have taken a photo of their notice board in the office. The large information board was hung at the implementation sites in Carmona, Pisa and Alandroal. The information boards have proved to be very useful to inform landowners, neighbours and interested visitors about what the project is about. The deliverable was prepared on 14 March 2019, with photos of all the information boards, both in the offices and at the

demonstration sites.

Handbook. We have finished the Spanish, English, Italian and Portuguese version of the training course material (handbook). In 2022 the logos of the project partners have been updated. 57. FR Annex 28.

Display. During the project, a total of 25 roll-ups were produced for fairs, conferences and events related to the dissemination of the project to target audiences such as farmers, administrations, etc.

Project leaflets/brochures. There were developed in line with the notice boards to ensure a common identity. Agrifood, in collaboration with the company "Materializando ideas", was responsible for the design and final production in brochure format. 3,009 information brochures have been produced for use at trade fairs and events, networking and meetings. 1,509 in Spanish, 500 in English, 500 in Italian and 500 in Portuguese. In 2022 the partners' logos were updated in this document. 52. FR Annex 23.

Layman's report. A draft version of the **Layman's report** was printed and distributed to the project partners and other stakeholders during the Final Conference (19/05/2022). After some final corrections suggested by the project partners and the project manager, the Layman report was finalized in 4 languages (EN, SP, IT and PT). In total, 500 copies were printed and distributed to the different project partners and to those attending the presentation of the results. The final version of the Layman's Report is available on the project website (Downloads) and is included in 51 FR Annex 22.

The continuation of communication after project closure has been set out in the After-LIFE plan, which document can be found on the website (Downloads) and in 53 Annex 24 of the FR After-LIFE Delivery Plan.

Performance indicators

Indicators	**Achievements**
First inventory of related LIFE projects	Done. 10 networking activities, contacted with 17 Life projects
Visits of other project participants to the test sites in Spain, Italy and Portugal	63.FR Annex 35: E2_Information and awareness-raising for general public and technical/scientific audience
Workshops organized	60.FR Annex 31: Presentations at national an international conference proceedings
Each partner has a project website linked to their website	Done
6 videos (1 introductory video, 5 local awareness videos)	58. FR Annex 29: 74 Videos also shared on Youtube

Deliverables

Deliverable name	**Expected date**	**Actual date**
Report on website launch (Agrifood)	11/2018	16/03/2019
Report on placing of LIFE Information Boards (Agrifood)	10/2018	14/03/2019
General public leaflets (ASAJA)	03/2019	03/2019
Layman's Report (Agrifood)	04/2022	04/2022
After Life Plan (Agrifood)	06/2022	06/2022

Milestones

	Expected date	**Actual date**
Project website launched (Agrifood)	10/2018	12/06/2018
LIFE Information boards placed (BALAM-SAHC-VF BERIO)	10/2018	14/03/2019

First contribution to ADAPT database (Agrifood-ASAJA)	12/2020	30/06/2022
Networking achieved and articles published online (Agrifood)	06/2022	06/2022

Attachments

48. MR Annex 22 **Deliverable**. E1_Report on website launch (Agrifood)
49. MR Annex 23 **Deliverable** E1_Report on placing of LIFE Information Boards (Agrifood)
50. MR Annex 24 **Deliverable** E1_General public leaflets SP, IT, PT, ENG
51. FR Annex 22: **Deliverable** E1 Layman's Report (EN, SP, IT and PORT)
52. FR Annex 23: **Deliverable E1** 5 Project leaflets with updated partners' logos (ESP, ENG, IT, PORT)
53. FR Annex 24: **Deliverabl**e F1 After Life Plan
57. FR Annex 28: **Deliverable** E1 Handbook with updated partner logos (ESP, ENG, IT, PORT)
54. FR Annex 25: E1 Stakeholders interested in the project
55. FR Annex 26: E1 2 Networking report with other projects
56. FR Annex 27: E1 3 European Climate Adaptation Platform Climate-ADAPT
58. FR Annex 29: E1 Videos shared on Youtube about the Life Resilience project
59. FR Annex 30: E1 9 Project commitment to the SDGs 2030

6.1.10 Action E2 Information and awareness-raising for general public

Foreseen start date: 01/07/2018 Actual start date: 01/07/2018
Foreseen end date: 28/06/2022 Actual (or anticipated) end date:30/06/2022

Activities carried out and achievements

This action complements the networking and dissemination efforts of the communication package with events and activities aimed at involving end-users, stakeholders and the general public in the development of the project. During the project, Life Resilience presentations were given at international conferences on *Xylella fastidiosa*, innovation and sustainable management practice in agriculture, olive variety development and ecological vector control. All partners were heavily involved in the dissemination and popularization of the Life Resilience project, using the brochures during their events. Several press articles and publications in local, national and international media were also produced. All these actions can be consulted on the project website.

In total, **50 information and awareness-raising** activities of all kinds were carried out during the project. The main objectives of these activities were to raise awareness among the local population about the importance of Xf in their region and to inform them about what our LIFE project is doing for it; to inform experts and scientists about the good practices used and the main results of the project to inform public bodies, NGOs, private companies and other entities about the opportunities generated by the project to collaborate and engage with them.

From the start of the project in 2018 until June 2022, we have reached a minimum audience of 7,000 people of the general public and scientific-technical reached through information and awareness-raising activities, including research and scientific groups, representatives of government agencies and public authorities, representatives of NGOs and local associations, individual farmers and landowners, and citizens in general. All these activities received good attention in the local, regional and international media.

E.2.1. Information and awareness-raising for the general public:

The partnership organised and participated in 31 awareness-raising events for the general public and technical scientists. In addition, between organised events and project participations in events and workshops, a minimum of 500 stakeholders from the general public and more than 6,700 scientific/technical people, all from different organisations, national governments, policy makers, as well as research groups and universities, private companies, civil society and other organisations, were brought together. These awareness-raising events included presentations of the project to government agencies and farmers' associations, as well as information events involving delegates from national authorities. While the awareness-raising events met with a relatively good response from the public, the field visits do not in all cases appear to be the most appropriate means of engaging the public, especially due to their often-remote location.

Special mention should be made of the visit of the Spanish Minister of Agriculture, Fisheries and Food, Luis Planas, visited the El Valenciano farm, which the BALAM company has in Carmona (Seville), where he was able to see the development of the R&D&I projects carried out, such as the project co-financed by the European Union's LIFE programme "Life Resilience".
Special mention should be made of the visit of the Spanish Minister Luis Planas and the Mayor of Cordoba, Isabel Ambrosio, to the BALAM headquarters in Santa Cruz (Cordoba). The PD, Teresa Carrillo, presented the LIFE RESILIENCE project as an example of good practice in the fight against the Xylella fastidiosa bacterium and the progress achieved so far. http://www.liferesilience.eu/luis-planas-visita-la-finca-el-valenciano-para-conocer-de-cerca-el-proyecto-life-resilience/
It was a successful event that generated a lot of interest among key stakeholders and the media. Four press articles were published in national and regional newspapers about the event (press links here).
Information for the general public and scientific can be found at the 63 FR Annex 35.

E.2.2. Dissemination of project objectives and results to technical/scientific audience
Partners organised 11 technical seminars (four face-to-face in Italy, Malaga Portugal and seven online between 2020 and 2022) and 1 final conference, and also participated in 8 national and/or international conferences where they presented information about the project and its main results. In addition, partners were present at several national and/or international fairs such as FIMART, EXPOLIVA and SMART Agrifood. The information of each event can be found in the download site on the project website. Numerous people from different interest groups (e.g. research groups, farmers, associations of olive, almond and citrus growers, etc.) had the opportunity to get to know the project partners, the objectives and the good practices employed. Farmers, research groups and climate change specialists learned about the project objectives and the opportunities it offers during three technical seminars, one in Malaga and two online, and another 31 during the final conference in Spain. In total, these activities aimed at a technical/scientific audience were attended by approximately 3,000 people per event. All information and awareness raising activities for both the general public and scientific and technical interest groups were communicated with presentations, posters, pictures and links to the website news in 63 FR Annex 35.

The **final conference** deserves a special mention. Entitled "Presentation of results of the Life Resilience project: 'A new approach against Xylella fastidiosa'", it was organised by BALAM on 19/05/2022 at the Spanish Engineering Institute in Madrid, gathering 35 face-to-face and 130 online participants, including all project partners, research specialists, members of farmers' associations, universities, olive growers and media, providing an excellent setting to inspire future collaborations. http://www.liferesilience.eu/life-resilience-un-modelo-replicable-de-practicas-contra-la-xylella-fastidiosa/

Journalists from local and national media showed great interest in the project and interviewed the partners. The materials can be found in the 64. FR Annex 36: Final conference materials

Press. All types of media took an interest in the project during its implementation, sharing the project's evolution and results through news, written articles, interviews and other types of publications. The total number of press releases was 75: 23 in Spanish, 16 in Italian, 20 in English media and 16 in Portuguese. The project appeared in a total of 338 publications, of which 13 were on the partners' website, 6 were interviews on TV or radio, 108 articles in the national press and 78 in the local and regional press. The project appeared in 55 other publications in specialised magazines or websites, was mentioned in 46 Italian and 5 Portuguese media. As a result, aspects of the project were disseminated in 4 different languages (Spanish, Italian, English, and Portuguese).

In addition, the project disseminated on its website 3 publications from international media related to studies on Xylella fastidiosa. Likewise, 4 scientific papers elaborated by the IBE-CNR, partner of the project, were published. All of them can be downloaded in the Scientific Reports section.

White paper: Given the scientific, technical and practical knowledge, the IBE-CNR presented the white paper as a tool for farmers and the general public, informing about the problems in the management of Xf infection and the solutions offered thanks to the results generated in this project.

Based on these data, it can be concluded that the project had a considerable impact on the media, both at national level in the implementing countries and at international level, reaching various types of stakeholders and a wide audience. Likewise, during the duration of the project, monthly newsletters were sent out with information related to the actions carried out during the Life Resilience project. A complete list of all newsletters sent with information about the project and the impact of the media reports is included in 61 FR Annex 32. The document is also available on the project website (Downloads).

Deviations of this action: It was foreseen two white papers and breakfast for members of the parliament (MEP) were organized by ASAJA. However, it was not possible, the first because under technical circumstances, the IBE-CNR has offered to do so because of the resent background and knowledge achieved during the trials performed in this project, which gave them the tools to put all the technical knowledge in a paper that can be used for different public. Secondly, besides the efforts of ASAJA's team, particularly of Jose María Castilla that is the ASAJA permanent representative in Brussels who was sending several emails and making phone calls to several MEPs it was not possible to arrange a day.

Performance indicators

Indicators	**Achievements**
Stakeholders interested in the project	Done 54.FR Annex 25
Information and awareness-raising for general public and technical/scientific audience	Done. 63.FR Annex 35
Technical seminars	Done. 30.FR Annex 31
White paper	Done. 65.FR Annex 37
Press releases	75 press releases SP: 23, IT: 16, ENG: 20 and PORT:16
Publications in local/national media	Done. 61.FR Annex 32
Presentations at international conferences	Done. 60. FR Annex 31
Fairs	Done. 63.FR Annex 35
Final conference	Done. 64. FR Annex 36

Deliverable

Deliverable name	**Expected date**	**Actual date**
Press recognition portfolio (Agrifood)	06/2022	06/2022

Presentations at national and international conference proceedings (Agrifood)	05/2022	05/2022

Milestone

Milestone	Expected date	Actual date
Technical seminar in Portugal (SAHC)	11/2019	03/2022
Technical seminar in Italy (SALOV/CNR)	05/2020	02/2019
Final Conference (Galpagro)	05/2022	05/2022

Attachments

60. FR Annex 31: **Deliverable** E2 Presentations at national and international conference proceedings
61. FR Annex 32: **Deliverable** E2 Press recognition portfolio
63.FR Annex 35: E2 Information and awareness-raising for the general public and technical/scientific audience
64. FR Annex 36: E2 Final conference materials
65. FR Annex 37: White paper

6.2. Main deviations, problems and corrective actions implemented

Technical

Action A1: Delayed publication of the deliverable due to changes made at the Madrid meeting (Design plans were completed in 12/2018 as due, but a few corrections to the deliverable were thereafter applied after the meeting in January (Madrid). Final publishable version was delivered in 02/15/19.

GREENFIELD has made a change in the way of centralizing the values obtained for different variables throughout the course of the project. Instead of developing an APP platform, we have opted for a **web viewer compatible** with all types of smartphones, tablets and personal computer operating systems. This substantial change implies an advantage as it allows a greater number of parameters to be introduced beyond those determined in the technical memory of the LIFE Project. On the other hand, itprovides greater simplicity for the implementation of internal changes in the data visualization application. This action was closed the 28 of February 2019.

Action A2. Delayed publication of the deliverable due to changes made at the Madrid meeting. Although materials were prepared before the meeting in Madrid, the documentation was edited into a final publishable version after the meeting (08/03/2019).

Training sessions were delayed until training material was perfectly completed. It was decided thinking about an increment in project sustainability that the partners of each country will be responsible for training in each demonstration farm. Moreover, to optimize the time and economic resources of the partners. Furthermore, additional training sessions will be given throughout the project to farm workers based on the activity being carried out, to refresh knowledge and ensure that the measures are being implemented following the guidelines of the project. This action was closed the 30 of June 2019.

Action C2: Solar/wind-powered irrigation systems installation was cancelled due to changes in Spanish regulations. Regarding the design of the treatments that were implemented in the field to increase the resilience of the crop was optimized for every demonstration farm. In the case of the demo farm in Italy, one of thetreatments was aborted. It was decided not to apply deficit irrigation treatment in that farm because it isbelow sea level. This means that plants roots are in contact with the water most of the time, making itimpossible to implement a water reduction in the crop. Due to soil characteristics in La Travesagna farm,T2 treatment could not be applied. To solve that problem a second plot was established in a different farm in a place called “Marina di Grosseto” the Farm is called “Il tombolo”. It is a super intensiveorchard of cultivar Arbequina alone and was established in 2007 at 4.5 x 1.6 m. The orchard was divided in two plots, one of them was a control plot and in the second a deficit irrigation treatment was established. One part was tilled the other half left with natural green coverage. Two levels of irrigationwere set: 100% of irrigation (780 m^3 per ha) and 35% irrigation (270 m^3 per hectare). The watering started in June.

Action C3: The potential use of vibrational or audio technology for natural vector control of cicadas forthe moment it is impossible to use this approach to attract or to confuse the insect vector. We believe that the machinery to be imported from Brazil is completely useless at the light of present knowledge since it will

take several years of novel research to have a deeper understanding of male/female or male/male communication. Several innovation activities were performed such as the evaluation of the froth to understand the efficacy of biological control measures and the soil biodiversity analysis in Spain and Portugal. Significant information was shared at international conferences and helped the redaction of the white paper.

Action C4: when contacting with the representatives of the 10 replication farms which had previously signed commitment letters during the proposal, they have changed their mind. This situation together with the pandemic condition, resulted in the resignation of their commitments. In that sense, to bring together new replications sites a great effort from the team members were assumed to find new replication farms. As a result**,** 13 replication farmers have signed letters of commitment and this action could started as foreseen. The farms cover a total of 1.861,9 ha. In addition, 30 new replication farm (2.194 ha) were committed to implement the model afterlife period (2022-2026) and 4 new Italian farms (40 ha) were considered to replicate since they implemented the methodology used by GREENFIELD to characterize NDVI through satellite images.

Action D1. Nest boxes (25) were produced and placed in each demo farm in autum (November2019). However, this was insufficient, and an expert company (Granja de Bixos) was contracted for the design and evaluation of hotels and nest boxes in the three farms, then 38 boxes were installed (2020 autumn) and evaluated one year later (2021). In total 163 insect/nest boxes

Action D3. Problems with using the KPI WEB TOOL application. Our monitor Cristóbal Ginés was working to solve the problem. Reduction of greenhouse gas emissions (GHG) was overestimated in the proposal, then new calculation parameters have been selected.

Action E2. It was foreseen two white papers and breakfast for members of the parliament (MEP) were organized by ASAJA. However, it was not possible, the first because under technical circumstances, the IBE-CNR has offered to do so because of the resent background and knowledge achieved during the trials performed in this project, which gave them the tools to put all the technical knowledge in a paper that can be used for different public. Secondly, besides the efforts of ASAJA's team, particularly of Jose María Castilla that is the ASAJA permanent representative in Brussels who was sending several emails and making phone calls to several MEPs it was not possible to arrange a day.

Organisational

Despite the amendments, there were no organizational changes in the companies that generated deviations, neither in technical nor administrative tasks.

Each organization has updated their task assignment documents in order to follow the entrance and exits of staff in its organization and taking into account their role. This includes the maternity leave in two particular occasions, one in Balam and the other in UCO, which both roles were substitute by another member.

Regarding a technical implementation in C2, several drone flights had been scheduled in Italy, which would be carried out byGREENFIELD. This implied the displacement of the technicians to carry out the flights in Traversagna – VF BERIO (Pisa). Subsequently, it has been decided to outsource an Italian company.This outsourcing has emerged as a much more sustainable alternative, since it implies savings in traveland maintenance expenses, which implies a reduction in the carbon footprint of the project due to a lower use of fuels. In addition, outsourcing of the service in Italy implies a greater manoeuvre to obtain drone flight permits, thus optimizing the process. Another advantage of carrying out such subcontractingis the possibility of adjusting the flight with greater precision in relation to weather conditions, since in certain conditions such as the occurrence of high-speed winds, drone flight is not possible. Thus, outsourcing allows the reprogramming of the flight at a much lower cost if the transfer of personnel from Spain had been made.

Financial

Changes in category costs for SAHC, GREENFIELD and VILLA FILLIPO BERIO, IBE CNR and UCO are reported in the financialparagraph (section 8). These changes did not incur a formal request for an amendment.

6.3. Evaluation of Project Implementation

Here below we report on the so far achieved results compared to the objectives and expected results. Under 6.4 we discuss the policy impacts of the project and how the project delivered the results foreseen in the Grant Agreement form B3.

Foreseen in the revised proposal	Achieved	Evaluation
A1 Selection and design of demonstration trials		
Objectives: • Determine baseline characteristics, soil and potential vector XF • Selection of measures to improve system productivity and sustainability	Yes Yes	The 3 demo areas were selected and characterized in term of soil and potential vector. The data obtained by the different methodology allowed design the treatments location in each farm and established the baseline to evaluate the impact of the measures proposed in action D1
Expected Results • Soil inventory (Baseline data study) • Inventory of presence of potential vector of XF • Measures to improve productivity and sustainability • Design of each demonstration trial	Yes Yes Yes Yes	Characterization of the 3 demo farms were realized for the different methodology: GREENFIELD prepared a base line of soil types in the three demonstration farms (SP, PT, IT) with all information provided by Map2soil methodology and lab analyses. In two farms (SP, IT) the soil variability was similar in PT la soil variability was very large. It allows design the treatments distribution implemented in C2. In addition to physicochemical soil analysis parameters, soil microbiological activity was determined as baseline for the Action D1. Fauna sampling was carried out in 3 demo farms (IT, PT, SP) by NUTRIPRADO. Within each area 3 different vegetation types were sampled and georeferenced for next monitoring in Action D1. 163 Nest boxes and hotel insects were selected as measures to improve and monitoring the impact in sustainability. All this information, compiled in a deliverable, allowed design the trials in each demonstration farm. The partners discussed the plan design during the SCM in Madrid (Jun 2019) until to get the final design.
A2. Training sessions and design of materials for demonstration trials		
Objectives: Design and share the practical and theoretical knowledges about XF and the sustainable model to implement during the project	Yes	The training for partners and staff took place on the 21 & 22 of January 2019 in Madrid by presentations. The theory was compiled in the deliverable after the meeting. The training continued with a visit to the demonstration sites where the methodologies were explained to all staff involve in the project. Additional trainings were carried out in each demo farm during the implementation and monitoring of the treatments.
Expected Results: • Staff trained on basic concepts of Xf fastidiosa • Staff trained on best practices to increase resilience • Staff trained on monitoring activities in D1	Yes Yes Yes	All the information about the XF basic concepts and different protocols were compiled in a single document (training materials), with as main purpose to have an easy access to the methodologies. In addition, this information was used in communication and dissemination material (leaflet, presentation, Manual of best practices, website…) to reach a wider audience interested in XF and sustainability practices.
C1. Development of disease-resistant olive varieties		
Objectives: Obtained 10-20 resistant olive varieties created and evaluated	Yes	18 potentially resistant new genotypes, which are derived from resistant cultivars to XF (‘Leccino’ and ‘Fs-17’), have been selected. UCO has implemented several complementary actions, in order to complete the evaluation of the selected genotypes. 4 new field trials, were planted (2 IT under infection condition, 1 IT and 1SP evaluating agronomical adaptation)

Expected Results: • Selection of olive parent with good agronomical characteristics and XF resistance • Good seed germination of the genotypes • New genotypes of the first stage (S.1.) of the Olive Breeding Program to develop new olive varieties resistant to XF • Appropriate growth in field and evaluation • Selection of 10-20 genotypes potentially resistant to XF	Yes Yes Yes Yes Yes	The breeding program of new varieties resistant to XF have been initiated and evolved successfully, improving the expectations from the experience in other improvement programs, mainly by shortening the times of each phase. 1000 genotypes were planted (2018 and 2019) after successful crosses conducted in 2017 and 2018. These genotypes growth in field properly and an and a plant and fruit exhaustive evaluation process (height, width, truck diameter, olive oil characteristic, fruit characteristic ..) was carried out during the consecutive years (2019, 2020, 2021, 2022). The 18 genotypes were selected and, after paternity tests by SSR DNA markers were carried out, were clonally propagated. The new plants generated were established in new 4 trials with replicates. In April 2022, 533 plants were delivered to Italy to evaluate the XF resistance in controlled condition (with bacterial inoculum) and in field under natural infection condition of XF.
C2. Demonstration in trial areas		
Objectives: Implement the integrated sustainable practices model to obtain farms resilient and sustainable.	Yes	Done through the implementation of the plan designed in A1 action, according to the methodologies shared in action A2. The success of this implemented model is ratified by the monitoring carried out in action D1
Expected Results: • Protocol and experimental method applied in 250 has. • Maintenance and regular control of farms for a good development of the project. • Treatments implementation: deficit irrigation, cover crops and improvement of soil health with biostimulants and microorganism	Yes Yes Yes	The sustainable practices model was implemented and improvement in 250ha (150 SP, 50 PT and 50 IT) for 3 years. To increase crop resilience in olive and almond production systems five treatments were implemented in each demo farm following the designed plan and methodology established in A1 and A2. The treatments (in term of dose, timing, and mode of application) were applied properly during 3 years with some consideration due to climate conditions. One of the key aspects was to continue managing the crop properly (soil, irrigation, pests, diseases, nutrition pruning and harvest) throughout the crop stage in all treatments, in order to correctly assess the impact of the proposed measures.
C3 Natural Vector Control Measures		
Objectives: Eco-friendly methods to control vector through sub-trials of organic and technological practices	Yes	More than 7 different trials were implemented in order to find eco-friendly methos to control vector3 of the evaluating alternative natural vector control under laboratory condition, 3 trials on farm to determinate the behaviour and distribution of XF vectors. Finally, a soil biological fertility trials was done in Spain and Portugal to improve plant growth and health.
Expected Results: • Trial with alternative Natural vector control measures • Mapping of vector behaviour and distribution • Functional biodiversity assessment and management • Audio Technology	Yes Yes Yes No	The trials allowed to obtain significant results about planted objectives as: the identification of the vector (*P. spumarius),* How to monitor vectors´presence, main problem associated to vector control and additionally, the role of the associated flora. An additional study to identify the importance of soil biological fertility for improving plant growth and health was evaluated. Participation in international conferences publishing 3 posters (as scientific publications)
C4 Replication Activities		
Objectives: Replication of Resilience model in at least 10 farms, to expand and transfer the knowledge to the sector as well as to accelerate market uptake and serve to enhance dissemination efforts.	Yes	13 replication sites in 3 countries: 7 in Spain, 1 in Italy and 5 in Portugal with replication agreements signed. These involved 1.861,90 ha in which the sustainable plan was implement during the last crop season of the project. These events provided a huge transfer of knowledge and awareness to civil society, expanding visibility over a remarkably wide Mediterranean territory; accelerated market uptake of the technology; and highly enhance dissemination efforts.

		Additionally, Italy reached 4 more farms adding 40 ha and a publication paper on remote sensing applications were published. Lastly, during the last year, 30 new farms (2.194 ha)signed the replication agreement letters to implement the model during After LIFE. In total 47 replication farms were achieved with 4.095,90 ha
Expected Results: • New best practices model implemented in 10 farms • Pre-analyse Sentinel satellite data of each replication site • Design of 10 specific management plan • Training sessions form replication partners • Technical Assistance • Discounted Materials • Replication and transfer plan for future uptake	Yes Yes Yes Yes Yes Yes Yes Yes	ASAJA organized previously different event to give visibility to the project and expand the replica farms. 13 replication farms were adhered and GREENFIELD pre-analysed with Sentinel satellite the farm. Moreover, the 4 new farms from Italy were also analysed.The management plans were designed with the help of partners. Training courses took place, where different stakeholders (NGOs, associations, landowners, government bodies, private companies, a.o.) got involved. In addition, technical assistance sessions, throughout the implementation of the designed plan, were done with the replication agents. All material is available on the project website to continuous transfer the ideas for future replications. New 30 farms were committed to implementing the model after life (2022-2026)
D1 Project performance indicators		
Objectives: • To monitor the project's results as it progresses. • To validate the expected project objectives as established in the Specific Indicators Table	Yes Yes	Periodic information was provided by each partner, which made it possible to monitor the progress of the project and record data to determine the specific indicators of the project.
Expected Results: • Technical monitoring report per partner • Specific Indicators Table	Yes Yes	All partners sent their monitoring information according to the database and forms provided, although some changes during the project were necessary. We have prepared some specific reports per some tasks. All the information required for completing the indicators table were provided. However, some aspects require a larger monitoring in order to detect significant changes (a.e. soil parameters).
D2 Conclusions and recommendations		
Objectives: To assess results against the original objectives and expectations of the project: 1) Evaluation of the overall project development 2) recommendation to ensure replicability and transferability. 3) Business plan.	Yes	Conclusions and recommendations made through the experience obtained on field trials and replications are provided on a specific deliverable
Expected Results: • Conclusions • Recommendations for replicability and transferability • Business plan	Yes Yes Yes	72 surveys were carried out to understand the initial socioeconomic relating to XF. Conclusions about Best practical model impact was evaluated. This model implementation allowed increase the soil health, plant resilience, sustainability and biodiversity of farms just we expect during the project. Water and Carbon footprints were reduced. The water consumption was reduced in 1.261.301,5 m3 (105.096,16 m3 by the demo farms and 1.156.205,34m3 by replication farms). The reduction of GHG emissions were estimated in 10.148,72 tons CO2eq (3,5687,7 tons CO2 eq. by the demo farms and 6.580,02 tons CO2 eq by replication farms) 17 replication farms were reached and other 30 replication farm were adhered to the after life plan. A business plan was developed
D3 Monitoring KPI´S		
Objectives: Monitoring what the Project achieved in relation to the original estimates	Yes	All the results evaluated with KPIs were achieved as planned except AWC (48% respect expected) and phytosanitary and fertilizer cost reduction (33% respect expected), apart from the GHG emission

		reductions, which were initially overestimates. Finally, the GHG emission were 3.568,7 eq tons CO2 by demo farms and 6.580,02 eq tons CO2 by replica farms.
Expected Results: • Updated LIFE KPI webtool • KPI Table and analysis of results achieved:	 Yes Yes	3 KPI analysis reports were sent throughout the project analyzing the achievements and the deviations found during its development.
E1 General Dissemination		
Objectives: to communicate the project outputs in an integral, transdisciplinary manner, to make the project concept visible beyond its local execution to a wide variety of possible audiences and to make it valuable after its set duration.		The dissemination pack, networking activities, liaisons with local stakeholders and broad dissemination activities have led to a significant list of LIFE projects, NGOs, companies, landowners and public authorities interested in applying the LIFE RESILIENCE model. Moreover, the concept became visible amongst international experts, farmers and local populations, also contributing to awareness on the importance of reforestation to combat climate change impacts.
Expected Results: • First inventory of related LIFE projects • Visits of other project participants to the test sites in Spain, Italy and Portugal • Workshops organized • Each partner has a project website linked to their website • 6 videos (1 introductory video, 5 local awareness videos)		All the project partners visited the different demonstration farms (SP, PT, IT). Due to restrictions by Covid19 not so many meetings could be held on site. Contacting with 17 other LIFE project 10 networking activities 5 workshops organized 11 technical seminars were held. Website traffic reaching 61.583 visits 74 videos were published on the project website, shared on the social network Youtube and sent to media specialised in the olive and almond sector.
E2 Information and awareness-rising for general public		
Objectives: Idem Action E1, complementing those efforts with planned events and activities.	Yes	Partners were very active in organising and visiting dissemination events and presenting project objectives and results. As a result, the project attracted the attention of various sectors and the number of attendees increased by every event, reaching in total over 1,140,200 people
Expected Results: • Presentations to interest groups or stakeholders at regional/national level • First technical seminar • Second technical seminar • Third technical seminar • Fourth technical seminar • Fifth technical seminar • Press releases and press publications • Presentations at international conferences • Fairs • Final conference • White paper	 Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes	BALAM organised several activities for education and research groups to learn about the Life Resilience project (+4000 people) The partners carried out several project´s presentations to stakeholders during the first year of the project: 32 presentations to interest groups or stakeholders (>7,000 people) 11 Technical seminars 75 press releases SP: 23, IT: 16, ENG: 20 and PORT:16 Total 292 Publications in local/national media: 13 partner web; 6 radio; 108 national press; 78 regional press; 55 specialized internet; 2 EU comission DG; 3 blog; 22 italian press; 5 portuguese press 4 Presentations at international conferences 5 fairs (>3,000 each) Final conference Presentation (19/05/2022) 135 attendees Monthly Newsletter sent White paper
F1 Project Management		
Objectives: • provide the overall coordination and management of project activities and financial control.	Yes	Project coordination was supported by a collaborative and proactive approach of partners and management was supported by satisfying tools and support provided by Teresa Carrillo. Results were satisfying.

• monitor, evaluate and enhance project progress towards objectives • assure communication and reporting to the project Monitor and EASME	Yes Yes	Regular contacts were maintained with the Monitor (Cristobal Ginés) by Teresa Carrillo on technical issues and by Kathy Franco on administrative issues. All monitoring visits were experienced as particular fruitful. Communication and reporting to the project Monitor (Cristobal Ginés) and EASME (Claudia Guerrini) it was as established with some delay in reporting, due to the big partnership and many activities to relate.
Expected results: • Compliant and smooth project execution • Reports: - Midterm Report - Progress Report - Final Report • Correctly reported project expenses • After-LIFE plan	 Yes Yes Yes Yes	Project execution went smooth, and difficulties could be faced with minor and effective deviations, that did not negatively affected expected results. Reports presented with some delay, due to the high number of partners that poses a major effort on merging information. Reporting of project expenses was a time-consuming effort for most partners. After-LIFE plan presented on time

6.3.1. Comparison of results achieved against the objectives.

Objective	
Foreseen in the proposal	**Achieved / Evaluation**
Evaluate and crossbreed **pathogen-resistantolive varieties** as resilient options for olive producers in potentially infected areas, **minimizing the risk of losses** due to XF andother pathogens. These new olive varieties can create different olive oils with new organoleptic qualities, **increasing the competitiveness in the sector.**	The selection of the olive cultivars acting as parents (genitors) in the breeding program was accomplished as first step of the project. The cultivars were selected according to their resistance to XF and positive agronomical characteristics. (6.202 harvested fruits). The crosses were done and the 2.481 seeds have germinated. Of which 1.000 seedlings were planted in El Valenciano in order to evaluate agronomical characteristics and resistance to XF.
Demonstrate **sustainable best practices and technologies** for intensive Mediterranean **olive and almond** production systems, on 250 ha in Spain, Italy and Portugal, that **lower their waterconsumption** and carbon footprint, **increase biodiversity** and resistance to pests/pathogens without compromising yield.	In order to increase crop resilience in olive and almond production systems. five treatments were implemented in each demo farm (150 ha SP, 50 ha IT and 50 ha PT) (action C2). The distribution of the treatments has been made based on results of physicochemical soil analysis and results of soil enzymatic activity, carried out in action A1.
Provide a **replicable model of best practices** forolive, almond, and other woody crops such as citrus and grapevine production systems in Europe, increasing their capacity to adapt to CC and future epidemics to be replicated ten-fold (2500 ha) during the project.	13 replication farm (1862 has) applied a sustainable management plan design with the lessons learned in action C2 and C3. 4 New farms were added in Italy (40 ha). 30 replication farms (2.194 has) are committed to implement sustainable management plans after-life. In total 47 replication farms were achieved with 4.095,90 ha
Involve multidisciplinary actors in transnational collaboration to provide **new prevention strategies and EU policies** for uptake.	37 technical meetings serving as platform to make synergies to prevent the spread of the XF in other areas, of which 8 are international conferences. Also, participation in 5 international agronomic fairs and the organization of the 5 technical seminars.
Expected Result	
Foreseen in the proposal	**Achieved / Evaluation**
Resilience & Sustainability	
Develop & test 10-20 new olive plant varietiesthat are XF-resistant and compatible with intensive production systems. Testing will takeplace in infected and non-infected regions.	1,142 genotypes were preselected and are being tested at El Valenciano farm and in total 1,000 seedlings were planted, 500 in 2018 and 500 in 2019. 18 genotypes were selected and, after paternity tests by SSR DNA markers were carried out, were clonally propagated. The new plants generated were established in new 4 trials with replicates. In April 2022, 533 plants were delivered to Italy to evaluate the XF resistance in controlled condition (with bacterial inoculum) and in field under natural infection condition of XF.
Demonstrate sustainable best practices and apply cutting-edge technologies that increase resilience of 150ha in Spain, 50 ha in Italy and 50 ha in Portugal (olive and almond)	5 different treatments in order to increase resilience are being tested among 3 demonstration farms, 150ha in Spain, 50 ha inItaly and 50 ha in Portugal

Increase in biodiversity by introducing auxiliary flora, and fauna via insect hotels and nest boxes	A mix of 7 species of cover crops were selectedand were sown in de demo farm. Insect hotels and nest boxes were installed with results of 100% of occupation
Reduction in GHG emissions of ~18.665 t of CO2 eq through reduced phytosanitary applications; decrease in water usage and tillage, and implementation of cover crops resulting in increased carbon fixation	Substitution of phytosanitary treatments, improved of water usage and cover crops were applied and will demonstrate the reduction of GHG emissions in the demo farms were of 3.557 tns of CO2 eq. The GHG estimated in replication sites was 6.580,02 tns of CO2 eq.
Reduction of vector insect population via natural vector control measures	In de action C3 several subtrials with alternative natural vector were studied
Trees will become healthier as phenolic compounds increase; low intensity water stress forces plants to become more vigorous, increasing resilience	Tree health are being evaluated in action D1. Considering different phenological stages (flowering, pit hardening, oil production initiation, pre-harvest, post-harvest)
A Handbook of Best-Practices including natural vector control measures will be created for replication and transfer of knowledge	A HANDBOOK of best practices has been developed and it is being distributed amongdifferent stakeholders. A WHITE PAPER with scientific, technical and practical knowledge about how management XF infection and the solutions was developed by IBE-CNR
Quality	
Maintaining/increasing quality by 30% (improved organoleptic & commercial quality) through improvement of soil & plant health and efficient use of phytosanitaries	Due to the application of sustainable practices such as the use of biostimulants increased phenolic compounds in olives (quality increase) around 15%.
20% reduction of water applied in olive fields will increase water stress on the field, causing the olive tree to produce a more concentrated fruit. A 10% decrease of water in the actual olive is expected, translating to less kg of olives transported. This results in diesel & CO2 savings. With lower H2O content the purity/quality of the end product will go up	A reduction of water of 105.096 m3 was reached in the demo farms. In the replica farms the water reduction was estimated in 1.156.205,34 m3 . The reduction of GHG emission due to the reduction of pumping is detailed in the 42. FR Annex 16
Socio-economic benefits	
13 farms preserved from XF infection, safeguarding jobs	In total 47 replication farms were achieved with 4.095,90 ha and through the project, 8 new jobs were created
60% decrease of production costs from savings on expensive inputs	The reduction of production costs was reduced but we but 60% was not reached
More than 1 million European farmers made aware of the environmental and economic effects of XF spread and what best practices can be applied	The consortium´s network has a direct line of communication with 1,140,200 farmers through various cooperatives and expressed support letters to which all the information that we have generated during the project has been sent

6.4. Analysis of benefits

6.4.1. Environmental benefits

a. Direct / quantitative environmental benefits:

The following direct environmental benefits are achieved:

- Increasing soil and therefore plant health. The project has demonstrated this achievement through the application of sustainable strategies and mainly thanks to the treatments that used biostimulants and cover crop. Soil chemical and biological parameters already improved during the relatively short duration of the project and the results of soil mycorrhizal potential and microbial biodiversity section showed that soil microbial communities differed in the two experimental years (2021 and 2022), with a higher abundance of bacterial species (S) and of dominant bacteria (H1 and H2) in cover crops samples than in control ones. By contrast, soil fungal communities showed a higher richness of species in control soil samples, compared with those of cover crops. Increment of soil microbiological activity due to an increment in soil enzimes as ß-Glucosidasa y DHA in treatments were bioestimulants were applied (T1 and T4). Consequently, an improvement in soil fertility was observed as expected. Soil microbiological activity and fertility improvement increased soil-plant resiliency.

	New Genotypes_XF Resistant	Regulated Deficit Irrigation	Bioestimulant	Cover crop	Control Insect Vector
Environmental Impact					
Biodiversity increase	●		●	●	●
Increase plant resilience	●		●	●	
Improved soil health	●		●	●	
Improved plant health	●		●		●
Water footprint reduction	●	●			
Carbon footprint reduction		●	●	●	
Control diseases	●			●	●
Control pests	●			●	●
Economic Impact					
Increase in final product value		●	●		
Reduction of input costs		●	●	●	●
Labor cost reduction		●	●	●	
Obtaining high value product	●	●	●	●	●
Recovery affected area	●			●	●
Sale of new genotypes	●		●	●	

- The selection of the resistance varieties to XF.
  UCO is the First genetic improvement program with the aim of obtaining a resistant variety and thanks to this project it has selected 18 new genotypes based of the agronomic characteristic evaluated. Among these particularities, the following stand out: Early production, High quality of oils, Low alternace in the production and Adaptation to different farming systems, from an intensive system to super- intensive systems. In other words, from plantations of 200 trees/ha to plantations of more than 2,000 trees/ha, depending on the new variety chosen, since several are being developed. The target public, with the acquisition of these varieties, intends to avoid any future problem related to Xf.
- Best agricultural practices, such as manual pruning, auxiliary nest boxes, sustainable irrigation, use of bioestimulant and cover crops, have demonstrated, that have an import environmental benefit in term of resilience, sustainability and biodiversity. Application of the innovative natural control methods have allowed a mapping the vector behaviour and distribution of this insect for a better control of the insect vector, demonstrating their efficacy in preventing the negative effects of XF in Mediterraneancountries.
- Lower crop water consumption and carbon footprint. Due to deficit irrigation practices in all demo areas, we had better quality olive oil (+ 15%), increasing the concentration of anti-oxidants. In addition, deficit irrigation practices allow reduce the water footprint. In the demonstration farms a reduction of 105.096,16 m^3 have been achieved. The replication farms also have been applied deficit irrigation. The water saving for replication farms was estimated considering the results achieve in the demo farms and the replication design management plans. A reduction of 1.156205,34 m^3 of water were estimated in the replication farms. The total saving water of the project was estimated in 1.261.301,5 m^3. Additionally, this efficient use of water allows decrease the use of phytosanitary and mineral fertilizers products and reduce the GHG emissions in the pumping station.
  The carbon footprint also was reduced with the implementation of the project. The deficit irrigation practices and the bioestimulant and cover crop have contributed to reduce in demo farms 3.568,7 ton CO_2 eq. The estimation of reduction in CO_2 in replica farms was of 6.580,02 CO_2 eq, which supposes a reduction of GHG emission during the project of 10.148,72 CO_2 eq,
- Increase biodiversity using cover crops to attract beneficial fauna (higher presence of natural vector controllers) predators while at the same time improving soil quality (N and organic matter

content), which in turn leads to lower requirements for chemical fertilizers. During the project we decrease the chemical fertilizers, tractor pass, increased the auxiliar fauna and flora which has been reflected in the improvement of biodiversity both on the ground and on the farms.

It should be acknowledged that most of the environmental benefits of this project can only start to be visible after several years from project implementation. This is especially the case for soil improvements, biodiversity and carbon fixation. However, slight improvements have been achieved in some indicators as a consequence of the application of cover crops and bioestimulant.

b. Qualitative environmental benefits

The effort to implement sustainable measures on demo and replica farms is aimed at obtaining the following qualitative environmental benefits besides the benefits mentioned here above.

- Increase in biodiversity by introducing auxiliary flora, and fauna via insect hotels and nest boxes.
- Due to reduced phytosanitary applications; decrease in water use and tillage, and implementation of cover crops resulting in increased carbon fixation. An important reduction of GHG emissions of CO_2 equivalent were archived (10.148,72 CO_2 eq).
- We have aroused interest in farmers regarding the use of measures to increase the resilience of the agricultural system. These measures can directly influence the environment, such as promoting an increase in biodiversity through the installation of nest boxes.
- An interest in improving soil health has been generated in recent years. When the project began, the use of microorganisms and biostimulants was unknown for the farmers and there was no European regulatory in this regard. However, the health of the soil has become one of the priorities of the sector.
- All these environmental benefice aims to mitigate the CC and the adaptation of the crop a this situation of CC.

6.4.2. Economic benefits

- Production costs have been reduced with the implementation of the sustainable measures in the 3 demo farms since we are using less water, fertilizers and other inputs as machinery fuel. The economic saving was increase when were incorporate 1862 has with the 13 replication farms.
- 8 Jobs created: BALAM, ASAJA, AGRIFOOD, SACH, UCO and GREENFIELD hired additional qualified staff to perform several technical or financial tasks in the project. All partners hired external labor force.
- Thanks to dissemination activities we have now reached more than 1,140,200 people and at the endwe expected to have around 1 million European farmers are aware of the environmental and economic effects of XF spread and what best practices could be applied in order to avoid XF dissemination

6.4.3. Social benefits

- By implementing the project at full scale, environmental awareness is increasing. Through training and positive incentives, the mentality of workers was influenced in a constructive way. In fact, after the training sessions in the demo farms, a change of mentality was perceived among the attendees regarding the implementation of more sustainable agricultural practices. Similar response was perceived in the dissemination and transfer sessions as well as in the training for the replica farms
- The implementation of the project had created an increment in job recruitment. Following the dissemination actions of the project, interest in farmers not linked to the project on the management of cultivation with sustainable practices and the impact it may have on small regional farms has been aroused.

6.4.4. Replicability, transferability, cooperation:

- **Replicability:** Replication results achieved yet during the project exceeded the original expectation. 13 replication sites (1862 has) were included like replications and a management best practices plan was implemented in each one. The model was implemented in other woody crops such as citrus and grapevine production systems in Europe, increasing their capacity to

adapt to CC and future epidemics. 4 additional replication farm (40 ha) evaluated NDVI with the innovative technology by GREENFIELD and CNR. Replication, networking and dissemination activities led activate the interest of a wide variety of stakeholders: farmers, cooperatives, associations, industry and even government. Additionally, 30 new adhesions of replica farms (2.194 has) were signed for the implementation of the model in an after-project period.

- **Transferability**: Working Groups organized by COPA-COGECA (European agricultural lobby), the Life Project consortium, through ASAJA (full member), has presented the Project from its birth to all the achievements obtained so far. In fact, as the XF is a transversal theme, the presentations have taken place in the following Working Groups (WG):
  - -WG Olive Oil and Table Olives
  - -WG Wine
  - -WG Phytosanitary Issues

  The consortium has shared information with other international experts and European projects regarding sustainability in olive and almond production, such as (H2020) XF-ACTORS and (H2020) POnTE. The first, Xylella Fastidiosa Active Containment Through a multidisciplinary-Oriented Research Strategy is the first project in Europe devoted to researching the bacterium XF. Their view backed strongly by the results of their research, whichwill be further used for uptake in Action A.1 is that "Successful XF disease management must use an integrated strategy. Exclusion and avoidance of the pathogen, cultural practices, controlof insect vectors and disease resistance are some of the control measures." The second, (H2020)POnTE, Pest Organisms Threatening Europe. This project focuses on minimizing the risk of introduction/impact of emerging pests threatening EU agriculture and forestry. One of their 3 targets is XF. Potential uptake includes their future results on biological control agents of vectors.

  Life Project, through ASAJA, has also been presented to the European Commission's Directorate-General for Agriculture in the Civil Dialogue Group on Olive Oil and Table Olives before the entire value chain, that is, DG Agriculture officials, producers, cooperatives, processors, oil mills, traders, consumer organisations and NGOs.

  Fairs, presentation at international conferences, press releases, technical seminar, website, social media and other communication and dissemination activities have been allow give visibility to the project and transfer the scope achieved in it.

- **Cooperation:** The consortium has participated in 10 networking activities to inform and raise awareness among other projects and has contacted with other 17 LIFE projects during the big event organized by **LIFE SAHARA in Madrid.** We updated information in the **Climate ADAPT platform**.

6.4.5. Best Practice lessons:

We were developed a guideline of best practices on how to increase the resilience of the system applying sustainable strategies. A HANDBOOK of best practices has been developed (4 languages) and it is beingdistributed among different stakeholders.

The **White paper** "Sustainable practices to prevent the impact of XF in intensive systems" informing to farmers and general public about the problems in the management of Xf infection and the solutions offered thanks to the results generated in this project.

The staff farm directly involved in the project attended to the training sessions in Spain, Italy and Portugal, Theoretical concepts were transferred during a morning session where 3 chapters were revised session by session. In addition, we toured the farm to determine in-situ the location of each of the strategies proposed. On the ground, the guidelines for implementing all measures were set. At this time we had the opportunity to review with the staff the protocols to be carried out. Some additional training sessions will be required at the time of implementation of the measures to those workers directlyinvolved to guarantee that everything is executed as proposed.

ASAJA organized several training replication sessions where a large part of its associates was able to access all the information generated in the project.

6.4.6. Innovation and demonstration value:

The main goal of the project is to promoting practices that maximize the agricultural system resilience. The consortium believes that minimize the possible impact of XF entry in currently non-infected areas at risk by increasing the plant and ecosystem's resilience and self-defense. Since the entry of this pathogen in the rest of Mediterranean is seen as very likely and difficult to contain, practices demonstrating that these farms can be fortified by ecosystem-based, input-optimized approaches will be crucial.

The novel aspects of the project that are being applied during this period are:
Development of resistant olive varieties (UCO); since the beginning of the project UCO is assessing several parent plants and seed germinated in order to obtain new disease-resilient and productive plant varieties. 18genotypes were selected and is evaluated on a precommercial scale in the After LIFE period.
Implementation of best practices (BALAM): the establishment of the trials in action C2 will led usto provide the entire 'package' for building resilience in Mediterranean intensive olive production with stronger varieties for cultivation and a set of management practices that benefit the system in its defence against pests and pathogens
Using innovative precision agriculture technologies (GREENFIELD): GREENFIELD has developed the M2S (Map2Soil) system which allows soil characterization on an agricultural plot from a resource management and makes more effective management decisions. GREENFIELD also has state-of-the-art technology for early detection of the disease in the crop through the use of drones equipped with thermographic and multispectral sensors.

6.4.7. Policy implications:

Life RESILIENCE is aligned with the main challenges of different EU Strategies, especially with the EU Strategy on Adaptation to CC and the specific legislation about Plant Health and Biosecurity (Directive 2000/29/EC) through preventive measures and control of the spread of XF. The obtention of new olive varieties resilient to future plagues, which may be intensified by CC, is an of these measures. Other activities of the sustainable measures plan of this project have an impact in several European police priorities, as set out below.

Introducing auxiliary flora and fauna through nest boxes and cover crops to balance population control is contributing to achieve several targets (1, 2, 3 and 6) of EU Biodiversity Strategy to 2020. Other activities as is the use of biostimulants to improving soil and plant health are closely linked to the Soil Thematic Strategy. With measures in addition to improve farm biodiversity and soil health, we are reducing the use of chemical phytosanitary products which has a very positive impact on the reduction of GHG emissions. A regulated deficit irrigation strategy contributes on the one hand to the Resource Efficient use, not only by reducing water consumption but also GHG emissions, because of reducing the energy required for water pumping. Furthermore, it has been proven that a controlled water stress influences the final product quality.

To date, different tasks were undertaken thought the implementation actions that are also contributing to the European Green Deal Strategy: we are focusing on a minimal use of chemical phytosanitary products and fertilizers, improving soil health through good management practices, implementing biological control of pests and diseases, arising efficient use of resources like the use of water, implementing green infrastructure in agricultural fields, sowing cover crops, in consequence achieving reduction in GHG emissions.

However, we are still in the learning process of how to minimize seedling infection and propagation. We are aware of the potential risk of transporting plants and the phytosanitary certificate that is needed. For now, we follow the communication from the EU: "COMMISSION IMPLEMENTING DECISION (EU) 2015/789 OF 18 MAY 2015 Commission Implementing Decision (EU) 2015/789 of 18 May 2015 as regards measures to prevent the introduction into and the spread within the Union of Xylella fastidiosa (Wells et al.) (notified under document C (2015) 3415)

LIFE RESIENCE activities allow farmers to adapt to the new demands of modern agriculture, such as

compliance with the United Nations Sustainable Development Goals (SDGs). Best sustainable practices promote the achievement of the SDGs, such as the use of natural methods to control vector insects, the application of irrigation strategies that reduce water consumption and the implementation of cover crops that increase fixation. of carbon" in addition to being a project that gives value to alliances between companies, farmers' associations, universities and research centers.

7. Key Project-level Indicators

COMPOUND CONTEXT	CONTEXT ITEMS	INDICATOR HIERARCHY	INDICATOR CODE	INDICATOR NAME	FIRST LEVEL DESCRIPTOR	FORESEEN VALUE	END VALUE	UNIT	Explanation of differences
Increasing crop resilience against XF through sustainable best practices and technologies	[ES/ES6/ES61/ES618, ES/ES5/ES52/ES521, ES/ES4/ES41/ES412, ES/ES4/ES43/ES431, ES/ES4/ES43/ES432, IT/ITI/ITI1/ITI17, IT/ITI/ITI1/ITI1A, IT/ITG/ITG1/ITG17, PT/PT1/PT18/PT186, PT/PT1/PT18/PT184]	Key Performance Indicators Hierarchy 2016-2017	1.5	Project area/length	Conservation or improvement of the status of an area or segment	250	2.154,8	ha	At the beginning of the project, only the surface from the demo farms was considered. However, the replication activities have had great weight in the project and are considered as "project area" - Demo farms: 250 ha agricultural land under sustainable management - Replica farms: 1862 ha agricultural land under sustainable management - Replication Farm NDVI methodology treatments: 40 ha - Xylella fastidiosa genotypes evaluation trial: 2,8 ha
Increasing crop resilience against XF through sustainable best practices and technologies	[ES/ES6/ES61/ES618, ES/ES5/ES52/ES521, ES/ES4/ES41/ES412, ES/ES4/ES43/ES431, ES/ES4/ES43/ES432, IT/ITI/ITI1/ITI17, IT/ITI/ITI1/ITI1A, IT/ITG/ITG1/ITG17, PT/PT1/PT18/PT186, PT/PT1/PT18/PT184]	Key Performance Indicators Hierarchy 2016-2017	1.6	Humans (to be) influenced by the project	Persons whose lives were directly, positively impacted by MAIN envir. actions of project - see Guide	This indicator was not contemplated at the beginning of the project	121.008	Number of residents within or near the project area	Indicator not estimated at the beginning. The expected impact could only have been considering individuals from the demonstration farms. However, the population where the activities were implemented have had a benefit in terms of sustainability and biodiversity.
Increasing crop resilience against XF through sustainable best practices and technologies	[ES/ES6/ES61/ES618, ES/ES5/ES52/ES521, ES/ES4/ES41/ES412, ES/ES4/ES43/ES431, ES/ES4/ES43/ES432, IT/ITI/ITI1/ITI17, IT/ITI/ITI1/ITI1A, IT/ITG/ITG1/ITG17, PT/PT1/PT18/PT186, PT/PT1/PT18/PT184]	Key Performance Indicators Hierarchy 2016-2017	1.6	Humans (to be) influenced by the project	Persons who changed their behaviour or practices due to the project actions	This indicator was not contemplated at the beginning of the project	21	Number of residents within or near the project area	The owners of farms where agricultural practices have been modified towards a model of good practices have been taken into account for this indicator. This implies demo farm owners (3) and replica farm owners (18)
Demo farms	[IT/ITI/ITI1/ITI17, PT/PT1/PT18/PT186, ES/ES6/ES61/ES618]	Key Performance Indicators Hierarchy 2016-2017	2.3.5.3	Water consumption for production	The project's environmental or climate action outcomes linked to its main objective	8,30	5,56	m3/unit produced	Initially for this indicator it was estimated (0,12 kg/m3) which is equal to 8,3 m3/kg. The estimated value has been improved thanks to the RDI strategy, since less water consumption has been required to obtain the same production.

Demo farms	[IT/ITI/ITI1/ITI17, PT/PT1/PT18/PT186, ES/ES6/ES61/ES618]	Key Performance Indicators Hierarchy 2016-2017	2.3.5.3	Water consumption for production	The project's environmental or climate action outcomes linked to its main objective	17.000	17.000	(number of units produced or measure of services provided) /year	The value at the end of the project has remained as expected. Since none of the implemented strategies have reduced production and instead have obtained significant environmental and economic benefits.
Increasing crop resilience against XF through sustainable best practices and technologies	[ES/ES6/ES61/ES618, ES/ES5/ES52/ES521, ES/ES4/ES41/ES412, ES/ES4/ES43/ES431, ES/ES4/ES43/ES432, IT/ITI/ITI1/ITI17, IT/ITI/ITI1/ITI1A, IT/ITG/ITG1/ITG17, PT/PT1/PT18/PT186, PT/PT1/PT18/PT184]	Key Performance Indicators Hierarchy 2016-2017	9.1	Adaptation area	Adaptation area	This indicator was not contemplated at the beginning of the project	2.154,8	ha	Although this indicator was not considered at the beginning of the project, the values obtained have been much higher than expected. As in indicator 1.5, both the demo and replica farms have carried out practices that have allowed them to adapt to the new climate change conditions.
Communication and dissemination	[ES, IT, PT]	Key Performance Indicators Hierarchy 2016-2017	10.2	Involvement of non-governmental organisations (NGOs) and other stakeholders in project activities	Public body/bodies	5	79	number of stakeholders involved due to the project	This indicator has evolved better than expected. Thanks to the involvement of the partners,relevant skateholders to provide climate resilience agriculture strategies have been contacted to provide climate resilience agriculture strategies of the project. At least 4 research groups; 9 national - regional and local authorities in agriculture; 12 university departments of forestry, agriculture, environmental sciences, phytopathology and entomology; 45 farmers associations and cooperatives; 5 NGOs and international organisations for agriculture, food security; 4 policy makers and members of the European Parliament.
Communication and dissemination	[ES, IT, PT]	Key Performance Indicators Hierarchy 2016-2017	11.1	Website (mandatory)	No. of unique visits	15.500	11.787	Number of unique website visits	Number of unique visits (11.787) to the website have been slightly lower than expected. On the other hand, the dissemination effort on social networks has been greater than expected, being a tool that is increasingly used in relation to the website.
Communication and dissemination	[ES, IT, PT]	Key Performance Indicators Hierarchy 2016-2017	11.2	Other tools for reaching/raising awareness of the general public	Number of different displayed information created (posters, information boards)	20	41	Number of outcomes (e.g. nr of reports, events, etc)	A total of 41 outcomes in term of posters (4), notice boards (12) and display (25) were created during the project, 21 more than expected.

Communication and dissemination	[ES, IT, PT]	Key Performance Indicators Hierarchy 2016-2017	11.2	Other tools for reaching/raising awareness of the general public	Number of events/exhibitions organised	35	12	Number of outcomes (e.g. nr of reports, events, etc)	Partners organised 11 technical seminars (four face-to-face in Italy, Malaga Portugal and seven online between 2020 and 2022) and 1 final conference.This value has been lower than expected, mainly due to the difficulty of organizing events during the COVID-19 period.
Communication and dissemination	[ES, IT, PT]	Key Performance Indicators Hierarchy 2016-2017	11.2	Other tools for reaching/raising awareness of the general public	Other distinct media products created (e.g. different videos/broadcast/leaflets)	20	3.083	Number of outcomes (e.g. nr of reports, events, etc)	Life Resilience project published a total of 74 videos on its social network Youtube and more then 3.009 (4 lenguages). This indicator was underestimated at the beginning of the project.
Communication and dissemination	[ES, IT, PT]	Key Performance Indicators Hierarchy 2016-2017	12.1	Networking (mandatory)	Members of interest groups / lobby organisations	255	27	No. of individuals	The consortium has participated in 10 networking activities and has contacted with 17 other LIFE projects. We have not achieved the initial purpose but now we understand that the indicator was overvalued
Communication and dissemination	[ES, IT, PT]	Key Performance Indicators Hierarchy 2016-2017	13	Jobs	Jobs	5	3,5	No. of FTE	For the Project 3,5 FTE roles have been created. 9 roles have dedicated in average 47% of the total worked time to the project.
Increasing crop resilience against XF through sustainable best practices and technologies	[ES/ES6/ES61/ES618, ES/ES5/ES52/ES521, ES/ES4/ES41/ES412, ES/ES4/ES43/ES431, ES/ES4/ES43/ES432, IT/ITI/ITI1/ITI17, IT/ITI/ITI1/ITI1A, IT/ITG/ITG1/ITG17, PT/PT1/PT18/PT186, PT/PT1/PT18/PT184]	Key Performance Indicators Hierarchy 2016-2017	14.1	Running cost/operating costs during the project and expected in case of continuation/replication/transfer after the project period	Running cost/operating costs during the project and expected in case of continuation/replication/transfer after the project period	2.968.675	2.566.421	€	Total Consolidated costs of the projects was 2.566.421€, slightly lower than expected but the activities have been carried out as planned with slight variations that have not affected the development and achievement of the project's objectives
Communication and dissemination	[ES, IT, PT]	Key Performance Indicators Hierarchy 2016-2017	14.3	Future funding	Beneficiary own contribution	This indicator was not contemplated at the beginning of the project	500.000	€	The beneficiary plans a budget of 500.000 t€o continue evaluating with the UCO the new varieties resistant to XF until they are commercialized.

Increasing crop resilience against XF through sustainable best practices and technologies	[ES/ES6/ES61/ES618, ES/ES5/ES52/ES521, ES/ES4/ES41/ES412, ES/ES4/ES43/ES431, ES/ES4/ES43/ES432, IT/ITI/ITI1/ITI17, IT/ITI/ITI1/ITI1A, IT/ITG/ITG1/ITG17, PT/PT1/PT18/PT186, PT/PT1/PT18/PT184]	Key Performance Indicators Hierarchy 2016-2017	14.4.3	Entry into new geographic areas	PORTUGAL				
Increasing crop resilience against XF through sustainable best practices and technologies	[ES/ES6/ES61/ES618, ES/ES5/ES52/ES521, ES/ES4/ES41/ES412, ES/ES4/ES43/ES431, ES/ES4/ES43/ES432, IT/ITI/ITI1/ITI17, IT/ITI/ITI1/ITI1A, IT/ITG/ITG1/ITG17, PT/PT1/PT18/PT186, PT/PT1/PT18/PT184]	Key Performance Indicators Hierarchy 2016-2017	14.4.3	Entry into new geographic areas	ESPAÑA (SPAIN)				
Increasing crop resilience against XF through sustainable best practices and technologies	[ES/ES6/ES61/ES618, ES/ES5/ES52/ES521, ES/ES4/ES41/ES412, ES/ES4/ES43/ES431, ES/ES4/ES43/ES432, IT/ITI/ITI1/ITI17, IT/ITI/ITI1/ITI1A, IT/ITG/ITG1/ITG17, PT/PT1/PT18/PT186, PT/PT1/PT18/PT184]	Key Performance Indicators Hierarchy 2016-2017	14.4.3	Entry into new geographic areas	ITALIA (ITALY)				
Increasing crop resilience against XF through sustainable best practices and technologies	[ES/ES6/ES61/ES618, ES/ES5/ES52/ES521, ES/ES4/ES41/ES412, ES/ES4/ES43/ES431, ES/ES4/ES43/ES432, IT/ITI/ITI1/ITI17, IT/ITI/ITI1/ITI1A, IT/ITG/ITG1/ITG17, PT/PT1/PT18/PT186, PT/PT1/PT18/PT184]	Key Performance Indicators Hierarchy 2016-2017	14.4.3	Entry into new geographic areas	ΕΛΛΑΔΑ (ELLADA)				

8. Comments on the financial

8.1. Summary of Costs Incurred

The cost incurred has been the 86% of the total budget established in the initial proposal. The most important deviation corresponds to the equipment line.

PROJECT COSTS INCURRED				
	Cost category	Total Budget according to the grant agreement in €*	Costs incurred within the reporting period in €	%**
1.	Personnel	1.727.874	1,723,734.78	100%
2.	Travel and subsistence	161.982	50,426.60	31%
3.	External assistance	506.000	454,027.59	90%
4.	*- Infrastructure sub-tot.*	0,00	-	-
	- Equipment sub-tot.	166.616	29,415.55	42%
	- Prototype sub-tot.	4.850	-	0%
5.	Consumables	147.480	96,492.44	65%
6.	Other costs	65.950	44,427.11	67%
7.	Overheads	187.923	167,896.68	89%
	TOTAL	2.968.675	2,566,420.74	86%

8.2. Estimation of person-days used per action

Action Type	Original budgeted person-days	Estimated % of person-days spent
A.1 Selection and design of demonstration trials	250,00	79.30%
A.2 Training sessions and design of materials for demonstration trials	242,00	96.65%
C.1 Development of disease-resistant olive varieties	1.076,00	106.37%
C.2 Demonstration in trial areas	3.948,00	72.57%
C.3 Natural vector control measures	897,00	81.93%
C.4 Replication activities	1.053,00	78.96%
D.1 Project performance indicators	1.033,00	66.55%
D.2 Conclusions and recommendations	180,00	113.19%
D.3 Monitoring KPI's	6,00	139.58%
E.1 General Dissemination	820,00	90.71%
E.2 Information and awareness-raising for general public	948,00	84.36%
F.1 Project Management	1.291,00	99.36%
TOTAL	**11.744,00**	**82.88%**

8.3. Summary of costs per action

Final Table

Action no.	Short name of action	1. Personnel	2. Travel	3. External assistance	4.a Infra-structure	4.b Equipment (ELIGEBLE Depreciated)	4.c Prototype	5. Purchase or lease of land	6. Consumables	7. Other costs	TOTAL
A.1	Selection and design of demonstration trials	32,390.20 €	2,210.90 €	35,802.50 €	0.00 €	10,275.65 €	0.00 €	0.00 €	4,846.80 €	301.08 €	85,827.13 €
A.2	Training sessions and design of materials for demonstration trials	34,284.47 €	6,130.80 €	0.00 €	0.00 €	0.00 €	0.00 €	0.00 €	0.00 €	0.00 €	40,415.27 €
C.1	Development of disease-resistant olive varieties	271,102.52 €	7,427.32 €	39,000.00 €	0.00 €	285.77 €	0.00 €	0.00 €	8,710.34 €	6,576.91 €	333,102.86 €
C.2	Demonstration in trial areas	382,034.63 €	2,236.12 €	174,454.36 €	0.00 €	14,695.94 €	0.00 €	0.00 €	69,892.25 €	1,718.79 €	645,032.08 €
C.3	Natural Vector Control Measures	126,059.47 €	3,598.54 €	42,700.00 €	0.00 €	0.00 €	0.00 €	0.00 €	1,051.64 €	0.00 €	173,409.65 €
C.4	Replication Activities	156,597.07 €	351.88 €	23,850.00 €	0.00 €	0.00 €	0.00 €	0.00 €	0.00 €	2,465.10 €	183,264.05 €
D.1	Project performance indicators	115,579.00 €	876.94 €	5,631.50 €	0.00 €	4,158.19 €	0.00 €	0.00 €	6,715.85 €	0.00 €	132,961.48 €
D.2	Conclusions and recommendations	41,181.54 €	40.00 €	4,990.00 €	0.00 €	0.00 €	0.00 €	0.00 €	0.00 €	1,815.00 €	48,026.54 €
D.3	Monitoring KPI´s	1,171.60 €	40.00 €	0.00 €	0.00 €	0.00 €	0.00 €	0.00 €	0.00 €	0.00 €	1,211.60 €
E.1	General Dissemination	138,296.76 €	1,763.02 €	6,781.11 €	0.00 €	0.00 €	0.00 €	0.00 €	4,066.31 €	4,285.68 €	155,192.88 €
E.2	Information and awareness-raising for general public	163,256.30 €	5,003.07 €	20,095.61 €	0.00 €	0.00 €	0.00 €	0.00 €	1,141.85 €	25,881.97 €	215,378.80 €
F.1	Project Management	261,781.22 €	20,748.01 €	100,722.51 €	0.00 €	0.00 €	0.00 €	0.00 €	67.40 €	1,382.58 €	384,701.72 €
										Over-heads	167,896.68 €
	TOTAL	1,723,734.78 €	50,426.60 €	454,027.59 €	0.00 €	29,415.55 €	0.00 €	0.00 €	96,492.44 €	44,427.11 €	2,566,420.74 €

9. Annexes

Complete list of documents sent in with final report. (MR -Midterm report, PR -Progress report, FR -Final report)

Deliverable (30)

1. MR Annex 01_ Deliverable F1_Signed Partnership Agreement (BALAM)
4. MR Annex 05_Deliverable A1_Report "Demonstration areas: Inventory & Design plans"
11. MR Annex 10_Deliverable A2_Training course material
12. MR Annex 11_Deliverable A2_Signed Attendance List of Training Courses
14. MR Annex 13_Deliverables C1_Report on the selection of parent plants and seed germination
15. PR Annex 01_Deliverable C1_Report on results of forced growth in environmental chamber
16. FR Annex 02_Deliverable_C1 Report on field trials new genotypes
21. PR Annex 02_Deliverable C2_Yearly report on activities in demonstration sites Year 1
22. PR Annex 03_Deliverable C2_Yearly report on activities in demonstration sites Year 2
23. FR Annex 05_Deliverable_C2 Yearly report on activities in demonstration sites Year 3
28. PR Annex 05_Deliverable C4. Manuals for replication training
30. FR Annex 10_Deliverables C4 Design of replication site management plans
35. MR Annex 16_Deliverable D1_LIFE Project Specific Indicators
38. PR Annex 07_Deliverable D1. Life Project Specific Indicators Table sent in with Progress Report
39. FR Annex 15_Deliverable D1 Life Project Specific Indicator Table sent in with FR
42. FR Annex 16_Deliverable D2 Carbon Footprint Assessment
43. FR Annex 17_Deliverable D2 Water Footprint Assessment
44. FR Annex 18_Deliverable D2 Conclusions and Recommendations report
45. MR Annex 21_Deliverable D3_KPI Analysis (Table)
46. PR Annex 08_Deliverable D3. KPI Analysis Table sent in with Progress Report
47. FR Annex 21_Deliverable D3. KPI Analysis Table sent in with Final Report
48. MR Annex 22_Deliverable. E1_Report on website launch (Agrifood)
49. MR Annex 23_Deliverable E1_Report on placing of LIFE Information Boards (Agrifood)
50. MR Annex 24_Deliverable E1_General public leaflets SP, IT, PT, ENG
51. FR Annex 22_Deliverable E1 Layman's Report (EN, SP, IT and PORT)
52. FR Annex 23_Deliverable E1_General public leaflets SP, IT, PT, ENG logos updated
53. FR Annex 24_Deliverable F1 After Life Plan
60. FR Annex 31_Deliverable E2 Presentations at national and international conference proceedings
61. FR Annex 32_Deliverable E2 Press recognition portfolio
57. FR Annex 28_Deliverable C3 Best Practices Handbook with updated partner logos (ESP, ENG, IT, PORT)

Technical Annexes (36)

2. FR Annex 01: F1Minutes of 14 SCMs
3. FR Annex 02: F1Responses of Commission Letters
5. MR Annex 06: A1 Baseline data El Valenciano farm, Spain
6. MR Annex 07: A1 Baseline data Charqueirao farm, Portugal
7. MR Annex 08: A1 Baseline data La Traversagna farm, Italy
8. MR Annex 09: A1 Technical monitoring report part 1
9. FR Annex 03: A1 Cover Crop Mixtures& Insect vector evaluation Nutriprado
10. FR Annex 04: A1 Nest boxes and insect hotels. Design and Evaluation
13. MR Annex 12: A2 Leaflets Training Course
17. FR Annex 05:C1 Contract signed with external company for shipment trials in Italy
18. FR Annex 06:C1 Market Study New cultivars resistant to Xylella fastidiosa
19. FR Annex 07:C1 UCO and BALAM agreement 10 years after Life-Resilience
20. MR Annex 14: C2 Wind power regulation in Spain
24. PR Annex 04:C3 two posters during the 3rd European conference on Xylella fastidiosa 04/2021 ("Atrractiveness of different colored sticky traps for spittlebug vectors of Xylella fastidiosa" and "Response of Philaenus spumarius and Neophilaenus campestris to potential semiochemicals".

25. MR Annex 15: C3 Poster international conference (Italy) & book of abstract
26. FR Annex 08:C3 Subtrials with alternative natural vector control measures
27. FR Annex 09:C3 Collaboration-IBE-UNIPI
29. PR Annex 06:C4 13 Signed Agreement Replication
31. FR Annex 11:C4 Training for replication (ASAJA)
32. FR Annex 12:C4 30 Signed replication contracts AFTER LIFE
33. FR Annex 13:C4 Preliminary characterization of AFTER LIFE replication farms
34. FR Annex 14:C4 2 papers_Cantini et al. Vegetative mapping remote sensing
36. MR Annex 17: D1 Protocol for measuring indicators established
37. MR Annex 18: D1 Report on technical meetings
40. FP Annex 38: D2 Surveys IT, SP, PT- ASAJA Life Resilience
41. FP Annex 39: D2 Survey Analysis
45. FR Annex 19: D2 Consultations with at least 1 governmental institution and 1 relevant NGO to compile policy review.
46. FR Annex 20: D2 Business Plan Developed
54. FR Annex 25: E1 Stakeholders interested in the project
55. FR Annex 26: E1 2 Networking report with other projects
56. FR Annex 27: E1 3 European Climate Adaptation Platform Climate-ADAPT
58. FR Annex 29: E1 8 Videos shared on Youtube about the Life Resilience project
59. FR Annex 30: E1 9 Project commitment to the SDGs 2030
63. FR Annex 35: E2 Information and awareness-raising for the general public and technical/scientific audience
64. FR Annex 36: E2 Final conference materials
65. FR Annex 37: E2 White book

Administrative Annexes

A. Financial Statements

In paper version: signed original statements and printed forms.
In electronic version: scanned signed statements and forms in excel

0. Consolidated Financial Statement, including:
a. Signed Standard Payment Request
b. Signed Costs Summary Statement
c. Signed Income summary Statement
d. Signed Consolidated Cost Statement
e. Signed Funds Distribution Statement
1. Signed Financial Statement of BALAM
2. Signed Financial Statement of GREENFIELD
3. Signed Financial Statement of ASAJA
4. Signed Financial Statement of AGRIFOOD
5. Signed Financial Statement of IBE-CNR
6. Signed Financial Statement of NUTRIPRADO
7. Signed Financial Statement of SAHC
8. Signed Financial Statement of V.F.BERIO & SALOV SPA
9. Signed Financial Statement of UCO

B. Responses to EC Letters.
1. 4 Answers to the Letter