LIFE Project Number

LIFE19/CCA/DE/001224

Final Report

Covering the project activities from 01.07.2020 to 30.06.2025

Reporting Date

30.09.2025

LIFE PROJECT NAME or Acronym

LIFE VineAdapt

Data Project

Project location:	AT/DE/FR/HU
Project start date:	01.07.2020
Project end date:	30.06.2025 **Extension date:** ./.
Total budget:	2.817.171,00 €
EU contribution:	1.544.264,00 €
(%) of eligible costs:	54,99 %

Data Beneficiary

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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 all sections 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's report 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 exception of 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 of signed 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 overall summary 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 same as 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	N/A
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)*	N/A
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 letters from the Agency (unless already submitted or not yet due) *In electronic version only*	N/A
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 figures

3. List of key-words and abbreviations

AREC (AT)	Agricultural Research and Education Centre Raumberg-Gumpenstein
HSA (DE)	Anhalt University of Applied Sciences
IMBE-AU (FR)	Mediterranean Institute of Biodiversity and Ecology of Avignon University
LGSA (DE)	Landgesellschaft Sachsen-Anhalt mbH
LKP (DE)	State Winery Kloster Pforta
Marrenon (FR)	Winery Cooperative Marrenon
ÖMKi (HU)	Hungarian Research Institute of Organic Agriculture
Silberberg (AT)	State Winery Silberberg

4. Executive Summary

Viticulture in Europe has to deal with the effects of climate change. Increasing summer droughts, a high risk of erosion due to heavy rainfall and the invasion of new pests require innovative solutions. The LIFE VineAdapt project aimed to improve the resilience of vineyard ecosystems to climatic changes. Increasing biodiversity and adapting vineyard management are crucial for agroecosystem resilience. From July 2020 to June 2025, eight practice and research partners from Germany, France, Austria and Hungary focused on five work packages (innovative greening of vineyard inter-rows, alternative undervine management, resource-efficient fertilisation methods, resource-saving irrigation and transnational assessment of ecosystem services in vineyards). Public relations and knowledge transfer measures helped to transfer the project results into viticultural practice. The project partners wanted to prove that the establishment of native vegetation in vineyards is possible under different geographical and climatic conditions showing positive biotic and abiotic effects. The implementation of resource-efficient and biodiversity-friendly management practices in vineyards was expected to result in a significant reduction in fertiliser demand and an improved carbon footprint. In addition, native vegetation should better regenerate after drought than conventional greening with non-native cultivars. By establishing species-rich vegetation in formerly open inter-rows, the carbon storage in the soil should be increased. Due to an expanded pollen and nectar supply from the wild plants, it was expected, that the occurrence of wild bees and pest antagonists increases significantly.

The LIFE VineAdapt project showed that significantly more plant species, wild bees, hoverflies, ladybirds and spiders occur in the biodiversity vineyards (vineyards with established flower strips) in all project regions. Soil erosion was also lower, suggesting greater resilience to flooding and drought in biodiversity vineyards. Mechanical treatment using a mower with a brush attachment proved to be the most effective and economical way to reduce undesirable plants under the grapevine plants. Regarding resource-efficient fertilisation methods, no major or generalisable differences in yield or grapevine vitality were found between the individual treatments. In France, irrigation had no effect on plant diversity, but the cover of flowering plants was lower. Spiders, wasps and ladybirds were significantly less common in irrigated vineyards. Soil organisms benefited from irrigation. In terms of ecosystem services, the “pollination and seed dispersal” ecosystem service was positively influenced because, among others, more wild bees were found in the biodiversity vineyards. The lower soil erosion in biodiversity vineyards had a positive effect on the “stabilisation and

control of erosion rates” ecosystem service. Local inhabitants perceive a stronger connection to their region when there are flowering vineyards. Tourists would prefer to spend holidays in such a region. So, there were also positive effects on cultural ecosystem services. Overall, the LIFE VineAdapt project had a positive ecological impact, contributing to more climate-adapted and biodiversity-friendly vineyards. There are also predominantly positive trends in the socio-economic impact. In the area of awareness-raising, the project has achieved a lot by reaching many stakeholders and the public through a high number of, amongst others, media outputs, workshops and field trips, newsletters, articles in thematic publications and project presentations at conferences. Key deliverables were especially several guidelines for winegrowers, for example on the establishment of climate- and biodiversity-friendly vineyards and respective step-by-step tutorials. All materials are available on the project website www.life-vineadapt.eu. The project label “Biodiverse Winegrowing” mark wine from biodiversity vineyards. It can be used by winegrowers sowing regional wild plant seed mixtures developed and recommended by the LIFE VineAdapt project partners in their vineyards.

The major problems encountered during the project include bad weather conditions such as drought, the Covid pandemic, different data safety regulations in the partner countries, complex agreements with the winegrowers, difficulties in data collection and staff changes.

5. Introduction

Viticulture in Europe has to deal with the effects of climate change. Increasing summer droughts, a high risk of erosion due to heavy rainfall and the invasion of new pests require innovative solutions. The LIFE VineAdapt project aimed to improve the resilience of vineyard ecosystems to climatic changes. Increasing biodiversity and adapting vineyard management were the main objectives in the project. Eight practice and research partners from Germany, France, Austria and Hungary focused on five work packages: innovative greening of vineyard inter-rows, alternative undervine management, resource-efficient fertilisation methods, resource-saving irrigation and transnational assessment of ecosystem services in vineyards. Public relations and knowledge transfer measures helped to transfer the project results into viticultural practice.

The project partners wanted to show, that the establishment of wild plant vegetation in the vineyard inter-rows is possible under different geographical and climatic conditions showing positive biotic and abiotic effects. The implementation of resource-efficient and biodiversity-friendly management practices in vineyards was expected to result in a significant reduction in fertiliser demand and an improved carbon footprint. It was anticipated that native vegetation will regenerate better after drought than conventional greening with non-native cultivars. By establishing species-rich vegetation, the carbon storage in the soil should be increased. Due to an expanded pollen and nectar supply from the wild plants, the occurrence of wild bees and pest antagonists in the inter-rows should be increased as well.

The establishment of native vegetation in the inter-rows should have therefore led to positive effects on erosion (lower soil abrasion), humification (more soil organic matter) and soil biota (higher soil fertility, better soil structure, higher water holding capacity). Flora and fauna in the vineyard ecosystems should be improved and increase the resilience of vineyard ecosystems, for example in terms of pest pressure (more native plants, nectar and pollen

sources, wild bees, pest antagonists). By greening the inter-rows with site-adapted native plants in all partner regions, carbon sequestration should be improved. In the undervine area, synthetic herbicides should be substituted by biodiversity-friendly alternatives. Thus, different methods should be tested in Austria and Germany: mechanical tillage, treatment with acetic acid, treatment with pelargonic acid, sowing wild plants directly under the vine plants and a mulch cover. Besides, alternatives to fertiliser spreading should be tested in Austria and Germany (lower fertiliser demand, better CO_2 balance): above-ground application of mineral fertiliser, below-ground application of mineral fertiliser directly in the inter-rows and organic fertilisation above- and below-ground. Resource-efficient irrigation aimed to reduce drought-induced stress in grapevine plants (decrease in leave water potential, increase in chlorophyll content, more yeast available amino acids) and decrease water consumption. Potential negative irrigation effects on biodiversity (change in target plants, pest antagonists, soil decomposition, soil biota, soil microbial activity, predation activities) should also be evaluated since irrigation increases plant productivity (crops and inter-row vegetation). Therefore, above- and below-ground drip irrigation should be compared with rain-fed controls in France and Germany. Furthermore, a comprehensive transnational evaluation of ecosystem services in vineyards should show that ecosystem services were influenced positively by the project.

The tested methods should be replicable and transferable within the respective winegrowing region and also in other winegrowing regions. However, they must always be adapted to the respective area. It was expected, that a stakeholder database is established and that the stakeholder like winegrowers, representatives of winegrower associations, policy makers, advisors of agricultural chambers or producer associations and consumers are regularly informed about the project via newsletters. Additionally, wine festivals, wine expositions, information panels and the website with step-by-step videos as well as a database of demonstration sites should be used for dissemination actions. In a Midterm Workshop, a Final Conference and furthermore in other conferences, the project should be presented and recommendations for climate-adapted and biodiversity-friendly viticulture should be given. The creation of a pictogram for climate- and biodiversity-friendly vineyards was expected to support the actions. Another expected result was a consulting service for winegrowers to minimise implementation risks and to maintain good contacts with the stakeholders even after the project.

As further long-term results, it was expected, that the project contributes to the EU Climate Adaptation Strategy, the EU Sustainable Development Strategy and the EU Strategy on Green Infrastructure. Demonstration and pilot actions were planned to demonstrate, evaluate and optimise specific greening and management methods in an ecosystem-based approach for vineyards on a transnational level, adopting them to a wider practice. Using a high variety of native wild plants in vineyard inter-rows provides suitable feeding, mating, nesting and overwintering habitats for various insect groups, including pollinators (e. g. wild bees, butterflies, hoverflies). Thus, the project also supports the EU Pollinators Initiative and the EU Biodiversity Strategy. The monitoring of the demonstration trials continues after the project to demonstrate the long-term sustainability of the actions for education and knowledge transfer to important stakeholders, to implement them into teaching activities and to continue the close cooperation between practice and research partners.

6. Administrative part

The project coordination was, amongst others, in charge of keeping the overview of the schedule and the finances. Apart from minor postponements, the project proceeded very well. All milestones were reached. Just one deliverable, the remote sensing tool to adjust the water amount to the need of the vine plants, could not be realised. Respective explanations are given in chapter 7. The project coordination organised the online project partner meetings. On a regular basis (4 times a year), they discussed the project progress and their activities. Common tasks were coordinated and events like the Final Conference planned. Data was exchanged via e-mail or a project cloud, provided by HSA. The project coordination acted also as contact point for the project partners to answer questions. Besides, it was responsible for the reporting. Although the Midterm Report had to be submitted three months later as planned, the other reporting was in time. The Midterm Report was followed by a deeper financial check by CINEA and Barbora Patockova from Ernst & Young. Barbora Patockova also participated in a project partner meeting in France and explained central financial requirements. Though the corrections of the financial reports were time-consuming for the project partners, the financial check was very helpful and appreciated. All addressed financial issues could be solved.

The greatest challenges in the project management process were the staff changes, both in the project coordination (LGSA) and in the teams of the project partners (HSA, LKP, ÖMKi, Marrenon) due to parental leave or to quitting the partner institutions. New staff members had to be introduced in an ongoing project process. Consequently, some postponements like the later submitting of the Midterm Workshop occurred. When there were changes in the teams of the project partners, the project coordination supported the incorporation by providing help in particular in financial reporting. All in all, the cooperation with the project partners worked very well and the communication with CINEA was smooth. The project coordination received all important information and responses were timely and exhaustive. A great support was the external monitor from ELMEN-Particip GmbH. Cornelia Schmitz gave very helpful hints, for example in terms of financial issues. The project coordination preferred to call Cornelia Schmitz directly than receiving information via the Helpdesk. Like this, a direct answer could be given and sometimes the discussion revealed other important aspects in addition. However, BUTLER proved to be a very suitable tool for submitting deliverables and reports. There weren’t any amendments to the Grant Agreement.

7. Technical part

7.1.Technical progress, per Action

Action C1 – Innovations in vineyard inter-row greening to increase biodiversity and resilience in vineyard ecosystems

Planned start date: 07/2020 Actual start date: 08/2020
Planned end date: 06/2025 Actual end date: 06/2025

Implementation of measures and staff
Appropriate high-diversity seed mixtures for vineyard inter-row greening were successfully identified in all countries at the beginning of the project. In Austria and Germany, two different types of seed mixtures for segregated greening were developed (seed mixtures for middle section und wheel track greening).

- Austria: middle section greening: 31 plant species, wheel track greening: 3 plant species
- France: 22 plant species
- Germany: middle section greening: 38 plant species, wheel track greening: 9 plant species; a total of 40 species were selected. In addition, a seed mixture with 28 plant species was developed for Saxony and a seed mixture with 32 species for Baden-Württemberg.
- Hungary: 19 plant species

Figure 1: Flowers of the 37 forbs included in the German mixture. A total of 40 plant species from 19 plant families (37 forbs, 3 grasses) were sown in the Saale-Unstrut wine region

All mixtures contain only native wild species of regional provenance that are adapted to the regional abiotic and climatic conditions. Selected species should be low-growing, drought resistant and not competitive to vine plants and together, they should provide nectar and pollen throughout the whole vegetation season. The development of the seed mixtures together with local experts and seed companies was an important and time-consuming process.

In total, in 62 vineyards across all countries, site-specific wild plant mixtures were sown on approx. 60 ha in vineyard inter-rows:

- **Austria**: 12 vineyards, 18 ha
- **France**: 12 vineyards, 11 ha
- **Germany**: 27 vineyards, 21 ha
- **Hungary**: 11 vineyards, 9 ha

The following persons were involved in Action C1 at HSA:

Staff	**Task**	**Time span**
Prof. Dr. Anita Kirmer	Scientific project coordination, integration of project results in teaching, networking and public relation activities	08/2020 – 12/2023
Prof. Dr. Sabine Tischew	Administrative project coordination, integration of project results in teaching	08/2020 – 12/2023
Dr. Daniel Elias	Project management, set up of biodiversity trials, field work, data analysis, publication of results, networking, public relations, since 1/2024: project coordination	10/2020 – 06/2025
Hendrik Teubert	Field work	01/2021 – 06/2025
Lea Sieg (née Schubert)	Field work, networking, public relations, development of step-by-step-tutorials and other information material	09/2020 – 06/2025 (Parental leave from 01/2023 – 03/2024)
Janik Schäfer	Replaced Lea Sieg during parental leave	03/2023 – 02/2024
Jan Karges	Field work	03/2024 – 09/2024
Roi Hendler	Data compilation and statistical analysis	03/2025 – 06/2025
Seven student assistants	Support of field work, data processing, information material, public relations	10/2020 – 03/2025

Other partners and colleagues supporting Action C1:

- LKP: Jens Eckner (until February 2024), Oliver Brand (until June 2024), Anne Hauschild (from August 2024 onwards)
- AREC: Dr. Wilhelm Graiss, Dr. Bernhard Krautzer, Katharina Gassner-Speckmoser
- Silberberg: Karl Menhart, Sabrina Dreisiebner-Lanz (Bio Ernte Steiermark)
- IMBE-AU: Prof. Dr. Armin Bischoff, Dr. Olivier Blight, Dr. Léo Rocher
- Marrenon: Thomas Combe
- ÖMKi: Dr. Tamás Miglécz, Dr. László Mezőfi, Fruzsina Szira

Main findings and role of the work package

Vegetation surveys

An increase in plant species richness in the biodiversity vineyards of all regions after sowing, compared to the conventionally greened and managed control vineyards, was observed. Already in the first year after sowing, vineyard inter-rows sown with species-rich seed mixtures of native wild plants showed vegetation cover similar to conventionally greened vineyard inter-rows, thus providing erosion control and allowing vehicle crossing. Spontaneous forbs, that originate either from the soil seed bank or seed rain, only occurred in large numbers in the first year after sowing. The occurrence of spontaneous species was the result of soil disturbance prior to sowing. From the second year (Austria, Germany, Hungary) or third year (France) after sowing, the wild plants from the seed mixtures were dominant in most of the vineyards. Spontaneously emerging forbs still added to the diversity of species and flowers in the sown biodiversity vineyards. The results also showed that the species-richness of spontaneous vegetation in French and Hungarian vineyards is already quite high which needs to be considered in recommendations for biodiversity-friendly management.

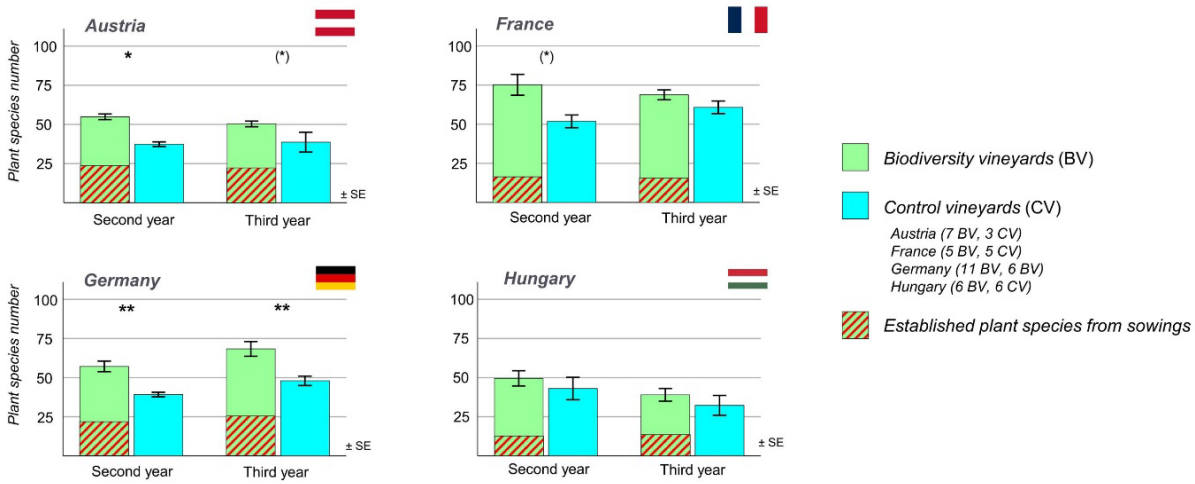

Figure 2: Number of plant species in the sown biodiversity vineyards in the second and third year after sowing compared to conventionally greened and managed control vineyards in the different project countries (400 m^2 transects)

Fauna surveys

Wild bee surveys were carried out in all project countries. In Germany and Hungary, the surveys took place between 2021 and 2024. In Austria and France, surveys were only carried out in 2024. However, in France wild bee abundance was measured in all years after sowing (2022 – 2025). Although the results are not directly comparable due to the geographical and climatic differences, it can be summarised that the higher number of bee species and the improved nectar and pollen supply was the result of the higher flower density and diversity. From the second year after sowing, significantly more wild bee species/individuals were found in the biodiversity vineyards sown with native wild plants. The most abundant species in Germany as well as in the other project regions were from the genus *Lasioglossum*. Several species with specific feeding (oligolectic species) and nesting behaviour (snail house bees) also occurred in the biodiversity vineyards.

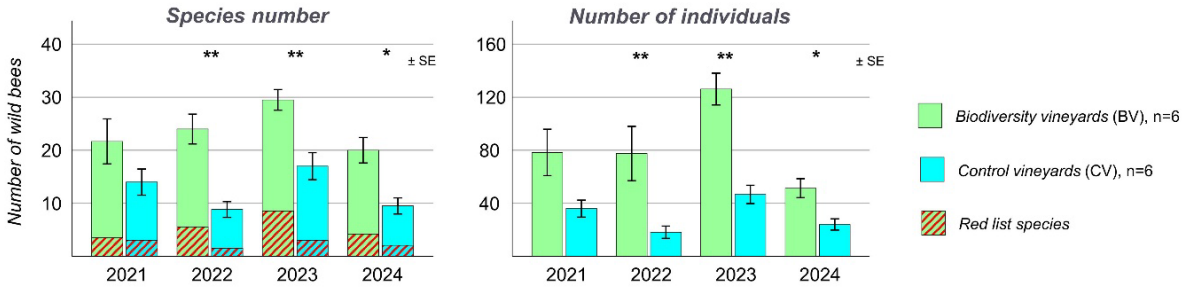

Figure 3: Number of wild bee species (including Red List species) and individuals in German vineyards (transects 400 m^2) during the study period (2021 – 2024)

The beneficial insect surveys were also carried out in all project countries. Due to the different geographic and climatic conditions, the results are not directly comparable. However, a positive trend was found for all groups of studied beneficial insects. More hoverflies, ladybugs, spiders and wasps were found in the sown biodiversity inter-rows. Only in Hungary, more ladybugs were found in the control vineyard inter-rows in the third year after sowing. The Hungarian finding may be explained by the higher cover of some annual weed species like *Ambrosia artemisifolia*, *Erigeron annuus* and *Chenopodium album*. The young shoots of these species usually attracted many aphids which were followed by ladybugs. This result confirms the importance of spontaneously emerging plant species for biodiversity conservation in vineyards although beneficial insects were more promoted by the sown plant species.

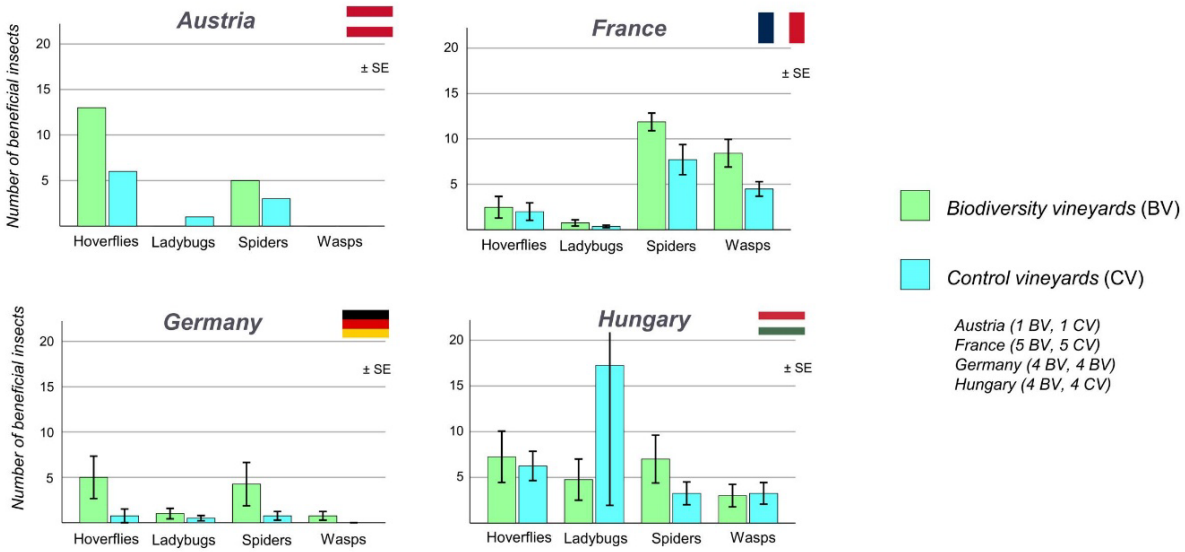

Figure 4: Number of individuals of beneficial insects (hoverflies, ladybugs, spiders, wasps) in the third year after sowing in all project countries (16 m^2 plots)

Observations of the pest *Scaphoideus titanus* were made in all project countries, but it did not occur (Germany) or its abundance was low and no significant difference could be detected between biodiversity and control vineyards. Predation rates (% of *Lucilia* larvae eaten by predators) were measured by all partners, showing a high variety between countries. In France, the predation rate was higher in biodiversity than in control vineyards. In Germany and Austria, the predator pressure was slightly (but not

significantly) higher on control vineyards. In Hungary no clear trend could be detected. Further studies are necessary.

Yield and health of vine plants

The wine yields fluctuated considerably during the project depending on the climatic conditions (summer droughts, late frosts). As the growing conditions in the winegrowing regions of the project countries were very different, no general conclusions can be drawn. In Austria, no significant differences in grape quality parameters, yield and the health of the vines could be detected between the biodiversity areas and the control areas.
In France, inter-row sowing did not affect grapevine yield. Even in the additional tilled inter-treatment, no differences were found compared with biodiversity sowing and spontaneous vegetation. However, winegrowers adjust grape number to maintain quality and remove grape in case of high productivity. SPAD chlorophyll index of leaves as well as grape sugar and amino acid content were not significantly affected by sowing or inter-row vegetation in general. The same was found for the grapevine leaf area index except for the second year in which values were little higher in spontaneous vegetation. In Germany, no significant differences were found in grape quality parameter and yield as well as in health status of the vine plants recorded in biodiversity and control vineyards, proving that a diverse inter-row vegetation did not impact vine plants and yield. A comparison of the years 2023 and 2024 clearly shows the influence of the weather. In 2023, late frosts in April led to a significant decrease of the yield in German vineyards.
In Hungary, in case of yield quantity, a year and site dependent effect was recorded. Overall, a slight decline of yield quantity can be expected, but no significant effect on yield quality was observed. A slightly higher SPAD chlorophyll index in the sown inter-rows was measured and no difference or clear trend was observed in the leaf area index.

Soil analyses

In French vineyards, a detailed analysis of the soil fauna showed significantly higher soil respiration rates and springtail densities in vegetated inter-rows compared to tilled inter-rows. Several springtails (*Entomobryomorpha* and *Symphypleona*) and mite groups (*Mesostigmata*) were more abundant in inter-rows sown with the high-diversity mixture compared to tilled inter-rows whereas differences to spontaneous vegetation were not significant. Organic matter decomposition of tea bags with standardised biomass was, however, slightly higher in tilled inter-rows suggesting that higher biological activity and mesofauna density of vegetated inter-rows was mainly driven by higher organic matter content. The findings highlight the beneficial effects of species-rich inter-row vegetation on soil fertility of Mediterranean vineyards. In Hungary, no differences in tea bag decomposition were observed between biodiversity and control inter-rows. Regarding soil analysis, most nutrients did not differ, but at some sites, higher nitrogen content in sown parcels was observed. In Germany and Austria, no major differences were found between the two treatments studied regarding the decomposition of tea bags and other soil analyses.

Since biodiversity is the foundation for important ecosystem services (e. g. erosion control, water retention capacity), a more diverse vegetation can increase the resilience of the vineyard ecosystem to climatic extremes (Action C5). Results of Action C1 are also very important for Actions C3 and C4 as a more diverse vegetation can support resource efficient fertilisation and irrigation. Action C1 is central for the overall project outcome.

Deviations from planning, problems, delays

Delays of milestones and deliverables	Modifications
Biodiversity vineyards established: In France, subcontracting delayed the project start to 11/2020. In France and Hungary, establishment of biodiversity vineyards was delayed due to restrictions related to the Covid pandemic. In Hungary, shortage of seed and late harvest times delayed the sowing to spring 2022 instead autumn of 2021 in Eger region. Milestone delayed from 09/2021 until 09/2022	Sowing of biodiversity vineyards finished: Germany (in time) Austria (in time) France (one year delay, finished in 09/2022) Hungary (finished in 05/2022)
Step-by-Step-Tutorials to demonstrate the establishment and maintenance of biodiversity vineyards were delayed by unfavorable weather conditions that hampered filming. Deliverable delayed from 06/2024 to 12/2024	The multilingual film was finished in 12/2024.
Fact sheets of wild bees, pest antagonists and plant species: Data processing and wild bee determination by an external expert was delayed until 12/2024. Therefore, discussions with project partners started in January 2025. Deliverable delayed from 12/2024 to 03/2025	All fact sheets were harmonised regarding content and layout and finished until 03/2025.

All other milestones and deliverables of Action C1 were in time.

Challenges	Solutions
Weather conditions in spring and summer of 2022 (all project regions) and 2023 (France) were very dry, so that germination and growth of the sown species was reduced in these years.	The vegetation recovered in 2023 and 2024 (France), respectively. In all project countries, almost all sown species persist over the observation period between 2021 and 2025.
In some German and Austrian as well as in most French vineyards, the competition of weeds and grasses was strong in the first year.	Timely mowing was used to successfully reduce the competitive pressure of emerging weeds (April to mid-May).
German wineries asked for more flowering species in the seed mixture to make the flowering inter-rows even more attractive to consumers.	Since one species (*Bupleurum falcatum*) did not establish, we replaced it by *Anthericum liliago* in 2025.
Two species of the French mixture showed very poor germination: *Centhrantus ruber, Plantago coronopus*	These species and *Malva sylvestris* (see next point) were replaced by *Agrostemma githago, Medicago minima* and *Trifolium arvense.*
Winegrowers in Germany and France complained about the vigorous and tall growth of the nurse plant species *Camelina sativa* in Germany and *Malva sylvestris* in France. Both were included to prevent erosion and suppress spontaneously emerging weeds in the first year after sowing.	Since other species in the seed mixture were also able to fulfil this function, we removed *Camelina sativa* from the German mixture already in 2022. *Malva sylvestris* was replaced in the French mixtures sown in 2023 and 2024.

Challenges	Solutions
In Hungary, *Papaver rhoeas* was very competitive at one site which made the winegrowers to till the sown inter-rows in the autumn of 2023.	For this particular site another mixture without *Papaver rhoeas* was composed and sown in spring 2024.
At some Austrian vineyards, a major issue was incorrect mulching, such as applying mulch directly on the biodiversity strip. In some cases, mulching was done too early, which negatively affected the emerging vegetation.	Recommendations were made to avoid incorrect mulching (early mulching of the track by removing the centre mulching blades; the mulching material should be placed under the vine plants).

Public relations

In all project countries, numerous public events and media activities were spreading the results of Action C1 to academia, administration, private sector and civil society. Examples for special events:

- A podcast on Action C1 was recorded and distributed via the AREC podcast channel (Austria).
- A special issue on vineyard management and biodiversity was edited in the international journal Basic and Applied Ecology including 3 publications of LIFE VineAdapt project and 5 of other European research groups (France, Germany).
- In April 2024, the Prime Minister of Saxony-Anhalt, Dr. Reiner Haseloff, visited ÖMKi in Hungary and got to know the project.
- In June 2024, the Minister for Science, Energy, Climate Protection and Environment of Saxony-Anhalt, Prof. Dr. Armin Willingmann, visited one project site in the Saale-Unstrut winegrowing region (Germany).

Acceptance of the measures

In Germany and France, winegrowers are very interested in using the seed mixture but they asked for financial support to cover additional costs for the rather expensive seed mixture. In Austria, interested and innovative winegrowers use the developed seed mixtures to promote biodiversity in their vineyards. In Hungary, a great part of the winegrowers is interested in sowing mixtures in the inter-rows, but still hesitant partly because the price of the mixtures and the fear of competition with vine grapes. Flavescence dorée (phytoplasm disease hosted by *Scaphoideus titanus*) is currently spreading in Hungary, causing severe problems in some locations. Farmers in these locations are afraid to use cover crops because they wrongly believe that some host plants may serve as hosts for *Scaphoideus titanus* and the associated phytoplasma diseases.

Financial subsidies are required to support the sowing of the rather expensive diverse seed mixtures with native wild plants in vineyards. In Austria, there is a subsidy programme to reduce erosion through year-round, area-wide greening, but the use of biodiversity mixtures is unfortunately not explicitly promoted. Discussions about ÖPUL funding are ongoing. In France, specific funding for sowing such biodiversity mixtures is still unavailable complicating the establishment of this approach. In Germany, discussions about subsidies for perennial wildflower strips in vineyards with the Federal Ministry of Economy, Tourism, Agriculture and Forestry in Saxony-Anhalt are ongoing. In Hungary, there are subsidies in the higher levels of CAP for different greening methods in perennial plantations, but the set of recommended/allowed species still has to be adjusted and the amount of the subsidy does not cover the costs of a high diversity seed mixture that

consists of the ecotypes of the given species. The Hungarian project partners tried to influence the new policy principles and regulations with limited success.

A similar activity outside LIFE VineAdapt project is AmBiTo, a joint project of Fair and Green association and Hochschule Geisenheim University to strengthen biodiversity in German viticulture. LIFE VineAdapt project co-operates with AmBiTo project, which works complementary in other German winegrowing regions.

Continuation of the work package
The Austrian seed mixture, developed within the LIFE VineAdapt project, proved to be suitable for the southern Styrian and Lower Austrian winegrowing regions and is available as "ReNatura® W2 Gumpensteiner flower strip mixture for fruit growing and viticulture" at Kärntner Saatbau. In France, the vineyards sown at the end of the project period will be monitored to evaluate changes in plant species composition of the mixture. Results will be communicated to the 400 winegrowers of the Marrenon cooperative. In Germany, HSA is currently establishing a wine institute. The results of the LIFE VineAdapt project will be further promoted by this institute. The monitoring of some of the biodiversity vineyards to evaluate long-term success of the sowing will be continued. In Hungary, further investigations are carried out in the sown inter-rows to reveal the effects of the sowings on the composition of arthropods on the vine plants and predation intensity. Vegetation sampling was also continued in 2025 to gather data to compile a new, more drought resistant seed mixture.

Action C2 – Development of a biodiversity-friendly undervine management

Planned start date: 07/2020 Actual start date: 05/2021
Planned end date: 06/2025 Actual end date: 06/2025

Implementation of measures and staff
Austria:

- Preparation and setup of the experimental variants by Karl Menhart (Silberberg)
- Assessment of vegetation cover, maximum/medium vegetation height, share of grasses, legumes and herbs, data analysis and creation of guideline by Karl Menhart (Silberberg), Sabrina Dreisiebner-Lanz (Bio Ernte Steiermark, external advisor), Dr. Wilhelm Graiss (AREC) and Katharina Gassner-Speckmoser (AREC)
- Experimental variants: pelargonic acid (2 x, backpack sprayer), acetic acid (2 x, backpack sprayer), mechanical vegetation treatment (2 x, held brush), sowing of suitable species (*Festuca rupicola*, by hand) and different treatments of sowed undervine plants, mulch film (special device)

Germany:

- Preparation and setup of the experimental variants by Oliver Brand (LKP, until June 2024)
- Assessment of vegetation cover and yield, data analysis by Jens Eckner (LKP, until February 2024) and Anne Hauschild (LKP, from August 2024 onwards)
- Experimental variants: pelargonic acid (2 x, backpack sprayer), acetic acid (2 x, backpack sprayer), mechanical vegetation treatment (rotary hoe)

Viticulture manager Jens Eckner was employed in LKP until February 2024, technical staff Oliver Brand until June 2024. Anne Hauschild took over the technical part from August 2024 onwards.

Main findings and role of the work package
Mechanical treatment of the undervine area is the most effective and economical option for vegetation control in Austria and Germany. The results show limited long-term effects of acid application – 3 to 4 applications are still too few for the entire growing season, but more than two applications are not legally permitted. The application of organic acids is not a practical method for the treatment of undervine growth. Costs and frequencies are high and a strong odor occurs. The further establishment of sown *Festuca rupicola* and the persistence against mechanical treatment will be monitored in Silberberg and the development of a redesigned species rich undervine seed mixture will be evaluated in a 5-year-project by the Highschool and Federal Office of Viticulture and Pomology Klosterneuburg, Lower Austria. Testing new methods and promoting implementation raised awareness among winegrowers, because the usage of total herbicides could be replaced or reduced by other management methods. The implementation of regional wildflower species (Actions C1 and C2) into agricultural landscapes can work as habitat for beneficial insects.

Deviations from planning, problems, delays
The expected start date for field work on C2 in July 2020 had to be postponed to May 2021 due to the Covid pandemic. The deliverables “Undervine management guideline for practitioners” was implemented successfully and on time. The milestones “Undervine management trials successfully installed”, “Information on implementation of trials available”, “Selection of remaining demonstration sites finished” and “Undervine management trials in database of demonstration sites” were all timely implemented in Austria. In Germany, the successful implementation of the trials was delayed because of a frost event in spring 2021. LKP could not carry out the treatments as planned because the regrowing shoots from the stems were needed for cultivation. Therefore, the trial was started in spring 2022. Silberberg added the testing of biodegradable mulch foil.

Public relations
- Lectures AREC: Krems/Donau in September 2022, Spitz in January 2023, 2024 and closing event 2025 – interest by wineries in creating permanent greening to reduce the mowing frequency
- Lecture Sabrina Dreisiebner-Lanz: Weinbauschule Eisenstadt, June 2023
- Lecture Karl Menhart: Austro Vin Tulln, February 2024
- Lecture Karl Menhart: practice day in Silberberg, July 2024 and field visit of trial sites for practitioners
- At the Vinea Wachau event in January 2025 order forms were provided to the 100 participants. At Silberberg, further vineyards will be sown with fescue mixtures.

Acceptance of the measures
In the frame of the “Vinea Wachau undervine greening project”, similar activities were conducted in terms of testing of various site-specific seed mixtures and 3 individual species on terraces and large terraces in the Wachau winegrowing region. Discussions on a complete herbicide ban are ongoing, hopefully future discussions will take the results of the LIFE VineAdapt project into account.

Continuation of the work package
During the school lectures and practical lessons, Silberberg will give young winegrowers and fruit growers insights into the tested possibilities for undervine vegetation management.

Action C3 – Reduction of greenhouse gas emission in vineyards by using resource-efficient fertilisation techniques

Planned start date: 07/2020 Actual start date: 07/2020
Planned end date: 06/2025 Actual end date: 06/2025

Implementation of measures and staff
In Germany, the project was carried out by various employees at LKP and HSA. From 2020 to February 2024, Jens Eckner from LKP was responsible for administrative management and, from 2022, also took on the role of the viticulture manager. His tasks included preparing the financial report, data analysis and public relations. Oliver Brand was responsible for operational tasks at LKP from February 2022 to June 2024, in particular data collection and support for public relations. From June 2023, Katharina Fehse took over the accounting and prepared the financial report. From August 2024, Anne Hauschild joined the team and took on operational tasks, data collection, evaluation and public relations. In September 2024, Dietrich Frank joined the project as the new viticulture manager and also took over administrative management, including evaluation and communication. In addition, further LKP employees supported the work on the project on a basic level. From HSA, Hendrik Teubert was responsible for collecting data on vegetation and bare soil cover, maximum/medium vegetation height, share of grasses, legumes and herbs. The personnel changes on the LKP side had a noticeable impact on the course of the project and led to delays in data collection and evaluation in individual phases.
In Austria, Karl Menhart from Silberberg was involved in planning and organisation and mainly Gernot Lorenz and Hannes Rothschädl from Silberberg were responsible for the creation and the maintenance of the test area. Sabrina Dreisiebner-Lanz from Bio Ernte Steiermark (external advisor) supported in terms of planning and organisation, data assessments and evaluation. Katharina Gassner-Speckmoser and supporting colleagues from AREC were involved in data assessments as well.

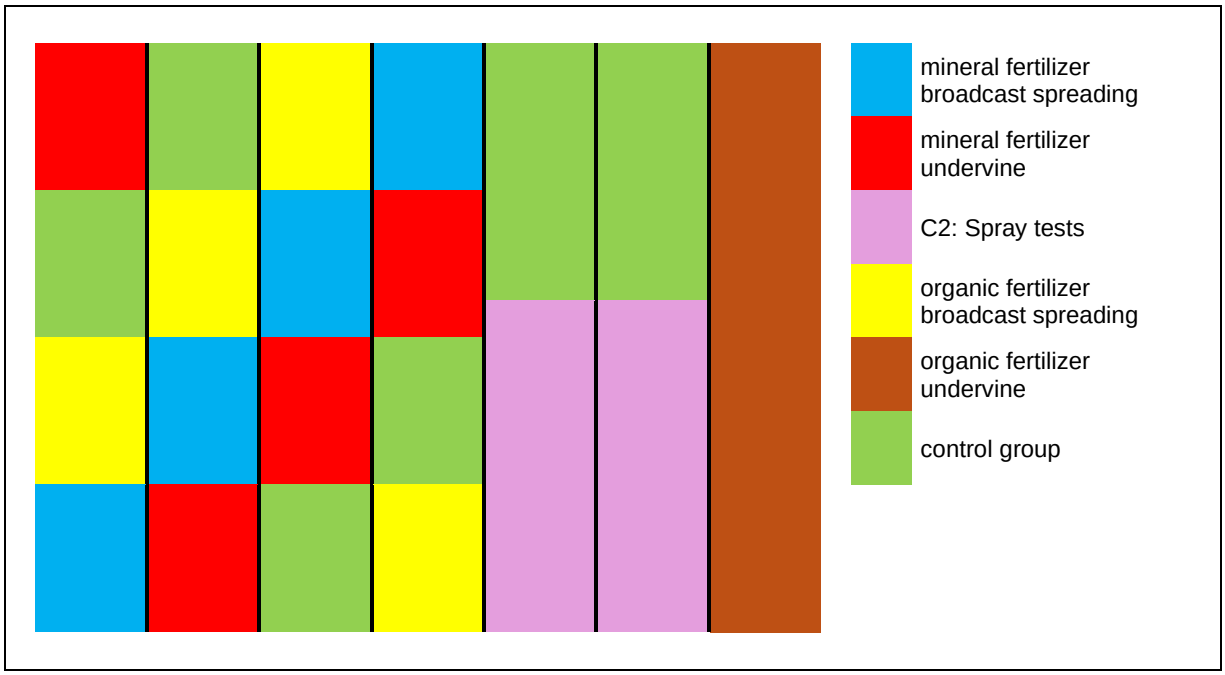

Figure 5: Experimental setup LKP, Germany

In Germany, the demonstration trial was originally planned at the Pfortenser Köppelberg site, but a late frost event in spring 2021 with localised damage made this site unsuitable. The trial area was therefore relocated to the Eulauer Heideberg site in 2022. In Austria, a demonstration vineyard was established with the Meletin grape variety at Silberberg. The surveys took place in the trial fields, grape samples were analysed on site and in the laboratory. Data collection was generally carried out by the operational staff. Soil samples were taken with a drill stick and analysed externally. Bare soil cover was recorded using the Canopeo app. Soil abrasion was calculated annually on the basis of the ABAG factor model, but not on a variant-specific basis. The chlorophyll values were recorded in Germany using a chlorophyll meter and in Austria using a N-tester. Grapes were counted and weighed to determine grape quantity; quality was analysed both internally and externally.

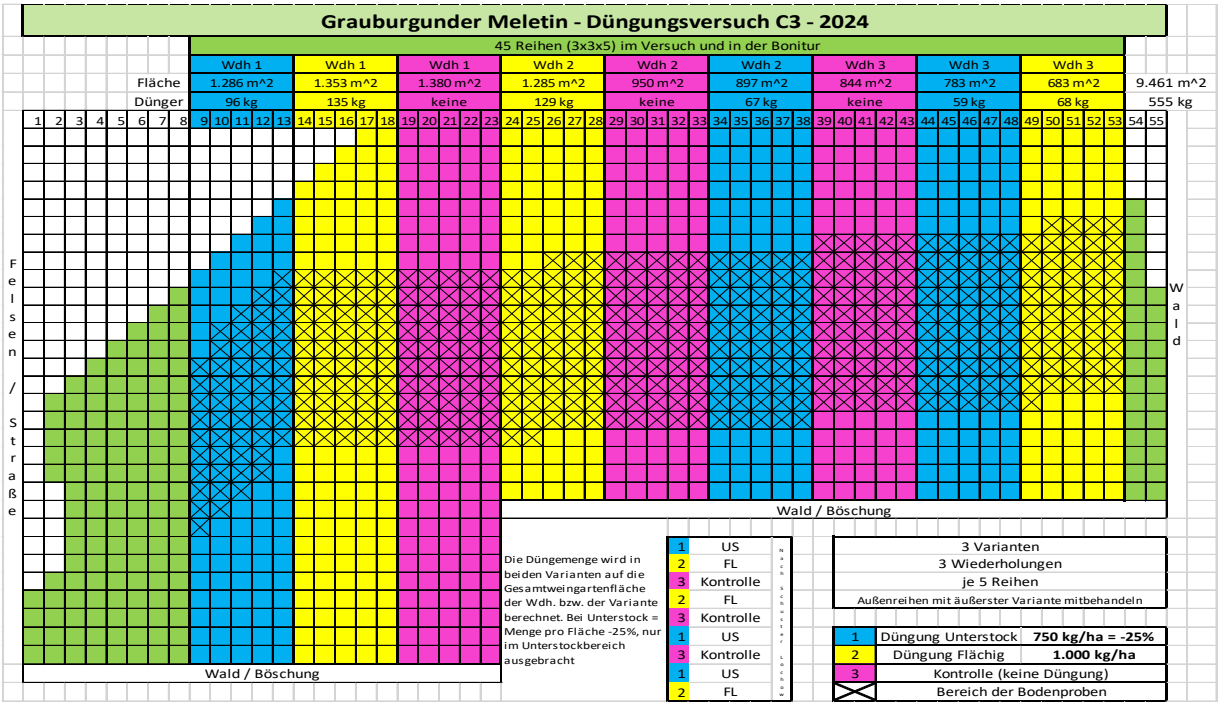

Figure 6: Experimental setup Silberberg, Austria

Main findings and role of the work package

There were no significant differences between organic and mineral fertilisation in terms of soil and vine health. The results suggest that organic fertilisers are comparably effective and have no negative effects on the parameters investigated. However, the financial outlay for organic fertilisers is significantly higher, while the workload was similar for both strategies. An additional advantage of organic fertilisation lies in its environmental impact: It reduces greenhouse gas emissions, promotes biodiversity and supports sustainable vineyard management.

Variant	Year	ph	P	K	Mg	Ct	Corg	Nt
Mineral fertiliser broadcast	2022 2023 2024	5,70 5,80	6,30 4,80	13,00 24,60	14,00 21,70	1,05 1,07	1,85 1,85	0,10 0,09
Organic fertiliser broadcast	2022 2023 2024	5,5 6,30	7,25 1,50	15,30 17,10	18,40 30,60	0,91 0,68	1,56 1,85	0,10 0,06
Mineral fertiliser undervine	2022 2023 2024	5,80 5,70	7,80 3,40	17,30 13,40	19,70 17,90	0,99 0,95	1,39 1,63	0,11 0,10
Organic fertiliser undervine	2022 2023 2024	n. a. 5,40	n. a. 1,70	n. a. 17,30	n. a. 22,80	n. a. 0,66	n. a. 1,13	n. a. 0,07
Control	2022 2023 2024	5,60 6,20	6,00 4,80	16,50 30,80	19,50 23,30	0,96 1,73	1,48 2,97	8,73 0,14

Figure 7: Results soil samples Germany

The site-specific fertilisation, in which only the undervine area in Germany was supplied with 75 % of the usual amount of fertiliser, showed no significant differences to the full-area fertilisation with 100 %. Neither grape quality nor quantity were measurably affected. This indicates a potential for savings without jeopardizing yield stability. In Austria, on the other hand, 2024 showed a higher grape weight and an increased harvest quantity with broad-area fertilisation compared to undervine fertilisation. However, this single-year data has not been validated and is therefore only transferable to a limited extent. Despite the higher costs of organic fertilisers, a reduced application rate, for example through partial application, can put the financial advantage of mineral products into perspective and conserve resources. The Tea Bag Index (TBI) was used annually in Germany to record soil activity. Biological activity was detected in all years, but without significant differences between the fertiliser variants. Year-to-year fluctuations were noticeable, which correlated strongly with the weather – in particular with increased precipitation.

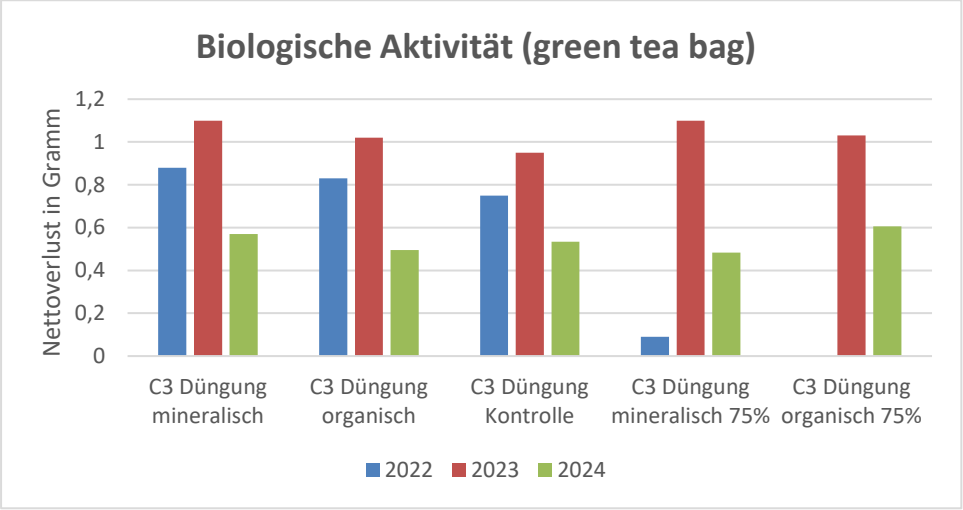

Figure 8: Evaluation of Tea Bag Index, Germany

The measures in Action C3 were closely linked to other parts of the project. For work package C1, it was necessary to coordinate crossings with the sowing of flower and grass mixtures in order to avoid seedbed damage. The targeted use of legumes could also reduce the need for fertiliser. In Action C2, deep fertilisation in the undervine area (e. g. by coulter) appears promising. It could combine nutrient supply and mechanical weed control and thus save work steps. No direct influence on drip irrigation is currently expected for C4. In dry years, selective undervine irrigation could support fertilisation. However, a combination with deep fertiliser applications is risky as the infrastructure could be damaged. Overall, fertiliser adaptation and reduction support resource conservation and are in line with the objectives of LIFE VineAdapt.

Deviations from planning, problems, delays

The trial setup in Germany was implemented as planned in April 2021. In addition, the trial data was transferred to the central database for demonstration plots on time. Due to unfavorable weather conditions in spring 2023, the installation in Austria was delayed by one year. The trial was completed in April 2024. Despite timely implementation, the evaluation revealed methodological limitations – especially in the “-25 % exclusively organic fertiliser” variant. Here, all replicates were distributed in only one row instead of randomly across the area. Due to this systematic error, a statistically reliable evaluation of this variant is not possible. Several unforeseen challenges arose during the course of the

project that affected data collection and analysis. Following a late frost event in spring of 2021, the original trial site at Pfortenser Köppelberg had to be abandoned and relocated to Eulauer Heideberg, which led to a complete loss of data for 2021. Multiple personnel changes without timely handovers led to gaps in the documentation, especially at LKP, which made it difficult to standardise the data collection. A late frost event in April 2024 caused a yield loss of around 80 % at Eulauer Heideberg site, with similar damage in southern Styria. The results from this year are therefore not representative due to the weather conditions and do not allow any reliable conclusions to be drawn about fertilisation. The annual precipitation, in particular the extreme drought in 2022 (432.8 l/m²), also influenced soil activity and nutrient storage. Technical difficulties were encountered with the Canopeo app – both during use and after staff changes due to a lack of reinstallation. Sheep's wool pellets caused blockages during undervine fertilisation, which made manual application necessary. Inaccuracies were caused by differing sample depths and inconsistent sampling times as well as widely varying laboratory results with identical sample material in Austria. Within the trial areas, different vine conditions (diseased, damaged, missing) led to further distortions. Furthermore, the additional trial variant “organic fertiliser only in the undervine area” could not be methodically evaluated as it was only carried out in one row of vines. The schedule for data collection – especially during the harvest – could not always be adhered to.

Public relations
Public relations work was hampered by staff changes, which led to delays in the implementation of planned measures. Nevertheless, the project was presented at winegrowers' training courses and public events. The public feedback was consistently positive – in particular, the resource-conserving cultivation and the targeted reduction in emissions were emphasised.

Acceptance of the measures
In view of stricter legal requirements for fertiliser reduction, the development of low-emission fertiliser systems is becoming increasingly important. The project experience also offers approaches for other crops. The comparison of permanent crops such as vines with annual or perennial plants broadens the perspectives. So far, there has been no firm feedback from regional winegrowers on the fertiliser trials. There were no similar activities outside the project.

Continuation of the work package
Organic fertilisation is to be continued at LKP. However, mechanical application only in the undervine area is currently not possible due to a lack of application technology. Extensive data collection as in the project will not be continued, but individual soil and grape quality measurements will continue to be carried out as part of normal practice for site-adapted cultivation.

Action C4 – Climate change induced drought, effects of irrigation and solutions for resource-efficient irrigation techniques

Planned start date: 07/2020 Actual start date: 01/2021
Planned end date: 06/2025 Actual end date: 06/2025

Implementation of measures and staff
The C4 report is only based on the environmental risk assessment of irrigation conducted in France, because the measures had to be abandoned in Germany. Action C4 was conducted in south-eastern France where drip irrigation was already in place when the project started. In all studies or subactions of C4, irrigated vineyards were compared with non-irrigated ones. The climate of the French sites is mediterranean to subcontinental with mild and humid autumns/winters and dry and hot summers. Rainfall is very rare and irregular from mid-June to mid-August (80 mm). Since summer drought has increased due to climate change, winegrowers have to cope with reduced grape yield and high sugar content increasing alcohol percentage. Irrigation helps stabilise yields and reduce sugar content. Consequently, the area of irrigated vineyards has exponentially increased in the last 25 years from nearly 0 % in 2000 to about 35 % nowadays. Irrigation commonly corresponds to 50-60 mm of precipitation applied from June to August by drip irrigation. Action C4 was divided in three subactions conducted consecutively in 2021, 2022 and 2023. The first subaction was a study on the effect of irrigation on inter-row vegetation and beneficial arthropods. The second subaction analysed the differences between irrigated and non-irrigated vineyards in vegetation and soil mesofauna abundance (springtails, mites). The third subaction consisted of an experiment that manipulated irrigation in two formerly irrigated vineyards to analyse the temporal dynamics of irrigation effects on soil mesofauna abundance, microbial activity and composition and organic matter decomposition. All subactions were designed and managed by IMBE-AU.

- Prof. Dr. Armin Bischoff: Work package leader, study design, public relations, PhD co-supervisor of Emile Melloul. As a plant specialist, he designed and led all the analyses carried out on vineyard vegetation.
- Dr. Olivier Blight: Study design, public relations, interactions with winegrowers, PhD co-supervisor of Emile Melloul. As a soil fauna specialist, he designed and led all the analyses carried out on the fauna.
- Léo Rocher: He contributed to the sampling surveys and plant identification.

All subactions were part of the PhD thesis of Emile Melloul. Another colleague, Prof. Dr Raphaël Gros from IMBE, was involved in the microbial part and further internship students supported the work in Action C4.

Main findings and role of the work package
Subaction 1: Effects on inter-row vegetation and beneficial arthropods
In the study year 2021, drip irrigation was applied twice or three times providing an additional water supply of about 50 mm (63 % of the summer rainfall). Although vegetation and arthropod surveys were conducted in May, before irrigation started, a negative effect of irrigation on beneficial arthropod abundance, in particular on ladybirds, crab spiders, parasitoids and wild bees in vineyard inter-rows was found.

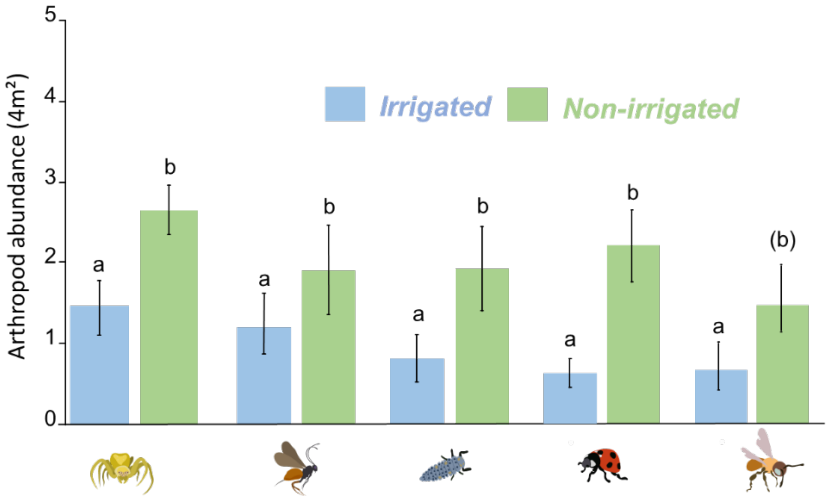

Figure 9: Effect of irrigation on beneficial arthropod abundance in 2021 (Melloul et al. 2024, Basic and Applied Ecology)

There wasn't any significant influence on plant species composition, but the flower cover was lower in irrigated vineyards. This may be due to a delayed phenology and/or irrigation induced changes in the mowing regime. Neither vineyard performance nor yield nor quality parameters were affected by irrigation in the study year.

Subaction 2: Effects on within-row vegetation and soil organisms
In contrast to subaction 1, all measurements were taken within the grapevine rows showing higher disturbance than inter-rows (glyphosate treatment and/or mechanical weed control). In April 2022, before irrigation started, vegetation cover was lower in irrigated vineyards whereas soil mesofauna abundance was not significantly different. During the irrigation period in August 2022, mite and springtail abundance was clearly higher in irrigated vineyards whereas neither plant cover nor plant species richness were affected. In contrast to the 2021 study, irrigation increased grapevine yield and reduced sugar content. The results suggest that the strong positive effects of irrigation on soil mesofauna abundance rapidly vanish after the irrigation period and are not significant any more in the following spring.

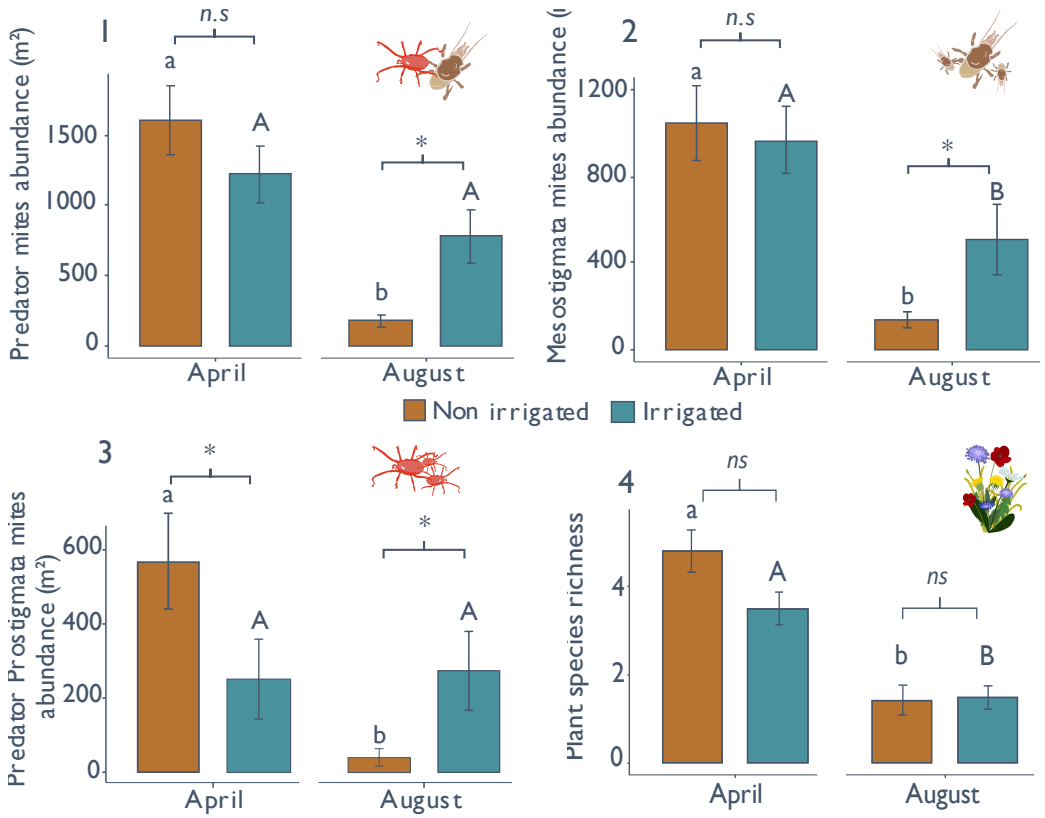

Figure 10: Effect of irrigation on the abundance of mesofauna (1: predator mites; 2: Mesostigmata mites; 3: predator Prostigmata mites) and plant species richness (4). Orange: non-irrigated, blue: irrigated (Melloul et al. 2025, Agriculture, Ecosystems and Environment)

Subaction 3: Temporal dynamics of irrigation effects on soil organisms and function
Temporal dynamics of irrigation effects were analysed in experimental plots within the same two vineyards. The experiment was established in irrigated vineyards, in which half of the irrigation tubes were covered with a plastic coat to exclude irrigation. The measurements focused on soil organisms within grapevine rows including soil microorganisms, soil fauna and soil functioning (respiration, organic matter decomposition). All parameters except for organic matter decomposition were measured four times: one week before irrigation, during irrigation, 48 h after irrigation and in September several weeks after irrigation (and with beginning autumn rainfall).

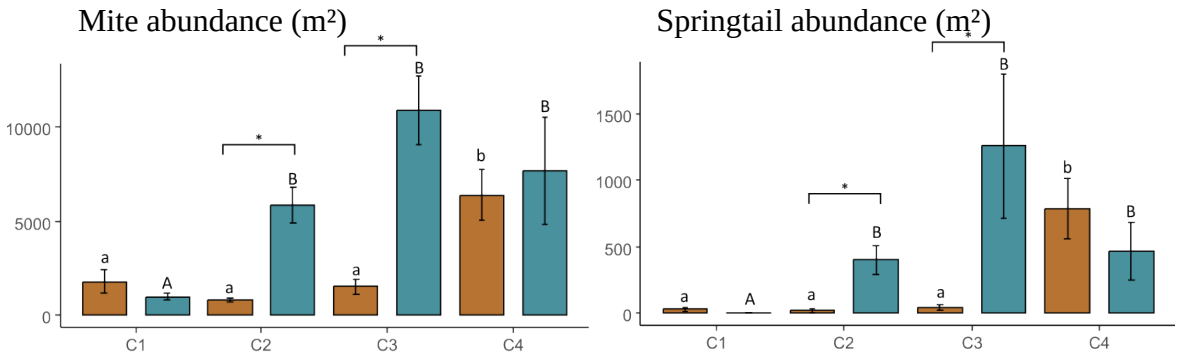

Figure 11: Effect of irrigation and sampling period mite and springtail abundance in the soil. C1: before irrigation, C2 during, C3 shortly after, C4 six weeks after. Orange: non-irrigated, blue: irrigated (Melloul et al. in press, Scientific Reports)

Mesofauna abundance, microbial biomass, soil respiration and organic matter decomposition were higher in irrigated than in unirrigated plots, but only at periods C2 and C3 whereas at period C4 all differences disappeared with an increase of abundance and activity in non-irrigated plots. Thus, the results confirmed the short-term character of irrigation effects on soil organisms already observed in the second subaction. Consequently, the current moderate irrigation seems to be appropriate for biodiversity conservation and soil functioning. However, monitoring over longer periods and different biodiversity metrics (e. g. functional traits) are required to finally evaluate the ecological impact of irrigation.

The results of Action C4 are closely related to Action C1, because winegrowers are afraid of water competition between inter-row vegetation and grapevine plants. Irrigation may help to reduce water competition and increase acceptance of inter-row vegetation. It further contributes to the sustainability analysis (Action C5). Although the demonstration of resource-efficient irrigation systems had to be cancelled, the results of Action C4 are key for a more sustainable use of irrigation water in viticulture.

Deviations from planning, problems, delays
The initially planned action on resource-efficient irrigation could not be set up. This action was scheduled by the German partner LKP, but bad weather conditions in the first year and technical problems in the second prevented the partner from running the experiment. Accordingly, the corresponding milestone “Irrigation trials are installed” could only be partly reached. The deliverable “Remote sensing tool to adjust the water amount to the need of the vine plants” was related to the experiment at LKP and had to be abandoned. In 2021, irrigation was started at LKP, but due to high precipitation, no differences were found between irrigation treatments and non-irrigated controls. Unfortunately, the irrigation trial was damaged by frost in the following winters. In spring 2024, late frost also damaged grapevine plants in the irrigation trial and thus remote sensing would not have revealed any differences between treatments. All other milestones and deliverables were reached and submitted as scheduled.

Public relations
The results and activities of Action C4 were included in 3 scientific publications. TV interviews, newspaper articles, internet publications (Youtube, IMBE TV, websites of Avignon University and IMBE research unit) allowed a wider media coverage – mostly in combination with Action C1. Results and conclusions were further discussed in scientific conferences, stakeholder workshops and winegrower seminars.

Acceptance of the measures
LIFE VineAdapt is as far as known the first project that systematically analysed ecological risks and advantages of irrigation in vineyards. Discussions with winegrowers and policy makers increased the awareness of future problems due to climate change. While irrigation water is still sufficiently available in the study region, further temperature increase combined with larger irrigated areas may rapidly change the situation as exceptional droughts in the past have already shown. In future projects, the ecological risk analysis in the same vineyards (subaction 1) should be repeated in order to obtain information on long-term changes in vegetation and ecosystem functions. It would be also interesting to test, whether irrigation improves the establishment of high-diversity inter-row seed mixtures. New proposals for national and international calls were submitted, but have not been successful so far.

Continuation of the work package
The 18 vineyards of subaction 1 will be further monitored to analyse the long-term irrigation impact on inter-row plant communities, associated arthropods and ecosystem services.

Action C5 – Sustainability analysis of project actions regarding optimisation of ecosystem services and climate change adaptations

Planned start date: 07/2022 Actual start date: 06/2022
Planned end date: 06/2025 Actual end date: 06/2025

Implementation of measures and staff
LGSA was responsible for Action C5, which consisted of a transnational evaluation of the partner countries' data on the assessment of ecosystem services. A set of indicators was developed based on the data collected in Action C1. In addition, a survey was conducted in all partner countries in 2023 and 2024 to assess selected cultural ecosystem services and some socio-economic issues. The partners' data was requested in 2023 for the years 2021 and 2022 and in 2024 for the years 2023 and 2024.

There was a change of personnel in Action C5. Dr Cornelia Deimer, who had been in charge of C5, left the company in December 2021. Johanna Weinreiter took over the management of C5 from November 2021 until the end of the project. The content of the project module was handed over in December 2021. Johanna Weinreiter also supported the work on Action D and developed the LIFE VineAdapt project label and the associated flyer together with HSA (Action E). She also supported Heike Winkelmann in her role as deputy project manager from October to December 2022.

Main findings and role of the work package
Ecosystem services are of great importance for viticulture, as they form the basis for sustainable and healthy wine production. They include a wide range of services that directly or indirectly support the vines and the winegrowing industry. With regard to climate change adaptation in viticulture by increasing biodiversity, it has been shown that sowing regional seeds has a positive impact. Based on the data analysis for the CICES classes, it could be seen that the floristic and faunistic indicators show predominantly positive development trends within the LIFE VineAdapt project. This also showed that the regional seed mixtures contribute to a positive development of the analysed ecosystem services in the vineyards and positively strengthen the vineyard ecosystem. The proportion of carbon and organic carbon in the soil on the biodiversity plots was also higher than on the control plots. The data evaluation for the CICES class “stabilisation and control of erosion rates” showed a clear positive effect with regard to soil erosion. Here, the application of the indirect calculation model showed that the soil abrasion on the organic areas is significantly lower than on the control areas due to the greening. Furthermore, the surveys showed that the flower strips also have a positive influence on cultural ecosystem services and can influence some important social and economic aspects such as the attractiveness of the landscape or the willingness to pay. The monetary valuation of ecosystem services based on the cost-benefit analysis could provide good guidance when it comes to convincing winegrowers of the added value of biodiversity areas in winegrowing regions. However, it is important to bear in mind the

social and sustainability-orientated benefits, as monetary translations cannot be found for everything.

The C5 work package carried out a transnational evaluation of all partner countries involved. The basis for this was, among other things, the data collection in Action C1.

Deviations from planning, problems, delays
The transfer and expansion of the LIFE VineEcoS indicators was planned as a milestone for December 2022. The processing of this milestone took longer overall (until May 2023), as it was not possible to transfer the indicators from the previous project. Instead, the CICES ecosystem classification was used to determine which services can be assessed on the basis of the common database of all partner countries in Action C1. All other implementation steps proceeded as planned.

There were no technical or financial problems or delays. Regarding the organisational component, all partner countries had to provide the data for C5 in order to be able to start the evaluation. Data delivery was sometimes delayed in the individual countries. On the one hand, this was due to a lack of insect specialists who could identify the bee species. On the other hand, there were also differences in the timing of the field trials and data entry. Human resources were overstretched from time to time and data preparation for C5 was sometimes very time-consuming.

Public relations
There were no public relations measures in C5.

Acceptance of the measures
The political actors show interest in the evaluation of ecosystem services, in particular in the monetisation approach, in order to be able to close a possible funding gap. As part of the work on C5, a monetary approach was demonstrated for Germany by drawing up a cost-benefit analysis. There were no similar activities outside the project.

Continuation of the work package
The report on Action C5 will be handed over to the political actors of Saxony-Anhalt for further use. No continuation of the work package is planned with regard to the evaluation of ecosystem services.

Action D – Monitoring of the impact of the project actions

Planned start date: 09/2021 Actual start date: 10/2021
Planned end date: 06/2025 Actual end date: 06/2025

Implementation of measures and staff
LGSA was responsible for Action D, but all project partners contributed by delivering the data for assessing the project impact, especially with regard to the reduction of climate change gas by carbon sequestration, resilience to flooding, resilience to drought, improved soil surface and increase in biodiversity. The project partners collected the respective data by measurements on the biodiversity trials and the control trials in the vineyards. The further indicators like participating wineries etc. were collected annually by the project partners by counting. In addition, the socio-economic impact was measured

via surveys in all participating winegrowing regions. The surveys for winegrowers, locals and tourists were mainly conducted online via the “Survey 123” tool from ArcGIS. The participation links were sent directly to the winegrowers, but were also published in the press and shared via other institutions such as tourism organisations as well as cities, municipalities and districts. Besides, also printed questionnaires were handed out, e. g. at wine festivals like “Weinmeile” in Saale-Unstrut winegrowing region (Germany). The surveys were conducted in 2023 and 2024 by ÖMKi, AREC, Marrenon and LGSA. Because the project coordinator was also in charge of Action D, please see the indications about staff changes in section F – Project Management.

Main findings and role of the work package
As results of Action D, the project impact was documented and assessed. Overall, the project had a positive ecological impact. Biodiversity vineyards seem to be more resilient to flooding and drought. Wild bees are significantly more common in biodiversity vineyards.

There are also predominantly positive trends in the socio-economic impact, although not all assumptions from the project application could be confirmed. In the area of awareness-raising, however, the project has achieved significantly more. The willingness to use biodiversity-friendly methods in the vineyard, for example, is increasing. More and more surveyed winegrowers from Germany, Hungary and France are using the methods of the LIFE VineAdapt project. Greening with site-adapted wild plant mixtures (regional seeds) is even used by the majority in Germany and France. In addition, most surveyed German, Austrian and French winegrowers use mechanical soil tillage and organic fertilisation. In Hungary, these values have at least increased from 2023 to 2024. Most of the surveyed winegrowers are prepared to invest, for example, in sowing perennial wild plant mixtures adapted to the location (regional seeds). In Germany and Austria, most of them would make a one-off investment of between 200.00 and 500.00 euros per hectare, in Hungary and France less than 200.00 euros per hectare. The main factors in favour of investment in all countries would be low costs, sufficient seed procurement options and appropriate funding opportunities. Most of the surveyed winegrowers already have a very good level of knowledge about biodiversity and climate change in viticulture. They also agree by a large majority that it is necessary to adapt viticulture to the effects of climate change. However, only the winegrowers in Hungary and France believe that more biodiversity could help with this. With the increasing use of project methods, more tangible goals are therefore likely to be pursued, e. g. improving erosion control through greening. Nevertheless, this is already part of adaptation to climate change, as vegetated soil is not so easily washed away during heavy rainfall events, for example, which may be a consequence of climate change. In Germany and Austria, most of the surveyed winegrowers were aware of the project, but not in Hungary and France. In contrast, the LIFE VineAdapt project is known to most of the surveyed locals and guests from Austria, Hungary and France. Even among these target groups, awareness of the project does not automatically increase the longer it runs. They have to be informed about it again and again. The level of knowledge on this topic is very different, but mostly at a moderate level, which has not consistently improved between 2023 and 2024. Nevertheless, most are aware that viticulture must adapt to climate change. However, fewer locals and visitors believe that greater biodiversity will help. Nonetheless, a clear majority is very much in favour of the project methods. Most of the surveyed locals and guests would also accept a 10 % surcharge for wine from vineyards with flower strips that promote biodiversity. To make the purchase decision easier, the price should not deviate too much

from the usual price and background knowledge about the promotion of biodiversity should be provided. Flowering vineyards are perceived very positively by the surveyed locals and guests. Most of the locals can identify more with their region if there are flowering vineyards. The majority of guests prefer to spend their holidays in winegrowing regions with flowering vineyards. A clear majority believes that flowering vineyards increase their well-being and their quality of life and stay.

Action D was crucial for the project on the whole, because it brought together the data of the single work packages, mainly of Action C1 and drew conclusions regarding the ecologic and the socio-economic impact. Action D was worked on in close line with Action C5. For example, common data collections were organised and the surveys were conducted with one questionnaire for each target group containing questions for Actions C5 and D. By this, double effort for the project partners and the target groups was avoided.

Deviations from planning, problems, delays
Originally, an annual data collection was planned. On the Monitoring and Steering Committee Meeting in October 2021, the project partners presented the so far measured parameters. The complete data for the years 2020 (before the start of the project), 2021 and 2022 were provided by the project partners in 2023, the data for the years 2023 and 2024 in 2024. All other implementation steps proceeded as planned. The deliverables "ecologic, economic and social impact assessment of Actions C1 to C4" were summarised and submitted in one report.

Data delivery was sometimes delayed in the individual countries. On the one hand, this was for example due to a lack of insect specialists who could identify the bee species. On the other hand, there were also differences in the timing of the field trials and data entry. Human resources were also sometimes overstretched and data preparation for D was time-consuming. Especially the surveys took a lot of time in preparing and conducting. It showed that relatively few people took part online. Thus, the project partners also handed out printed questionnaire, e. g. at events. Nevertheless, the return rates were quite low.

Public relations
Initially, no public relation measures were planned in Action D. However, the surveys were communicated to the press. As a result, several press articles and social media contributions were published.

Acceptance of the measures
This doesn't apply for Action D.

Continuation of the work package
For Action D is inseparably linked with the LIFE VineAdapt project, it ends with the projects' end.

Action E – Communication and dissemination of results

Planned start date: 07/2020 Actual start date: 07/2020
Planned end date: 06/2025 Actual end date: 06/2025

Implementation of measures and staff
LGSA was responsible for Action E, but all project partners participated in the communication of objectives and results. Two times a year, the project partners sent a list with their activities to LGSA. All project partners contributed to the database of demonstration sites, to the articles in expert's literature and to the media outputs. They also organised workshops and field trips for regional multipliers and winegrowers and used public festivals and expositions to inform tourists and local inhabitants. LGSA was mainly responsible for updating the website and for developing the general project flyer, the flyer for the label "Biodiverse Winegrowing", the flyer with the recommendations for climate-adapted and biodiversity-friendly viticulture and the flyer regarding the results ("Layman's report"). In addition, LGSA organised the Midterm Workshop and the Final Conference. The label "Biodiverse Winegrowing" was developed by LGSA together with HSA. HSA mainly developed the step-by-step tutorials and, in addition, an annual calendar with project vineyards pictures. LKP, ÖMKi, AREC and IMBE-AU set up the information panels and plates in vineyards. HSA, ÖMKi, AREC and IMBE-AU sent newsletters to the stakeholders regularly. LKP, HSA, ÖMKi, AREC, Silberberg, IMBE-AU and Marrenon offered consulting for winegrowers, integrated the project results in teaching activities and presented the project at relevant conferences.

Because the project coordinator was also in charge of Action E, please see the indications about staff changes in section F – Project Management. From 2022 on, Lena Anik Schober from LGSA supported Action E, mainly in updating the project website and in assisting events.

Main findings and role of the work package
As results of Action E, 11 information panels and 32 information plates were set up in the biodiversity vineyards. The multilingual project website www.life-vineadapt.eu offers practical material like the step-by-step-tutorials, that inform winegrowers about the establishment of inter-row greening with regional seed mixtures. The short videos are available in all partner languages. Besides, the database of demonstration sites with 72 entries is online.

Figure 12: Information panel in an Austrian vineyard (© photo: Silberberg)

Within Action E, several leaflets were developed. The general project leaflet informs about the targets and the work packages (1st edition English: 1,500 copies, 1st edition German: 1,500 copies). Because it was exhausted, it had to be reprinted in 2023 and then, a French version was also published (2nd edition English: 500 copies, 2nd edition German: 500 copies, 1st edition French: 1,000 copies). In addition, the pictogram resp. the project label for wine produced in climate-adapted and biodiversity-friendly vineyards "Biodiverse Winegrowing" was developed. It is available in all partner languages as digital file and printed in form of a hang tag (1st edition English: 250 copies, 1st edition German: 8,250 copies, 1st edition French: 3,000 copies, 1st edition Hungarian: 3,000 copies). Winegrowers can use it, if they establish flowering strips with regional seed mixtures including wild plants in the vineyard inter-rows. Within the project, trademark protection for the label in the 4 languages was applied at EUIPO.

Figure 13: Label "Biodiverse Winegrowing"

Because the German hang tags were exhausted, they were reprinted in 2025 (2nd edition German: 500 copies). To explain the criteria for the label and to inform winegrowers and consumers, a leaflet was developed and printed (English: 500 copies, German: 2,500 copies, French: 1,000 copies, Hungarian: 1,000 copies). Furthermore, a leaflet with recommendations for actions on measures to support climate-adapted and biodiversity-friendly viticulture was developed and printed (English: 50 copies, German: 350 copies, French: 200 copies, Hungarian: 200 copies). It is primarily addressed to decision-makers in politics and administration who can help to create appropriate framework conditions and incentives for climate-adapted and biodiversity-friendly viticulture. Policy-makers were also integrated in various events like the meeting and the project presentation for the Prime Minister of Saxony-Anhalt Dr. Reiner Haseloff in Budapest in 2024.

Figure 14: Meeting with the Prime Minister of Saxony-Anhalt Dr. Reiner Haseloff in Hungary, 2024 (© photo: ÖMKi)

The “Layman’s report” was also written in form of a leaflet, which presents the results of the work packages (English: 100 copies, German: 700 copies, French: 300 copies, Hungarian: 300 copies).

Figure 15: Title pages of the LIFE VineAdapt leaflets

Various events were organised to inform special target groups about the project. So more than 24 workshops and field trips for regional multipliers as well as over 37 workshops and field trips for winegrowers were organised. About 24 times, annual festivals and expositions were attended to present the project to local inhabitants, winegrowing stakeholders and tourists. This led to a high media presence, including over 100 public relation outputs (newspaper articles, TV and radio reports, social media postings) dealing with the project. There are more than 9,000 persons in the stakeholder databases, who received about 30 newsletters from the project partners. More than 1,800 winegrowers were advised in the frame of the consulting service.

Figure 16: Field trip with winegrowers in Austria, 2024 (© photo: LGSA)

In 2023, a virtual Midterm Workshop was organised. Different experts from research institutions and winegrowing businesses presented their work in relation to the topics of the LIFE VineAdapt work packages. About 70 participated in this workshop. Besides, there were regional workshops in each partner country with over 80 participants all together. In 2025, the Final Conference was organised in person in Freyburg/Unstrut (Saale-Unstrut-winegrowing region, Germany). About 65 persons participated in the presentations of the results of the work packages and a field trip to a biodiversity vineyard. More than 1,000 students were trained within the project. The project partners took part in more than 32 conferences and presented the project. Over 21 articles were published in thematic publications about LIFE VineAdapt. Knowledge exchange took place for example with the SECBIVIT project of Universität für Bodenkultur Wien University in the frame of the Midterm Workshop and the AmBiTo project of Universität Geisenheim University at the Midterm Workshop, the Final Conference and on a regular basis.

Figure 17: Midterm Workshop (local part) in France, 2023 (© photo: IMBE-AU)

Figure 18: Final Conference (field trip) in Germany, 2025 (© photo: LGSA)

Action E was crucial for the project on the whole. LIFE VineAdapt combined scientific presentation of results and knowledge transfer to winegrowers, stakeholders and the broad public. All project partners contributed to a successful public relations work.

Deviations from planning, problems, delays
The project website was prepared in 2020, but went online only in May 2021 in the complete version, because more time to develop the contents was needed. The information panels were not set up until March 2022, but until September 2023. The coordination with the winegrowers, who had to agree on the installation, was sometimes time-consuming. The database of demonstration sites was online only in February 2023 instead of June 2022, because it took longer to obtain the agreement of the winegrowers to publish their indications. The Midterm Workshop did not take place in 2022, but in April 2023 due to staff changes in the project coordination. The step-by-step tutorials were not ready until June 2024, but in December 2024. Due to unfavorable weather conditions the shooting days had to be postponed until the end of June and some late summer aspects should be included, too. Afterwards, cutting, text adaptation and especially inserting multilingual texts took also more time. All other implementation steps proceeded as planned.

Acceptance of the measures
This doesn’t apply for Action E.

Continuation of the work package
The activities of Action E are crucial for the dissemination, also beyond the projects’ end. As mentioned in the After LIFE Action Plan, the knowledge transfer continues by sending out newsletters and by advisory and educational offers for winegrowers, viticultural advisors and students. Furthermore, the project label is still available for winegrowers who fulfill the criteria. The project results are further published and the exchange of experience takes place at national and international conferences and workshops.

Action F – Project management

Planned start date: 07/2020 Actual start date: 07/2020
Planned end date: 06/2025 Actual end date: 06/2025

Implementation of measures and staff
LGSA as coordinating project partner was responsible for Action F. Within the project management, ongoing tasks were realised, such as the organisation of project partner meetings, monitoring and steering committee meetings and the collection and checking of financial reports. Twice a year, the project partners had to send their financial reports to LGSA. In addition, the project management kept an eye on the timetable of the project and was available answering questions of the project partners. It was in charge of the reporting, uploading deliverables to BUTLER and keeping the contact with the external monitor of ELMEN-Particip GmbH Cornelia Schmitz and CINEA.

There were several staff changes. Jörn Freyer was in charge of the project management from July 2020 to July 2021 until he left LGSA. In August and September 2021, Heike Winkelmann was responsible interim. Lydia Hohlstein took over from October 2021 to September 2022 until she left LGSA. From October to December 2022, Heike Winkelmann was responsible interim. Then Isabel Reuter took over the project management from January 2023 until the end of the project. She was also in charge of Action D – Project Monitoring and Action E – Communication and Dissemination of Results and she supported the work on Action C5 – Ecosystem Services. For example, the assessment of subsidies, which was planned in Action C5, was done by her, because she had the general overview of the project partners and their activities. Thus, it appeared more suitable that the project management assesses funding possibilities in the different partner countries (both for the methods tested in the LIFE VineAdapt project and a possible follow-up project). Heike Winkelmann supported Action F from 2023 on mainly in incorporating Isabel Reuter and in assisting events.

Main findings and role of the work package
As results of Action F, the partnership agreements, green public procurement procedures and an extract of the project data from the KPI webtool were submitted. Besides, an After LIFE Action Plan was developed and the Final report was prepared. The Midterm report and two progress reports were submitted, 3 monitoring and steering committee meetings and 21 project partner meetings (including 4 meetings on-the-spot) were organised.

Figure 19: Monitoring and steering committee meeting in Germany, 2021 (© photo: LGSA)

Figure 20: Project partner meeting in Austria, 2024 (© photo: HBLFA)

Action F was crucial for the entire project. On the one hand, the project management coordinated the tasks and the project partners. On the other hand, it acted as contact point for the other beneficiaries and external stakeholders.

Deviations from planning, problems, delays
The first steering committee meeting did not take place as planned until June 2021, but in October 2021. The Midterm report was only submitted in December 2022 instead of September 2022. This was due to staff changes in these years. All other implementation steps proceeded as planned. The staff changes in 2021 and 2022 were challenging. New staff members had to be introduced and in the same time, deadlines had to be kept.

Public relations
Originally, no public relation measures were planned in Action F. Nevertheless, the monitoring and steering committee meetings were communicated to the press. Especially the second monitoring and steering committee meeting in February 2023 raised public attention. As a result, two TV reports, several press articles and social media contributions were published.

Acceptance of the measures
This doesn’t apply for Action F.

Continuation of the work package
For Action F is inseparably linked with the LIFE VineAdapt project, it ends with the projects’ end.

7.2. Main deviations, problems and corrective actions implemented

The major problems encountered during the project include bad weather conditions, in particular extreme drought, the Covid pandemic, different data safety regulations in the partner countries, time-consuming agreements with the winegrowers, difficulties in data collection and staff changes.

Due to unfavourable weather conditions and the harvest, some planned seedings could not be realised as planned in late summer/autumn 2020 and 2021 and were therefore sown in the following spring/autumn. Drought conditions in many European regions (Germany, France, Hungary) had a negative effect on the development of the sown species. In particular, the low rainfall in the first half of 2022 caused heavy drought problems in some areas. In the following years, there was more precipitation and the inter-row vegetation established in all partner countries. In Austria, there was even so much rain in spring 2023 that the installation of the Austrian fertilisation trial had to be postponed to April 2024. The slippery floor did not allow to drive over with the respective machines. After difficulties with the installation of the irrigation trials in Germany, the German irrigation system was damaged by frost in the following winters. In spring 2024, late frost also severely damaged the grapevine plants in the irrigation trial. Thus, the remote sensing tool to adjust the water amount to the need of the vine plants, could not be used at all.

The Covid pandemic prohibited, amongst others, project partner meetings on-the-spot in the beginning of the project. Therefore, all project partners had less travel costs than planned. The project partner meetings were mostly held online. However, the pandemic had also effects on the technical implementation. For example, the sowing machine could not be transported due to Covid restrictions in Austria in autumn 2020 and did thus not arrive in time for autumns sowing. The sowing had to be postponed until May 2021. In addition, the employment of external personnel was sometimes not possible because of strict work contact regulations. There were also less events like festivals, expositions, workshops and field trips.

For respecting the different data protection regulations in the four European partner countries, not one newsletter was published, but rather individual/regional newsletters were distributed by the project partners. The database of demonstration sites was not published online until February 2023 also because of data safety reasons.

The agreements with the winegrowers, who had to consent to the installation of the information panels, was sometimes time-consuming. Thus, the information panels were only set up until September 2023 instead of March 2022.

Data delivery for Actions C5 and D was sometimes delayed in the individual countries, amongst others, due to differences in the timing of the field trials and data entry. Human resources were at times overstretched because data preparation was time-consuming. The complete data for the years 2020 (before the start of the project), 2021 and 2022 were therefore provided by the project partners in 2023, the data for the years 2023 and 2024 in 2024.

The staff changes and their effects were already addressed in chapter 6. Other minor deviations are addressed in chapter 7 within the single actions.

7.3. Evaluation of Project Implementation

Evaluation Action C1 – Innovations in vineyard inter-row greening to increase biodiversity and resilience in vineyard ecosystems

Action	Foreseen in the revised proposal	Achieved	Evaluation (successes/lessons learned)
C1 – Greening of inter-rows	Objective: Increasing native biodiversity in vineyard inter-rows by sowing local seed mixtures of native plant species to promote beneficial insects such as pollinators (wild bees) and pest predators (hoverflies, ladybugs, spiders, wasps) Methodology: Sowing success was monitored. Important indicators were: number and cover of target plant species, wild bee abundance, abundance of specific predator groups (hoverflies, ladybugs, spiders, wasps), bare soil cover and soil abrasion, yield and health of the vine plants, soil decomposition rate Expected results: Strengthened capacity of the vineyard ecosystem to cope with natural extremes (summer droughts, heavy rainfalls), thus making vineyards more resilient to climate change and new pests	yes	Successes: Sowing of native wild plants significantly increased the biodiversity in vineyards compared to conventionally greened and managed control vineyards. The higher structural and flower diversity resulted in significantly higher numbers of species and individuals of beneficial insects (wild bees, hoverflies, lady bugs, spiders, wasps). The increase in biodiversity resulted in a potentially higher resilience to climatic extremes. Compared to species-poor control vineyards, the species-rich biodiversity vineyards showed a higher vegetation cover that reduced the risk of soil erosion. In Mediterranean vineyards, species-rich inter-row vegetation resulted in higher soil fertility. Knowledge gaps in the selection of suitable plant species for biodiversity seed mixtures in different winegrowing regions and the effects of a diverse vegetation in vineyard inter-rows on beneficial insects (pollinators, pest antagonists) were reduced by the project. Lessons learned: However, future research should focus on the effects of fungicides commonly used in vineyards on pollinators and other beneficial insects. In addition, studies on effects of higher above-ground biodiversity in the inter-rows on the soil biome in the vineyards are of great importance, as higher below-ground biodiversity may have positive effects on the water and nutrient

			supply of the vine plants, which could increase their resilience to climate change. Interactions with undervine and surrounding vegetation in particular of semi-natural habitats may also be important for ecosystem services in vineyards and need to be involved in future studies.

Evaluation Action C2 – Development of a biodiversity-friendly undervine management

Action	**Foreseen in the revised proposal**	**Achieved**	**Evaluation (successes/lessons learned)**
C2 – Undervine Manage-ment	Objective: Identifying and demonstrating effective, biodiversity-friendly undervine management practices in vineyards, aiming to reduce reliance on synthetic herbicides and enhance ecosystem services like biodiversity and erosion control Methodology: Pilot trials (~1 ha) are conducted in representative vineyard sites in Austria and Germany involving commercial winegrowers Four treatment variants are tested: (1) pelargonic acid herbicide, (2) acetic acid herbicide, (3) mechanical weed control and (4) sowing with adapted species. Key methods include vegetation analysis, bare soil cover	yes	Successes: Mechanical treatment of undervine area for vegetation control is the most effective and economical option in Austria and Germany. The establishment of sown *Festuca rupicola* and the persistence against mechanical treatment shows good results. The development of a redesigned species rich undervine seed mixture will be evaluated in a following project. Lessons learned: The application of organic acids is not a practical method for the treatment of undervine growth.

	estimation (incl. Canopeo app), equipment practicability assessments and economic evaluations. Expected results: Identification of the most effective and practical undervine management strategies that minimise environmental impact and maintain or improve vineyard biodiversity		

Evaluation Action C3 – Reduction of greenhouse gas emission in vineyards by using resource-efficient fertilisation techniques

Action	**Foreseen in the revised proposal**	**Achieved**	**Evaluation (successes/ lessons learned)**
C3 – Fertilisation	Objective: Underground fertiliser application directly in the root zone of the vines (including effects on biodiversity, yield, grape quality and economic significance) with potential savings compared to conventional fertilisation widely distributed Methodology: Block trial (Germany), demonstration vineyard (Austria) collected parameters: soil samples (by drill stick) before and after fertilisation (values collected:	yes	Tests (soil samples, chlorophyll content/N-tester, soil cover, harvest quantity and grape constituents) show no significant differences in Austria and Germany. Fertiliser quantity can be reduced without loss. Less quantity means lower costs means high economic relevance. Lessons learned: Technical effort: Compost spreader with conveyor belt ideal or expand conventional spreader. Workload: no time savings. Different laboratories came to different results. Measuring points should be marked in order to always achieve the same measuring depth. Yield depends on the year and the weather or the supply from the previous year. Year 2024 not representative due to the extreme late frost in Germany and Austria at the end of April.

	pH, humus, P, K, Mg, Ct, Nt, total N), calculation of yield in kg/ha per variant (grape weight * number of grapes/variant), chlorophyll measurement 2 x per year (July to max. September), soil coverage via the Canopeo app, grape Oechsle and NOPA ingredients (nitrogen supply to berries) Expected results: The amount of fertiliser can be reduced (by 25 %).		
	Objective: Organic fertilisers achieve the same or better results than synthetic fertilisers (including effects on biodiversity, yield, grape quality and economic importance). Methodology: Block trial (Germany), demonstration vineyard (Austria) collected parameters: soil samples (by drill stick) before and after fertilisation (values collected: pH, humus, P, K, Mg, Ct, Nt, total N), calculation of yield in kg/ha per variant (grape weight * number of grapes/variant),	yes	Studies (soil samples, chlorophyll content/N-tester, soil cover, harvest quantity and grape constituents) show no significant differences in Germany. In Austria, clear positive effect on berry weight/harvest quantity. Organic fertiliser achieves the same and better results. The reduction of greenhouse gases and promoting circular economy are promising. But the costs for organic fertiliser are significantly higher. Lessons learned: Positive effect “only” in one year, no generalisation possible. There are high price differences depending on the type of fertiliser. Higher costs could be offset in the long term by higher harvest volumes.

	chlorophyll measurement 2 x per year (July to max. September), soil coverage via the Canopeo app, grape Oechsle and NOPA ingredients (nitrogen supply to berries) Expected results: Better energy balance, more sustainable use of resources through circular economy and/or local nutrient recycling.		
	Objective: Litter decomposition Methodology: Tea Bag Index (only in Germany) Tea bags were buried for 90 days, after drying weight loss was measured, two varieties compared. Differentiation between green tea and roiboos tea (20 tea bags per variety). Expected results: Better understanding of the interaction between climate and litter decomposition.	yes	Always a measurable decrease in weight between the variants. No significant differences between the variants, seems to be dependent on the year (annual temperature and precipitation) – independent of fertiliser type and quantity. Lessons learned: Difficult to find all the tea bags or not to destroy them when digging.

Evaluation Action C4 – Climate change induced drought, effects of irrigation and solutions for resource-efficient irrigation techniques

Action	Foreseen in the revised proposal	Achieved	Evaluation (successes/lessons learned)
C4 – Irrigation	Objective: Ecological risk assessment of irrigation Methodology: Comparison of irrigated and non-irrigated vineyards (subaction 1: 9 irrigated and 9 non-irrigated plots on inter-row vegetation and beneficial (above-ground) arthropods, subaction 2: 5 irrigated and 5 non-irrigated plots on intra-row vegetation and soil mesofauna, subaction 3: 12 irrigated and 12 non-irrigated plots on soil fauna, soil micro-organisms and soil functions) Expected results: Reduced plant diversity due to eutrophisation and corresponding negative effects on beneficial arthropods, positive effects on soil organisms and functions due to higher biomass and litter production	yes	Successes: Current drip irrigation just compensating evapotranspiration losses during summer seems to be well adapted to vineyard ecosystems. Lessons learned: Irrigation involves environmental risks including a reduction in diversity and abundance of beneficial arthropods. Significant negative effects on beneficial arthropods, but not on plant diversity, magnitude of negative effects relatively small. Potential negative effects on vegetation and associated arthropods need to be monitored over longer periods. Positive effects on soil organisms and functions confirmed, but only of short-term character (several days/weeks), suggesting direct positive effects of soil moistures and not biomass/litter mediated effects.
	Objective: Test of resource-efficient irrigation techniques	no	Resource-efficient irrigation could not be tested due to technical problems

Methodology: Testing underground, drip irrigation, controls without irrigation in a field experiment Expected results: Identifying the most resource-efficient variant		
Objective: Remote sensing tool to analyse stress and vitality of vine plants under different management: irrigated, not irrigated, sown with native wild plants, sown with commercial ryegrass Methodology: Unmanned Aerial Vehicles (UAV) with a multispectral camera, ground truth data (chlorophyll fluorescence, leaf water potential, plant health status, nitrogen index, leaf area index) for the calibration of remote sensing data Expected results: Assessing the impact of different irrigation variants, adjusting the amount of water precisely to the need of the vine plants	no	Not possible due to damages of the trials

Evaluation Action C5 – Sustainability analysis of project actions regarding optimisation of ecosystem services and climate change adaptations

Action	Foreseen in the revised proposal	Achieved	Evaluation (successes/lessons learned)
C5 – Ecosystem Services	Objective: Creation of an indicator list for the transnational evaluation Methodology: Review of the CICES classes and orientation to the current state of science, transfer indicator list LIFE VineEcoS Expected results: List of indicators whose data can be filled in by the partners and which can be assigned to ecosystem services, excel spreadsheet template that can be used for the query for all partners	yes	Successes: Indicator list according to CICES and database C1 was drawn up, excel spreadsheet template worked very well Lessons learned: It was not possible to transfer the indicators from the predecessor project LIFE VineEcoS, as the selected indicators did not follow a common evaluation scheme and the basis was also the database of Action C1. Action C5 requires a number of different evaluation approaches, some of which this action was only able to fulfil to a limited extent. This was due to the fact that the joint data collection of the partners was also defined in Action C1 and hardly any more time and financial effort could be invested in the survey. Here it is necessary to agree from the outset which indicators can be assessed for a transnational evaluation and can be filled with data from all partners and what type of evaluation should be carried out. Data query should not coincide with grape harvest.
	Objective: Transnational evaluation of ecosystem services Methodology: Statistics Expected results: Results table with assessment and evaluation of the	yes	Lessons learned: Due to the inadequate data quality and lack of data, the evaluation quality of the assessment of ecosystem services was also affected. Due to this reason, some indicators could not be evaluated.

	individual indicators and ecosystem service classes		
	Objective: Socio- economic and sustainability assessment Methodology: Quantitative surveys with different target groups Expected results: Sustainability assessment scheme if possible monetary	yes	Successes: Enabled a better assessment of the socio-economic perspective, such as the willingness to pay or the attractiveness of winegrowing communities and was included as an evaluation of the cultural ecosystem services. Lessons learned: Hard to integrate in the monetary assessment (cost-benefit-analysis)
	Objective: Monetary assessment of ecosystem services Methodology: Cost-Benefit-Analysis Expected results: Where possible, demonstrating the added monetary value of maintaining or establishing ecosystem services in vineyards	yes	Lessons learned: A cost-benefit analysis was carried out for Germany as an example. The data from the project could only be used to a very limited extent due to the different quality and quantity in some cases. Therefore, regional indicator values from scientific practice were used. The analysis can consequently only provide examples of which indicators are useful for such a calculation. This approach is also criticised in the scientific community, as transferring ecosystem services to a monetary level sometimes reduces the complexity of the impact effects too much.
	Objective: Assessment of subsidies	no	The assessment was carried out under Action F – project management.
	Objectives: Assessment of project impacts	no	The assessment was carried out under Action D – project monitoring.

Evaluation Action D – Monitoring of the impact of the project actions

Action	Foreseen in the revised proposal	Achieved	Evaluation (successes/lessons learned)
D – Project Monitoring	Objective: Reduction of climate change gas by carbon sequestration Methodology: Used indicator: area of successfully implemented biodiversity vineyards in ha Expected results: Assuming that ca. 50 ha will be vegetated, this will correspond to 10 t Corg ha-1 a-1	yes	Successes: In total, 62 biodiversity vineyards with an area of 59.34 ha were established in all project regions. 59.34 ha of greened area corresponds to 11.87 t Corg ha-1 a-1. Lessons learned: The mentioned value of ca. 1,000 ha in the proposal related to the total area of potentially interested winegrowers and is not realistic.
	Objective: Resilience to flooding Methodology: Used indicators: bare soil in 4 x 4 m² plots (average annual cover in %), soil abrasion in kg/ha/year Expected results: Resilience to flooding will be improved considerably	yes	Successes: Overall, the proportion of bare soil in the biodiversity vineyards is only 1 % lower on average than in the control vineyards. But the situation is clearer when it comes to soil abrasion. In all partner countries, soil abrasion is 81 % lower on average in the 2nd and 3rd year after sowing in the biodiversity vineyards than in the control vineyards.
	Objective: Resilience to drought Methodology: Used indicators: plant species cover in 16 m^2 plots in %, number of established plant species in 16 m^2 plots, number of pest antagonists such as ladybirds, hoverflies, spiders and wasps in 16 m^2 plots, pest	yes	Lessons learned: Some indicators couldn't be used, because of methodological difficulties (e. g. leaf area index) or other distortions (e. g. abundance of *Scaphoideus titanus*).

larvae predation in % and chlorophyll fluorescence in SPAD value (absolute numbers) Expected results: Improved resilience to drought. Flower-rich vegetation will also attract beneficial organisms such as natural enemies, therefore lowering pest pressure in the vineyards. As a consequence, a lower stress level in grapevine plants due to increased biodiversity is expected.		
Objective: Increase in biodiversity Methodology: Used indicators: number of bee species and number of endangered bee species in 16 m^2 plots Expected results: A considerable increase of wild bees, by at least 150 % until the end of the project is expected. The no. of threatened bee species is expected to increase by at least 50 %.	yes	Successes: Overall, the frequency of wild bees in all partner countries is on average 162 % higher in the biodiversity vineyards than in the control vineyards. Data on endangered wild bees is only available for Germany and Hungary. In these two countries, there are on average 168 % more endangered wild bees (Red List species) on the biodiversity vineyards than on the control vineyards.
Objective: Implementation of new methods Methodology: Used indicators: no. participants in	yes	In 2024, 77 winegrowers in all partner countries use the project methods. 72 winegrowers are directly involved in the LIFE VineAdapt project. 62 biodiversity vineyards with an area of 59.34 ha were successfully established. In

stakeholder database, no. of participants in conferences, workshops & field trips, no. of website visits, no. of consultations, no. of public relation events, no. of printed information distributed & downloaded from website, no. of students & advisors educated, amount of wine with project label sold, no. of participating wineries, no. of winegrowers adopting project methods Expected results: It is estimated that 5 % to 10 % of the winegrowers will implement the new methods. This may result in a total of ca. 160 to 320 winegrowers with a vineyard area of 1,000 ha to 2,000 ha newly established biodiversity-friendly and climate adapted vineyards.		the project objectives (proposal, p. 24), it is mentioned, that 46 biodiversity vineyards with a total area of ca. 50 ha should be established. Thus, this target was reached. In addition, many people were reached by the dissemination actions of the project partners (see section 7.1, Action E and section 7.4). Lessons learned: The value of 1,000 to 2,000 ha related to the total area of potentially interested winegrowers and is not realistic.
Objective: Measuring the socio-economic impact Methodology: Quantitative surveys, assessing indicators: no. of tourists in project regions, increase in no. of persons aware of	yes	Lessons learned: Because less people took part in the online surveys, the project partner handed out printed questionnaires, for example at events like wine festivals. This secured more returns. Nevertheless, the participation in the surveys was low. The results of the surveys are therefore not representative and their significance is very limited.

	climate or biodiversity issues, no. of winegrowers participating, no. of winegrowers adopting project methods		

Evaluation Action E – Communication and dissemination of results

Action	Foreseen in the revised proposal	Achieved	Evaluation (successes/lessons learned)
E – Communication and Dissemination of Results	Objective: Notice boards Expected results: 11 notice boards, 32 thematic specific smaller notice boards	yes	Lessons learned: The coordination with winegrowers took more time as planned.
	Objective: Multilingual project website	yes	Lessons learned: Though the project partners had own accounts, it hasn't worked out, that everybody contributes to the website. It appeared, that it was easier and faster to send the contributions to the project coordinator, who uploaded them. One responsible for updating the website is needed.
	Objective: Layman's report Expected results: 800 copies	yes	
	Objective: Public relation outputs Expected results: 80 outputs	yes	Successes: The project partners were very active in their public relations work. There were significantly more outputs than planned (over 100).
	Objective: Project flyer Expected results: 5.000 copies	yes	
	Objective: Leaflet about criteria & pictogram for	yes	

wine produced in climate-adapted and biodiversity-friendly vineyards Expected results: 5.000 copies		
Objective: Field trips/workshops for regional multipliers Expected results: 16 events	yes	
Objective: Presence at annual public festivals to inform tourists and local inhabitants Expected results: 20 events	yes	
Objective: Building-up a stakeholder database and sending newsletters Expected results: 8 newsletters	yes	Successes: The newsletter appeared to be an uncomplicated opportunity to inform the stakeholders about the project. There were significantly more newsletters as planned (about 30).
Objective: Field trips and training events for regional winegrowers Expected results: 16 events	yes	
Objective: Mid-project/Midterm workshop Expected results: 100 participants	yes	Successes: It was a good combination between one central event (online conference) and local events in every partner country.
Objective: Final conference Expected results: 200 participants	yes	Lessons learned: Due to technical reasons, it wasn't possible to offer a hybrid event. This would have surely attracted more stakeholders in Austria, France and Hungary. All in all, about 65 persons

		participated in person in Freyburg/Unstrut (Germany).
Objective: Open offices/consulting service Expected results: at least 200 winegrowers/year	yes	Lessons learned: It showed that consulting is very important. Winegrowers need information on greening, particularly regarding the seed mixture, seeding technology, seeding time and pruning.
Objective: Step-by-step-videos	yes	Successes: The videos proved very successful in demonstrating the establishment of flowering strips in the vineyard inter-rows.
Objective: Database of demonstration sites Expected results: 50 best practice examples	yes	
Objective: Development of criteria and a pictogram for climate-adapted and biodiversity-friendly vineyards	yes	Lessons learned: The label is used by the project partners and cooperating winegrowers, but some winegrowers criticised, that there are already many labels. It is therefore quite hard to keep the overview (also for consumers) and to establish a new label.
Objective: Integrating project results about climate-adapted and biodiversity-friendly viticulture in teaching activities Expected results: at least 500 students/year	yes	Lessons learned: The courses reached over 1,000 students all together. If one takes the conferences into account as well, the target of 500 students per year was reached.
Objective: Thematic publications Expected results: 16 articles in national and international	yes	

practice-orientated journals		
Objective: Presentations at relevant conferences in Europe Expected results: 10 events	yes	Successes: The project partners were present at significantly more conferences (over 30).
Objective: Leaflet recommendations for actions on measures to support climate-adapted and biodiversity-friendly viticulture Expected results: 800 copies	yes	
Objective: Knowledge exchange with other projects	yes	Successes: There was a very fruitful exchange with AmBiTo project of Hochschule Geisenheim University in terms of methodology, composition of seed mixtures and organisational questions. The project responsibles presented their interim results both at the Midterm Workshop and the Final Conference of LIFE VineAdapt.

Evaluation Action F – Project management

Action	**Foreseen in the revised proposal**	**Achieved**	**Evaluation (successes/lessons learned)**
F – Project Management	Objective: Creation of a project management unit Methodology: Ongoing exchange via modern communication means Expected results:	yes	Successes: The exchange between HSA and LGSA worked very well.

	Partnership agreements		
	Objective: Implementation of project working groups at both regional level and transnational level Methodology: Project meetings Expected results: 8 common on-the-spot meetings with the project partners, regional working group meetings at least 4 times a year, consisting and long-lasting contracting	yes	Successes: Regular project meetings took place. Lessons learned: Due to the Covid pandemic, just 4 (and not 8) on-the-spot meetings took place, but also 17 online project partner meetings.
	Objective: Application of a project management toolset Methodology: Project monitoring database, work plan, financial performance database (updated at least 2 times a year) Expected results: Identifying possible deviations and challenges soon enough to find appropriate solutions	yes	Successes: The project management toolset worked very well.
	Objective: Communication of the project management unit with CINEA and the external monitor Methodology: Ongoing contact, meetings, reports	yes	Successes: Communication with CINEA and external monitor worked very well. Lessons learned: Only 3 monitoring visits were possible for the external monitor.

Expected results: Monitoring visit once a year, 2 progress reports, 1 Midterm report, 1 Final report		
Objective: Elaboration of an After-LIFE-Action Plan Expected results: Basis for active application and dissemination of climate adapted winegrowing methods	yes	Lessons learned: It wasn't easy to find the balance between realising the future tasks and the capacities of the project partners beyond the projects' end (finances, staff).
Objective: Assessment of subsidies	yes	Were assessed both for the methods tested in LIFE VineAdapt project in all partner countries and a possible follow-up project.

Policy impact

The project actions demonstrated, evaluated and optimised specific greening and management methods in an ecosystem-based approach for vineyards on a transnational level, adopting them to a wider practice. Therefore, the project contributed to the EU Climate Adaptation Strategy, the EU Sustainable Development Strategy and the EU Strategy on Green Infrastructure. By using a high variety of native wild plants in vineyard inter-rows, that provides suitable feeding, mating, nesting and overwintering habitats for various insect groups, including pollinators (e. g. wild bees, butterflies, hoverflies), the project supported the EU Pollinators Initiative and the EU Biodiversity Strategy. The tested methods are replicable and transferable within the respective winegrowing region and also in other winegrowing regions. However, they must always be adapted to the respective area.

In Germany, policy-makers are interested in adopting the project recommendations. Politicians and representatives of administrations were often present at events of the LIFE VineAdapt project. For example, The Prime Minister of Saxony-Anhalt Dr. Reiner Haseloff and the Minister for Science, Energy, Climate Protection and Environment of Saxony-Anhalt Prof. Dr. Armin Willingmann wanted to get to know the project better. The German project partners elaborated proposals for integrating the measures successfully tested within the project in the future funding strategy of Saxony-Anhalt and handed them to the Ministry for Economics, Tourism, Agriculture and Forestry of Saxony-Anhalt. This Ministry also supports the LIFE VineAdapt project by covering a part of the own contribution of the German project partners. On occasion of the Final Conference, the State Secretary of the Ministry for Economics, Tourism, Agriculture and Forestry of Saxony-Anhalt Gert Zender promised to further support practical solutions in adapting viticulture to climate change. In Austria, the measures successfully tested in the

project, are already fundable to a certain extent. The French and the Hungarian partners also tried to get into contact with policy-makers, but only with limited success. On European level, there was an experience exchange with Copa Cogeca (association of European farmers and agri-cooperatives) and a project presentation for its wine working group. All in all, staff capacities for lobbying were very low.

7.4. Analysis of benefits

1. Environmental benefits
   a. Direct/quantitative environmental benefits:
      The project area resp. the adaptation area was larger than expected. 46 vineyards with ca. 50 ha of total biodiversity vineyard area were estimated. In fact, 62 biodiversity vineyards with an area of 59.34 ha were established. These vineyards provide habitats for wild bee species and other beneficial insects. It was expected, that the abundance of wild bees increases by 150 %. In fact, the abundance of wild bees was on average 162 % higher on the biodiversity vineyards than on the control vineyards.

   b. Qualitative environmental benefits
      Biodiversity vineyards are clearly more resilient to flooding and drought, because the vegetation cover on the 16 m² plots was on average 9 % higher in the 2nd and 3rd year after sowing in the biodiversity vineyards than in the control vineyards. In addition, soil abrasion was 81 % lower on average in the 2nd and 3rd year after sowing in the biodiversity vineyards than in the control vineyards. The establishment of vegetation also helps to better store and retain carbon in the soil. This means overall, that biodiversity vineyards seem to be more resilient to climate change.

2. Economic benefits
   The creation of 5 jobs was foreseen. In fact, 10 jobs (full time equivalents) were created within the project by the project partners.

3. Social benefits
   There weren't any KPI listed in this section. Nevertheless, the project had a positive social impact. The surveys with locals and tourists in the partner winegrowing regions showed, that flowering vineyards are perceived very positively by the surveyed locals and guests. Most of the locals can identify more with their region if there are flowering vineyards. The majority of guests prefers to spend their holidays in winegrowing regions where there are flowering vineyards. A clear majority believes that flowering vineyards increase their well-being and their quality of life and stay.

4. Replicability, transferability, cooperation
   The project raised much awareness. More than 12 million people were reached by public relations measures like press articles, TV reports and social media posts and not only 10 million as expected. Regarding the website visits, 25,000 visits were foreseen. In fact, there were 79,972 visits from 2021 to 2025. In terms of change of behaviour, it was expected, that 100.000 persons will be positively influenced by the project. In fact, there were more than 488.000 persons like winegrowers, students or multipliers like winegrowing associations influenced by workshops, field trips, annual festivals,

conferences, networking events, teaching activities, newsletters and consultations inside and outside of the project area. These persons will integrate the knowledge transferred by the project partners into their future winegrowing activities.

The methods proven within the project can help make viticulture more resilient to climate change. They are replicable and can be adapted to other wineries in the project winegrowing regions and to other winegrowing regions. Crucial is the suitable and site-adapted composition of the seed mixtures and an appropriate management. Although the majority of the surveyed winegrowers within the project would invest in the greening of the vineyard inter-rows, it is important to offer funding, because the wild plant seed mixtures are much more expensive than conventional seed mixtures. The cost-benefit-analysis shows, that the gap between costs and benefits is about 800.00 euros per hectare. Thus, the replication is somewhat policy-dependant.

5. Best Practice lessons

In the “Innovative greening of vineyard inter-rows” work package, the flower strips coped well with drought and provided plenty of nectar and pollen. Significantly more plant species, wild bees, hoverflies, ladybirds and spiders were found in the biodiversity vineyards in all project regions. Soil erosion was also lower there, suggesting greater resilience to flooding and drought. However, appropriate management was important. The seed mixtures with certified regional wild plant species have to be adapted to the respective winegrowing region, but worked very well in general. In the “Alternative undervine management” work package, the mechanical treatment using a mower with a brush attachment proved to be the most effective and economical variant. In the “Resource-efficient fertilisation methods” work package, no major or generalisable differences in yield or vine vitality were found between the individual variants. In the “Resource-saving irrigation” work package, it was found, that drip irrigation is resource-efficient when it is realised at night (or in the evening or early morning), not during the day. In addition, winegrowers should use automatic irrigation systems to better control the amount of water and the period of irrigation.

6. Innovation and demonstration value

Within the LIFE VineAdapt project, innovative methods were used in the different partner countries, so at national and international level. This includes the greening of the vineyard inter-rows with site-adapted regional wild plant mixtures, the alternative undervine management, the resource-efficient fertilisation methods and the resource-saving irrigation variants. In the “Transnational assessment of ecosystem services in vineyards” work package, all project components were evaluated using data analyses and surveys. The CICES classification of ecosystem services from the European Environment Agency served as a very good basis. Additional indicators helped to assess the effects of the methods used in the project. Besides, the cooperation between practice and research partners worked very well.

7. Policy implications

The legislation in the partner countries is very different and so are the policy implications. In most European countries, no subsidies are available for sowing high diversity seed mixtures. The costs of such mixtures are quite high (depending on the country about 1,200 Euro/ha) representing a considerable financial effort for winegrowers. In Austria, there is already an elaborated funding strategy, which

includes the greening of the inter-rows to a certain extent. In Germany, the project partners proposed a system of environmental bonuses to the responsible Ministry for Economics, Tourism, Agriculture and Forestry of Saxony-Anhalt. Contrary to Hungary, Germany and Austria, rules to use local seeds from native plants in organic vineyards are quite restrictive in France. Certification bodies asked for an organic certification of each plant species of the mixtures involving a high administrative effort. Furthermore, in Hungary the wildflower seed market is underdeveloped.

8. Key Project-level Indicators

The project specific KPI are evaluated under section 7.4. In addition, there are general KPI, such as NGO, number of hotlines/information centres created, number of students and number of professionals. It was expected, that 10 stakeholders are involved in the project. In fact, 12 stakeholders like winegrowing associations, agricultural associations, tourism associations, nature parks were involved. Apart from the estimated value of one information centre or hotline created, there are actually 4 information centres or hotlines established, that means one contact institution in each partner country. The practical project partners LKP, ÖMKi, Silberberg and Marrenon will be available for requests and consultations (also after the end of the project). The numbers of students and professionals are lower than expected. Directly reached by teaching activities of the project partners, at conferences and other training or educational events were about 1,200 students and by workshops, field trips and other events about 1,400 professionals like winegrowers (and not 2,000 each as estimated).

9. Comments on the financial report

General comment on the financial report:
Overall, the planned budget wasn't sufficient. 6 project partners overdrew their budget and 2 project partners spent less than planned. That means, that 6 project partners had to increase their own contribution. The deviations in the cost categories vary. The project partners needed more personnel costs, consumable costs and other costs, but less travel costs and equipment costs. Generally, travel costs were lower for all project partners due to the Covid pandemic and respective travel restrictions. Equipment costs were saved for example by renting machines. Personnel costs were higher because of wage rises and the need of more personnel for time-consuming manual work. The reasons for the higher consumable costs and other costs are manifold. They are explained in the following detailed comments.

Comments on the financial report of AREC:

- Personnel: The deviations from the originally planned budget for personnel costs result mainly from inflation-related salary adjustments over the last 4 years as well as from the biennial increments provided for in the employment contracts of the "non-additional staff" employees of AREC (contract employees or civil servants), which take place every two years. As a result, salaries have risen sharply since the project was applied for.
- Travel: A large part of the transnational project meetings were held online, which mean that significantly less travel costs incurred.

- Other costs: Due to the Covid pandemic, no conferences were held on site in connection with the project. After the pandemic, the conferences were mostly held online without a conference fee, so the planned conference fees didn’t incur. Since the project was submitted, the costs for translation programmes have been greatly reduced, which are covered by general access via the HBLFA. As a result, no directly billable translation costs incurred. Instead, other direct costs incurred for the repeated transport of the HBLFA sowing machine by truck to set up the trials and for demonstration at the practitioner's days.

Comments on the financial report of HSA:

- Personnel: Cost savings from other cost categories were used to do additional field work. HSA assessed, for example, the establishment success of sown seed mixtures on 12 vineyards (instead of the initially planned 6 vineyards) and increased the survey dates of pest antagonists from one to three per year, starting in 2023.
- External assistance: Remote sensing to assess the impact of different irrigation variants in the German irrigation trial was not carried out due to the irrigation trial was damaged by frost. Thus, there were less costs.
- Consumables: Cost savings from other cost categories were used to buy more seed mixtures for installing more biodiversity trials, that increased costs in the Consumables cost category.

Comments on the financial report of IMBE-AU:

- Travel: Travel costs were lower than expected, because the Covid pandemic limited travel to project partners until 2022.
- External assistance: External assistance costs were higher because the consortium agreed on the importance of more detailed soil chemical and physical analyses in C1 and C4 as indicated in the proposal.
- Equipment: Equipment was finally not necessary. Laptops were funded by Avignon University. The information panels were finally built by IMBE-AU, which reduced costs. The remaining costs of material had to be changed to Consumables because the amount was lower than 800 Euros net (limit for equipment at Avignon University).
- Consumables: Consumables costs were higher than expected because the sown area was much larger than initially scheduled, which increased the costs for seed material. IMBE-AU could partly compensate these higher seed costs by a reduction of costs for soil invertebrate analysis in using own resources.
- Other costs: Wild bee identification was added to the project costs. Wild bee identification was initially not included in the budget. However, the project partners agreed on the importance of wild bees for the project and IMBE-AU had to add these costs to the budget. The compensation for winegrowers indicated in the initial budget appears as “seedbed preparation” in the financial report.

Comments on the financial report of LGSA:

- Travel: Due to the Covid pandemic, there were less on-the-spot visits as estimated. Thus, there were less travel costs.
- External assistance: There are higher costs in this cost category. On the one hand, the project flyers were exhausted and had therefore to be reprinted in German and English. Because a French version was missing so far, such a version was set up and printed as well. On the other hand, a leaflet about the criteria and a pictogram for wine produced in climate-adapted and biodiversity-friendly vineyards was foreseen in the

proposal, but not in the budget. Therefore, there were expenses for design and print of the leaflets and the pictogram (as hang tag).

- Other costs: In this cost category, also higher expenses incurred. Only text translations were planned, but for the Midterm Workshop and the Final Conference, interpreting was needed as well. As agreed with the external monitor and CINEA, the project label "Biodiverse Winegrowing" was registered as European trademark, for which costs incurred. In addition, LGSA subscripted for the regional newspaper "Naumburger Tageblatt" (online) for collecting the articles about the LIFE VineAdapt project which appeared in the winegrowing region Saale-Unstrut. For the participants of the Final Conference and other stakeholders of the project, LGSA ordered folders, pens, writing pads and bags. Furthermore, there were fees for the deposit copies of media reports and artist's social charges.

Comments on the financial report of LKP:

- Personnel: New staff had to be hired. General wage increases and individual salaries led to higher costs. In addition, familiarisation with the project took more time. Poor weather conditions required more labour-intensive manual work and therefore led to more working hours.
- Travel: During the Covid pandemic, travel was not possible or was very limited. The estimated volume was therefore not required.
- External assistance: Repairs and other costs didn't incur.
- Equipment: Instead of a new machine, an existing one was supplemented with an attachment, which was significantly cheaper than the originally planned machine.
- Consumables: As the area for the fertilisation trials was significantly reduced, much less fertiliser had to be purchased.
- Other costs: General cost increases led to higher costs. The planning and implementation of the Final Conference was more expensive than planned.

Comment on the financial report of Marrenon:

- External assistance: Originally, no costs were planned in this category. But in the course of the project, grape analysis services had to be done.

Comments on the financial report of ÖMKi:

- Personnel: Personnel costs were budgeted based on the significant involvement of junior scientists. However, ÖMKi engaged more senior and post doc staff during the project than foreseen in the proposal, resulting in higher overall salary costs.
- External assistance: Unfortunately, an expert for *Scaphoideus* monitoring was not planned during the preparation of the project. This need arose during the project's active phase and was also requested by the other project partners in order to align the scientific methodologies. In addition, the proposal did not include an expert fee for the scientist who was actively involved in developing the seed mixture used in the LIFE VineAdapt trials. He is a former employee of ÖMKi and his many years of experience in developing diverse seed mixtures for vineyards was necessary in the initial phase of the project.
- Consumables: Due to the unexpected and unfavourable weather conditions, a higher amount of the seed mixture was used during the duration of the project than foreseen in the budget. In addition, some components of the high diversity seed mixture were more expensive and more difficult to purchase due to the limited availability of the seed of non-standard plant species.

- Other costs: Travel cost for the speaker at the Final Conference and costs for organising one project meeting were unfortunately not foreseen in the initial budget. These factors led to a higher amount of other costs being claimed for the project.

Comments on the financial report of Silberberg:

- Travel: The reason for the deviation from the estimated amount is mainly due to the Covid pandemic and a shortage in personnel. Therefore, some of the planned trips could not be made and when they were made, fewer participants than planned could take part.
- External assistance: Due to personnel shortage, more external assistance was necessary. Especially in terms of the scientific coordination, help was necessary to meet the project goals.
- Equipment: Due to the use of more rental machines it was not necessary to buy the equipment.

9.1. Summary of Costs Incurred

All financial rules were respected.

PROJECT COSTS INCURRED				
	Cost category	Budget according to the grant agreement in €	Costs incurred within the reporting period in €	%
1.	Personnel	2,254,585.00	2,376,894.15	105.42
2.	Travel and subsistence	146,020.00	67,700.32	46.36
3.	External assistance	111,980.00	109,948.51	98.19
4.	Durables goods: total non-depreciated cost	17,800.00	3,609.86	20.28
	- Infrastructure sub-tot.	0.00	0.00	
	- Equipment sub-tot.	17,800.00	3,609.86	20.28
	- Prototype sub-tot.	0.00	0.00	
5.	Consumables	71,867.00	77,201.08	107.42
6.	Other costs	31,450.00	51,396.18	163.42
7.	Overheads	183,469.00	182,595.00	99.52
	TOTAL	**2,817,171.00**	**2,869,345.09**	**102.17**

9.2. Accounting system

Accounting system

The beneficiaries work with different accounting systems in order to manage and monitor the project costs.

AREC: AREC is a public body and has an obligatory financial code within the organisation of the Ministry of Agriculture, Regions and Tourism (42K0K926). The Ministry is using the SAP system. Furthermore, every department of AREC has an individual code (e. g. N for Analytics or 2 for Department No 2). Finally, every project or activity gets an assigned financial code. In the case of LIFE VineAdapt, the financial code is 190. If an invoice for LIFE VineAdapt is to be paid by Department No 2, it will be referred to using a combination code: 42K0K926 - 190 – 2. This code is unchangeably connected to the respective invoice.

LGSA: LGSA uses the internal accounting system Hamburger Software Finanzwesen, 3.10., which is also used for LIFE VineAdapt. The corresponding project account is 241-002-0. The internal accounting procedure works as follows: accounting receives the invoice and forwards it to the project management. The invoice is pre-audited and stamped. The project management sends it back to accounting for payment via business unit management. The original invoices are stored centrally in the accounting department.

HSA: HIS FSF-GX, Project account: P9110213004

LKP: Internal Cost unit 90002. The internal accounting procedure works as follows: accounting receives the invoice and forwards it to the project management. The invoice is pre-audited and stamped. The project management sends it back to accounting for payment via business unit management. The original invoices are stored centrally in the accounting department.

IMBE-AU: Internal project code: 20DAVINERSEU

ÖMKi: ÖMKi uses the internal accounting system “RLB ügyviteli rendszer, Kettős könyvviteli program” and payroll accounting system “Novitax”, which is also used for LIFE VineAdapt. The corresponding project account is LIFE. The internal accounting procedure works in the following way: accounting receives the invoice and forwards it to the project management. The invoice is pre-audited and stamped. The project management sends it back to accounting for payment. The original invoices are stored centrally in the accounting department.

Marrenon: Marrenon is a Simplified Joint Stock Company (SAS). It has an internal accounting department for managing the budget and invoices. Invoices and expenses related to the LIFE VineAdapt project are filed under the reference: LIFE19 CCA/DE/001224. The project coordinator at Marrenon is responsible for validating the invoices with the accounting department.

Silberberg: For the project partner Silberberg, all costs are booked and settled via the project number LIFE2020-25.

Time recording system

The beneficiaries use different systems or procedures to record employees' time.

AREC: There are electronic and manually completed timesheets filled in by the project employees. Staff members are entering their personal code electronically when entering

and leaving the premises. The assignment of working time to different projects is separately entered into an electronic system. Every project or activity has its own code (e. g. VineAdapt: 2482, subactions are also deposited for selection). In the case of business trips, the working hours are entered in a timely manner. Due to differences between the time registration system and the project assignment system, minor deviations may appear. At the end of the month, every staff member prints out two sheets: one with the time documentation and the second one with the assignment of working time to projects/activities. The electronic system of the reported month is then closed and the information forwarded to the Ministry. Both documents are signed by staff members and supervisors and kept for evidence. All persons claiming personnel costs in the financial report prove the time with timesheets.

LGSA: The LGSA uses ZEUS WebServices as its electronic time recording system. In addition, project-related staff write LIFE time sheets (if they worked at least 192 hours per year).

HSA: Two employees (non-additional salary costs) are delegated to the project for a clearly defined percentage of their working time. Further employees (additional salary costs) and student assistants were employed on the basis of a working contract.

LKP: LKP uses e2n as electronic time recording system. In the employment contracts of the project employees, fixed percentages of working hours are agreed. All other persons involved in the project prove the hours worked on the project by keeping time sheets (if they worked at least 192 hours per year).

IMBE-AU: No special time system is used. Each team member involved in the project provided an assignment letter indicating the percentage of working time dedicated to the LIFE project.

ÖMKi: ÖMKi is using a paper-based timesheet system. The excel based timesheets are filled in by the project employees electronically and at the end of the month, every staff member prints them. Documents are signed by staff members and supervisors and kept for evidence. Each employee proves the time of performance with timesheets.

Marrenon: The employment contract of the project coordinator of Marrenon specifies a fixed percentage of working time for the LIFE project. For other persons involved in the project, the working time is tracked with timesheets (if they worked at least 192 hours per year).

Silberberg: For the employees in the project, secondments are agreed in the employment contract, each with a percentage share of the working time.

Invoices

Generally, invoices clearly linked to the LIFE VineAdapt have to mention the project code provided by CINEA: LIFE19 CCA/DE/001224. All beneficiaries add the project code to its invoices and/or stamps the reference code LIFE19 CCA/DE/001224 on the invoices and on every travel documentation that refers to LIFE VineAdapt.

9.3. Partnership arrangements

Partnership Agreements on project implementation were made between the coordinating beneficiary and the associated beneficiaries. In § 10 of the partnership agreements, the payment terms are defined. The coordinating beneficiary transfers the 3 rates to the associated beneficiaries according to the deadline named in the agreements: first rate (40 %) within 15 days after receiving the signed agreements, second rate (40 %) within 30 days after receiving funds from CINEA and the third rate within 30 days after receiving final payment from CINEA. In addition, the agreement regulates the procedure of the financial reporting in § 4. Two times per year, the associated beneficiaries send their financial reports covering the project related costs and showing the expenditure status of six months to the coordinating beneficiary.

10. Annex

Index of Deliverables

LIFE VineAdapt – Index of Deliverables

Name of the Deliverable	Short Description	Action	Status
Partnership agreements incl. workplan and financial performance template	Signed partnership agreements	F	Done
Flyer on project goals and project activities	General project flyer, available in English, German and French	E	Done
Establishing of a common baseline regarding the selection of suitable native species for country specific seed mixtures	The project partners of every partner country used this baseline for the selection of the seed mixtures.	C1	Done
Green public procurement procedures	Were set up for every beneficiary	F	Done
Extract of the project data from the KPI webtool	Available as .PDF and .XLSX	F	Done
Initial newsletter to all stakeholders in database to establish contact	There wasn't a central newsletter, but one for every partner country (amongst others for data safety reasons).	E	Done
10 information panels (stationary)	11 information panels and 32 information plates were installed.	E	Done
25 media outputs (online, press, TV, radio)	Even more than 25 media outputs were published until 31.12.2022.	E	Done
Leaflet about criteria for wine produced in climate- and biodiversity-friendly vineyards and the related pictogram	Leaflet accompanying the project label "Biodiverse Winegrowing", available in English, German, French and Hungarian	E	Done
Pictogram for climate-adapted and biodiversity-friendly vineyards	Project label "Biodiverse Winegrowing", available as file and as hang tag in English, German, French and Hungarian	E	Done
Report on intermediate results	First results regarding ecosystem services with data from all partner countries	C5	Done
4 Step-by-Step tutorials (videos)	The videos in all partner languages show step by step the establishment of flowering strips in the inter-rows of vineyards.	C1/E	Done
Environmental risk assessment of irrigation systems	The risk assessment involves the impact of irrigation on vegetation, beneficial arthropods and soil organisms.	C4	Done
Database with 50 examples of successful demonstration sites	There are 72 examples of successful demonstration sites in the database, which is online on the project website.	E	Done

Fact sheets of important pest antagonists	Four groups of pest antagonists are presented: wasps, hoverflies, ladybugs and spiders. The deliverable was adapted to the respective partner winegrowing regions.	C1	Done
Fact sheets of plant species suitable for seed mixtures	The total species list and fact sheets of the most common wild plant species from the seed mixtures that were sown and detected in the demonstration vineyards are presented. The deliverable was adapted to the respective partner winegrowing regions.	C1	Done
Fact sheets of wild bee species suitable as indicators for biodiversity vineyards	The most common wild bee species in the flowering inter-rows of the demonstration vineyards are presented. The deliverable was adapted to the respective partner winegrowing regions.	C1	Done
Suggestions for improvement of selected seed mixtures for all partner regions	Suggestions are given for all partner winegrowing regions.	C1	Done
Guidelines for the establishment of climate- and biodiversity-friendly vineyards	Information is given on the establishment and maintenance of wild forb inter-rows in vineyards. The deliverable was adapted to the respective partner winegrowing regions.	C1	Done
Layman's report	Published in form of a leaflet describing the results of the project, available in English, German, French and Hungarian	E	Done
Recommendations for action for decision makers and administrative bodies	Published in form of a leaflet describing measures for climate- and biodiversity-friendly viticulture, available in English, German, French and Hungarian	E	Done
Remote sensing tool to adjust the water amount to the need of the vine plants	Couldn't be realised due to technical problems (see explanation in the Technical Report, section 7.1, Action C4)	C4	Not possible
Resource-efficient fertilisation guideline for practitioners	The tested fertilisation techniques are described in detail.	C3	Done
Resource-efficient irrigation guideline for practitioners	The tested irrigation techniques are described in detail and recommendations are given.	C4	Done
Undervine management guideline for practitioners	The tested undervine management techniques are described in detail.	C2	Done

16 articles in expert's literature	Even more than 16 articles were published in expert's literature.	E	Done
80 media outputs (online, press, TV, radio), cumulated	Even more than 100 media outputs were published.	E	Done
After-LIFE action plan	Agreed with all project partners	F	Done
Documentation of project impact per year	Table with data of all project countries	D	Done
Ecologic impact assessment of actions C1 – C4	Report on the basis of the data of action C1 – C4 (joint report for ecologic and socio-economic impact assessment)	D	Done
Economic impact assessment of actions C1 – C4	Report on the basis of the data of action C1 – C4 and the surveys (joint report for ecologic and socio-economic impact assessment)	D	Done
Social impact assessment of actions C1 – C4	Report on the basis of the data of action C1 – C4 and the surveys (joint report for ecologic and socio-economic impact assessment)	D	Done
Report on sustainability analysis and utility analysis of ecosystem services and climate change adaptation	Results regarding ecosystem services with data from all partner countries and cost-benefit-analysis for Germany	C5	Done
Final report	Consisting of Technical report and Financial report	F	Done