agromitiga

Development of climate change mitigation strategies through carbon-smart agriculture

Life Agromitiga

Layman report. LIFE17 CCM/ES/0001401

PROJECT FICHE

Title: LIFE17 CCM/ES/000140. Development of climate change mitigation strategies through carbon smart agriculture.

Acronym: LIFE Agromitiga.

Start date: 15/09/2018

End date: 29/02/2024

Coordinating beneficiary:

Spanish Association of Conservation Agriculture Living Soils (AEACSV).

Associated beneficiaries:

- Young Farmers' Agricultural Association of Seville (ASAJA Seville).
- Department of Sustainability, Environment and Blue Economy of the Regional Government of Andalusia.
- European Conservation Agriculture Federation (ECAF).
- Andalusian Institute for Agricultural, Fisheries, Food and Organic Production Research and Training (IFAPA).
- University of Cordoba.

Total budget: 2.782.957 €.

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INTRODUCTION

El suelo, uno de los recursos naturales vitales para la producción de alimentos, cons-
Soil, which is one of the most vital natural resources for food production, is the largest carbon pool in terrestrial ecosystems. With 2.4 trillion tonnes in the top two meters, soil is the world's second largest reservoir of carbon after the oceans, storing up to three times more than the atmosphere and four times more than above-ground biomass. To give an idea of what this amount represents in terms of greenhouse gas (GHG) emissions, a 5% reduction in the carbon stored in soil would be equivalent to emitting CO_2 into the atmosphere over a period of 2-4 years.

The carbon stored in the soil is the result of the sink effect it has on atmospheric CO_2, an effect produced through the photosynthetic activity of plants and the subsequent incorporation of carbon into the soil permanently when these vegetative structures degrade. For all these reasons, soil is currently an important ally in the fight against climate change, thanks to the sequestration of atmospheric carbon produced by its sink effect, thus reducing the concentration of CO_2.

However, as soil stores carbon, it can also be lost through agricultural malpractice in the form of CO_2 emissions or through phenomena such as erosion and runoff. Tillage-induced soil disturbance is one of the major causes of soil carbon loss. In this respect, studies have confirmed that intensive agriculture based on tillage has contributed to the loss of between 30% and 50% of soil carbon in the last two decades of the 20th century. Thus, tillage has a direct influence on CO_2 emissions from the soil to the atmosphere, both in the short term (immediately after tillage) and in the long term (during the growing season). This is because tillage stimulates the production and accumulation of CO_2 in the porous soil structure through mineralisation of organic matter. The mechanical action of tillage leads to the breakdown of soil aggregates, with the consequent release of CO_2 trapped inside the aggregates and its subsequent emission into the atmosphere.

Based on these considerations, actions to decarbonise the agricultural sector include increasing the soil carbon sequestration capacity and reducing GHG emissions in general. This is where agricultural practices that favour the regeneration of the natural resources of agricultural ecosystems, such as **Conservation Agriculture** based on the elimination of tillage, the maintenance of vegetation cover on the soil, and the practice of crop rotation, come into their own.

OBJECTIVES

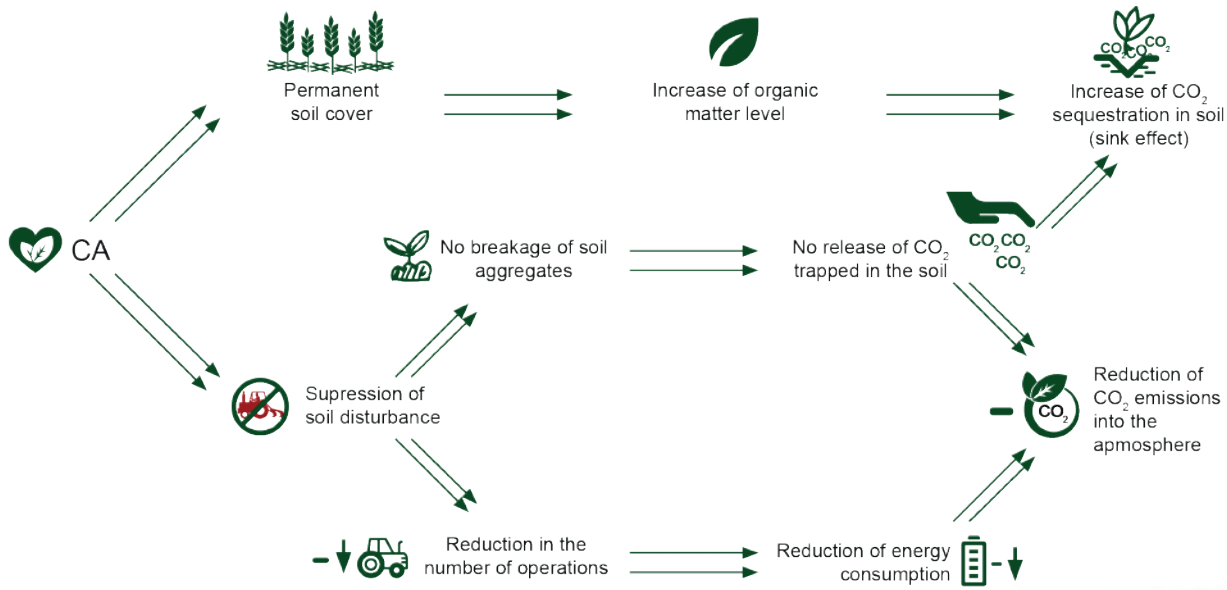
OBJECTIVES

In this context, the **LIFE Agromitiga** project, a European initiative co-financed by the European Union's LIFE Programme, promotes the development of low-carbon management systems through the implementation of Conservation Agriculture practices for both arable and woody crops. The objectives of the project are as follows:

- To improve the state of knowledge about the contents of carbon in agricultural soil.
- To design and implement a method to calculate carbon footprint in the cultivation stage of crops, eligible for international verification standards and carbon footprint calculation.
- To develop a technological tool to evaluate and quantify the increase of carbon in soils due to better soil management practices, as a basis for the development and monitoring of policies linked to climate change and emissions trading.
- To demonstrate the ability of Conservation Agriculture to reduce greenhouse gas emissions in the Mediterranean Basin.
- To encourage the development of soil management systems that mitigate climate change, through training and raising awareness of stakeholders linked to agriculture.
- To spread and transfer the experience and the soil management philosophy to similar Mediterranean areas.

CONSERVATION AGRICULTURE: THE CARBON FARMING PARADIGM

Thanks to the application of its three principles (no tillage, ground cover, crop rotation/crop diversification), Conservation Agriculture promotes several mechanisms that contribute to carbon sequestration and the reduction of GHG emissions.



ACTIONS

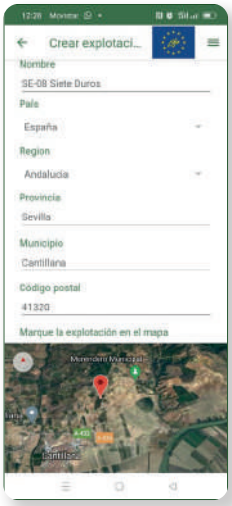
ACTIONS TAKEN

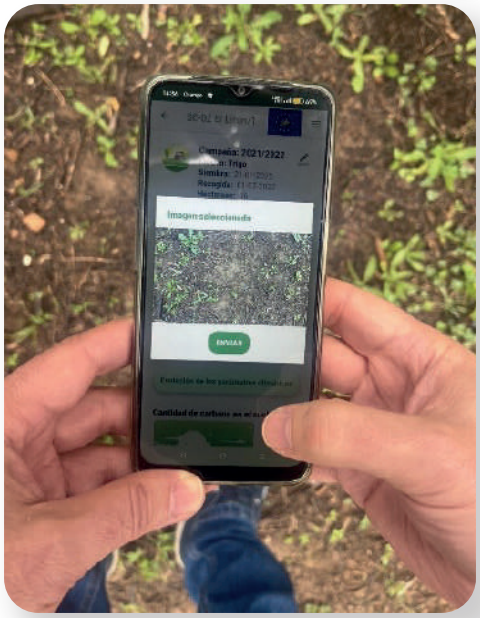
To achieve these objectives...

We have developed a software tool (App) that allows, through photographs taken by mobile devices, the estimation of the carbon content present in the soil and verification of its increase owing to Conservation Agriculture. In addition, the application calculates the CO_2 emissions of a crop management system based on the agricultural operations carried out on the crop. This tool makes it possible to monitor annual GHG emissions and soil carbon content.

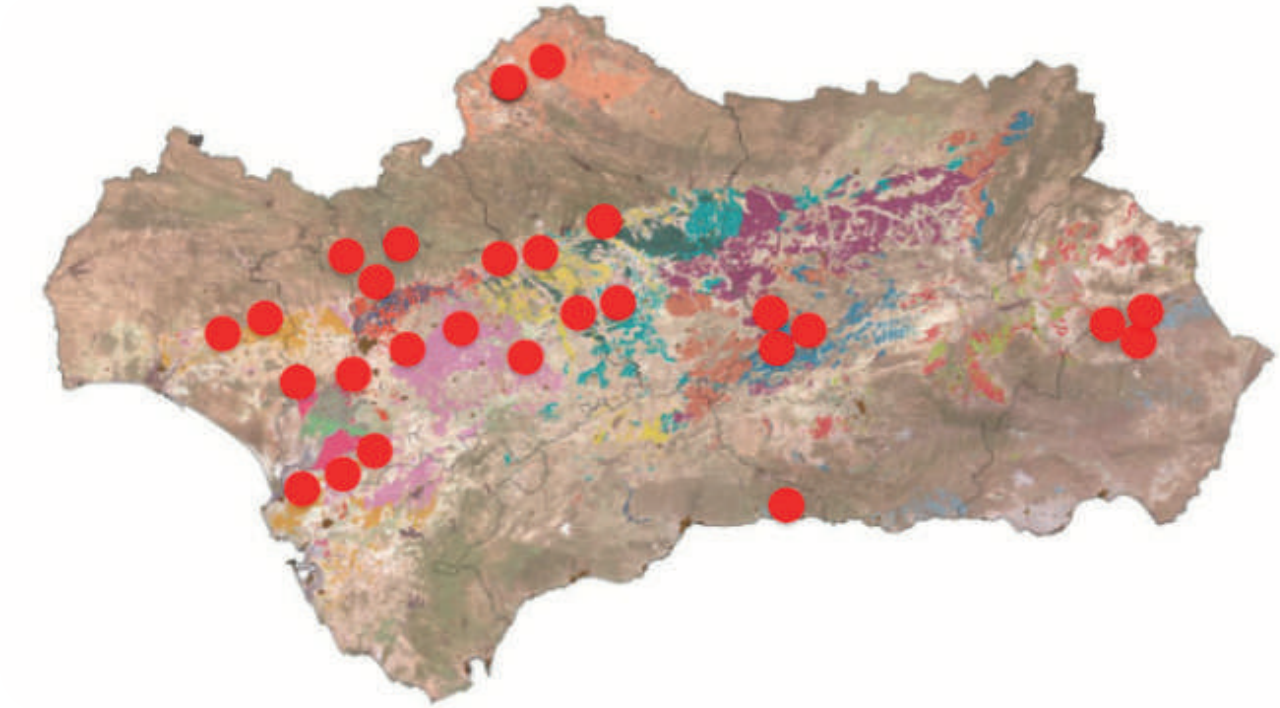
ANDROID APP ON Google play

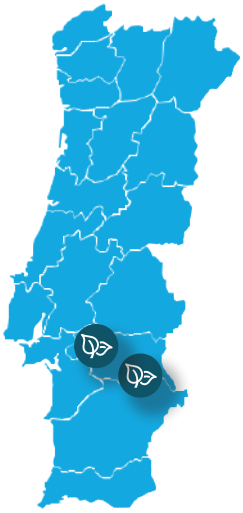
Download on the App Store



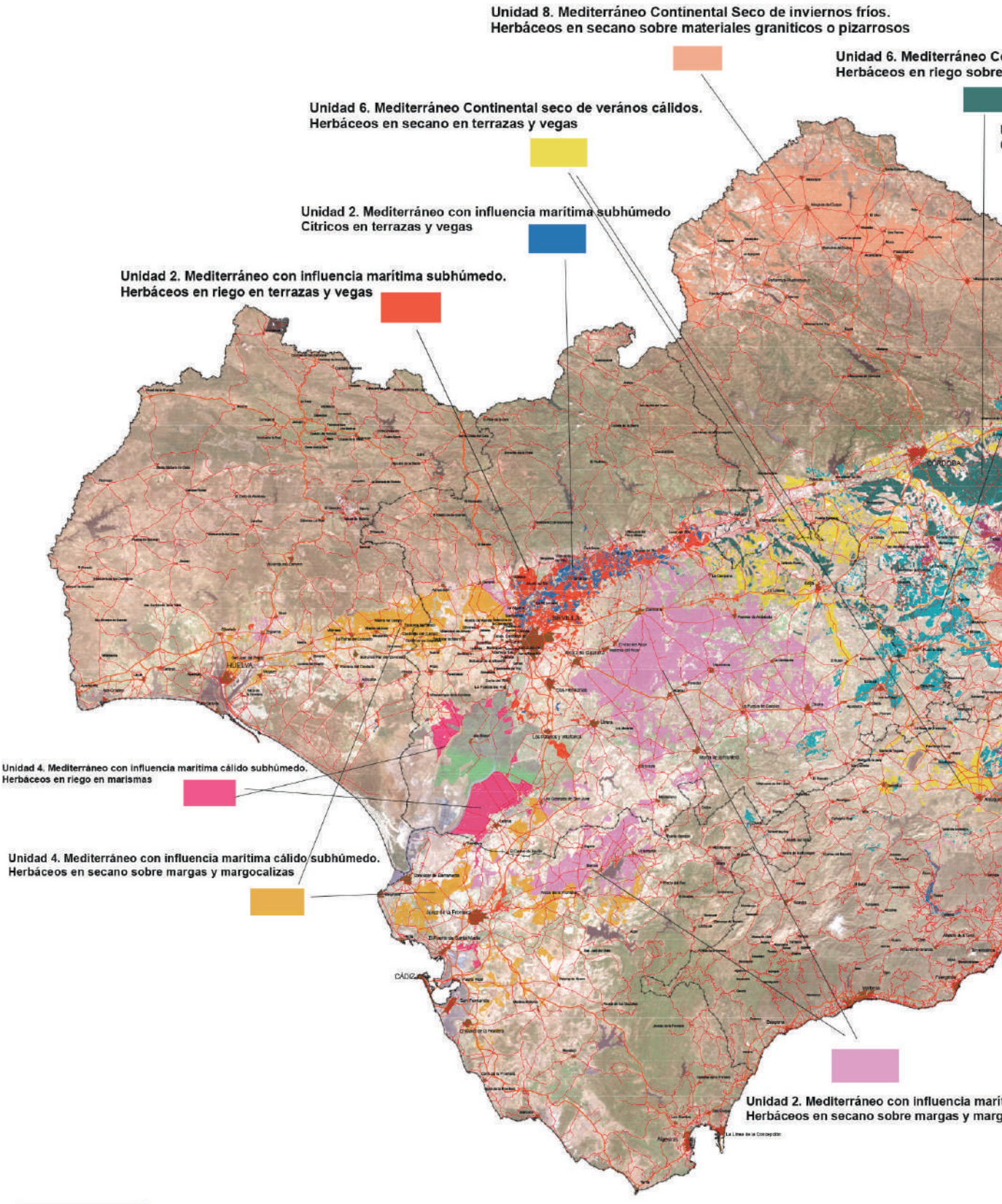


We established a network of 41 Demonstration Farms, where soil carbon and GHG emissions have been monitored, verifying the increase in carbon sequestration and the reduction of emissions due to the use of Conservation Agriculture practices, both in arable and woody crops. On these farms, environmental, economic, and social sustainability has also been monitored through indicators that have made it possible to quantify the degree of sustainability of a plot according to its management.





Soil and climate zoning of Andalusia has been carried out, and the carbon content of its agricultural soils has been determined to see how Conservation Agriculture mitigates climate change through carbon sequestration under different climate and soil conditions. Eight edaphoclimatic zones of agricultural interest in Andalusia were identified.



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Unidad 6. Mediterráneo Continental seco de veranos cálidos.
Olivar sobre margas y margocalizas

Unidad 8. Mediterráneo Continental Seco de inviernos fríos.
Olivar sobre margas y margocalizas

Unidad 13.
Mediterráneo Continental de altiplanicies secas y frías.
Herbáceos en secano sobre conglomerados

Unidad 15 y 16. Mediterráneo Subdesértico
Frutales sobre materiales
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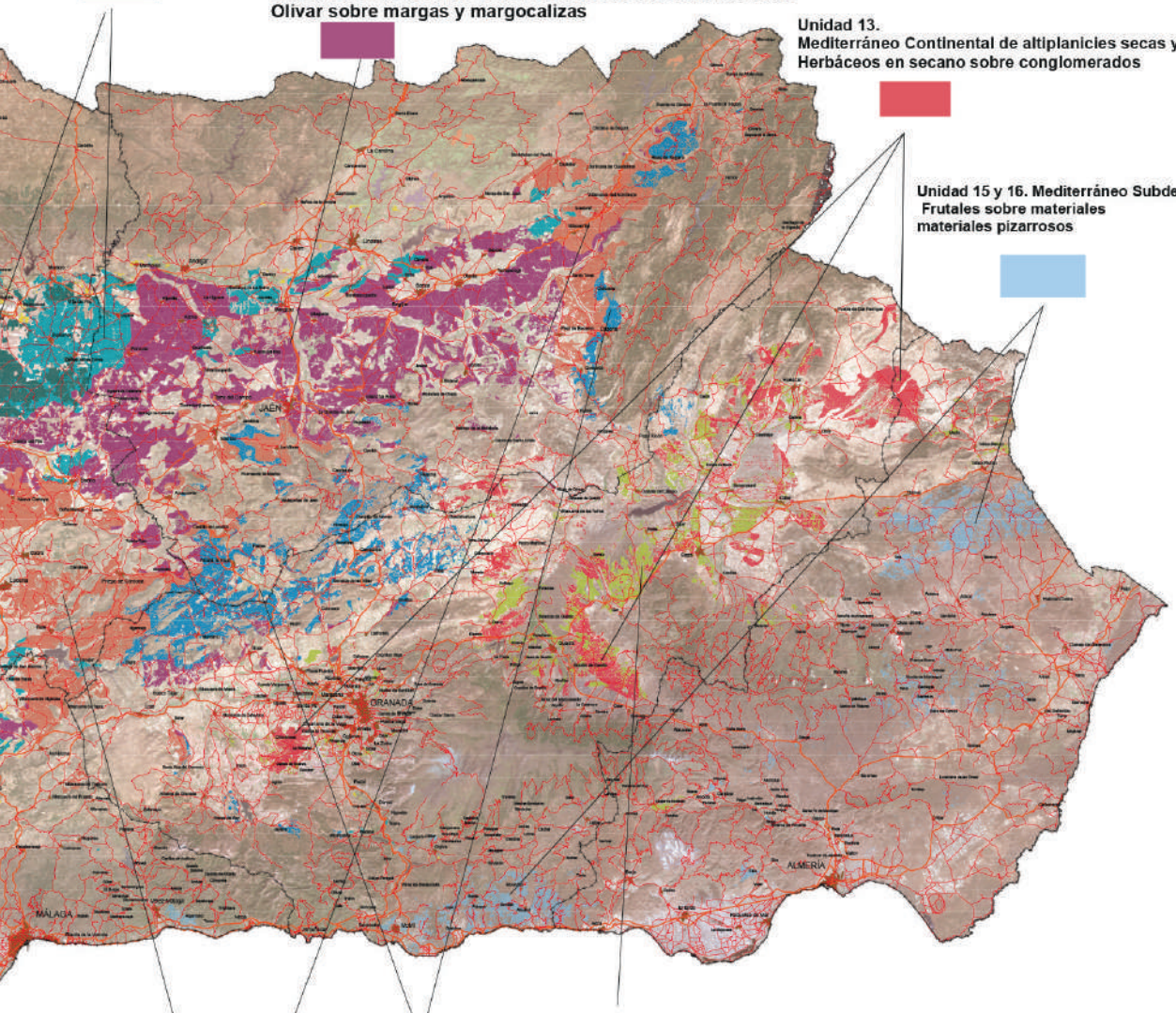

Unidad 13.
Mediterráneo Continental de altiplanicies secas y frías.
Frutales sobre conglomerados

Unidad 7. Mediterráneo Continental Subhúmedo de inviernos muy fríos.
Olivar sobre margas y margocalizas

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Unidad 9. Mediterráneo Continental Subhúmedo de inviernos fríos y veranos cálidos.
Olivar sobre margas y margocalizas

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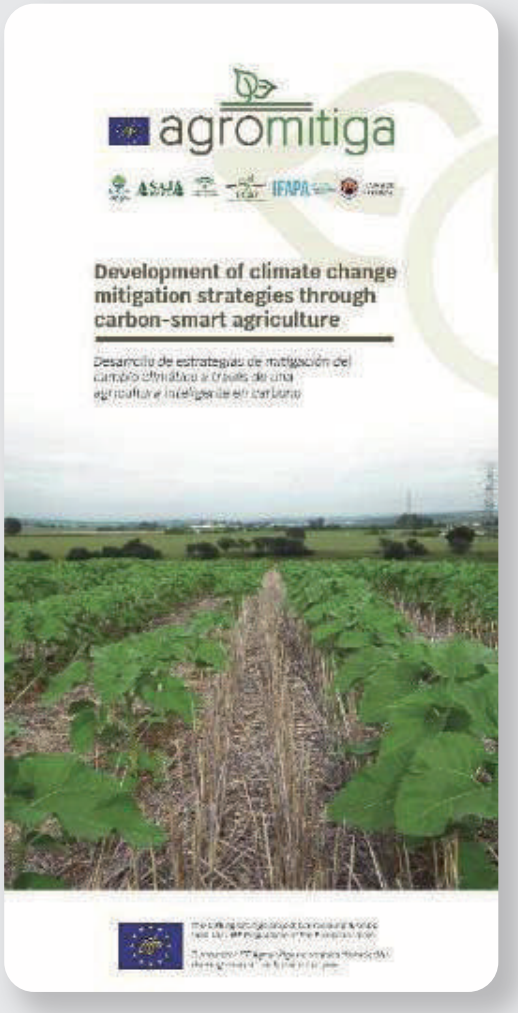
A governance and sustainability plan has been implemented, which has led to social and institutional participation in the projects of various actors in the agricultural sector, from academia (Impact Advisory Board), farmers (Farmers for Climate Network), legislators, and private companies (Governance Forum).

A multitude of dissemination and training activities have been held aimed at publicising the project and its results, raising the awareness of the main agents in the sector in relation to climate change, as well as training technicians and farmers in the Best Management Practices used in the project (field days, seminars, online courses, and European conferences).



Articles, technical reports, and manuals have been produced, which will be used to determine the Carbon Footprint of a crop; to carry out subsequent studies; to facilitate the implementation and monitoring of the agricultural practices promoted by the project, both from an agronomic and administrative point of view; or as a documentary basis for implementing measures to support mitigation and adaptation to climate change within the EU and national and/or regional regulations.

RESULTS

RESULTS OBTAINED

Carbon Sequestration

In one hectare, within the first 30 cm of the soil.

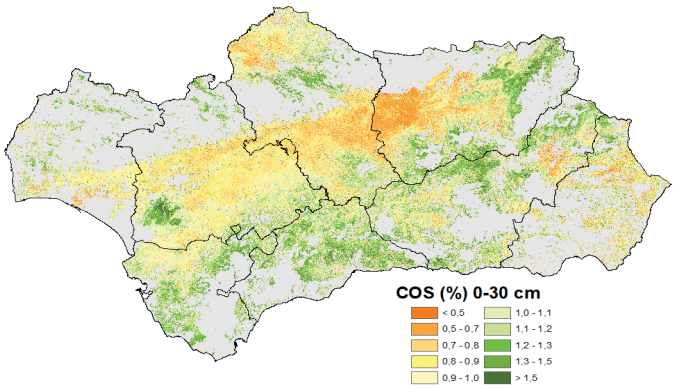
- **no-tillage has sequestered** on average **16 times more carbon** per year than **conventional tillage.**
- .on average, **the annual increase in carbon in no-tillage was 1.02 t.**
- .**the soil carbon content in no-tillage is 23% higher** than that of soil under **conventional tillage**.
- .**groundcovers has sequestered** on average **2 times more carbon** per year than **conventional tillage.**
- on average, **the annual increase in carbon in groundcovers was 2.11 t.**
- **the soil carbon content in groundcovers is 29% higher** than that of soil under **conventional tillage**.

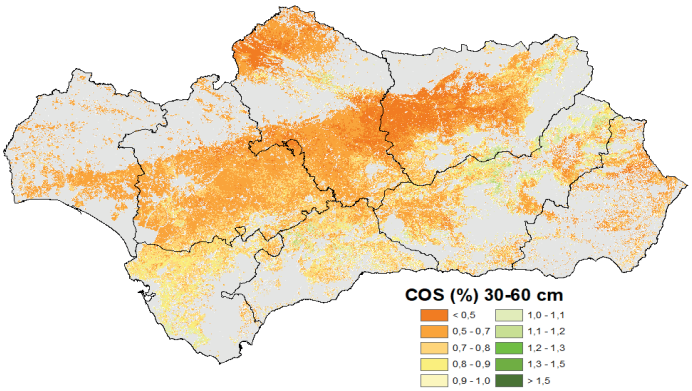
Wetter soil-climatic zones with higher clay content favour carbon sequestration compared to drier soil-climatic zones.

Based on these values, **with the current area of Conservation Agriculture in Spain, the agricultural soil would be sequestering 11.5 M t per year.**

Soil carbon content

More than 600 samples taken from Andalusian agricultural soils made it possible to determine the current organic carbon content in the first 60 cm of the soil profile. In the future, this could be used to define the baseline against which to compare the gains of any agricultural practice aimed at improving the sink capacity of the soil.





Greenhouse Gas Emissions

No-tillage reduced annual CO_2 eq emissions by 16% compared with arable crops managed under conventional tillage.

Groundcovers reduced annual CO_2 eq emissions by 10% compared to woody crops managed under conventional tillage.

Based on these values, **with the current area of Conservation Agriculture in Spain, 241.4 kt of CO2 eq per year would be saved.**

Conservation Agriculture, a sustainable system in all its dimensions

To assess the sustainability of the management system on each of the demonstration farms in the network, **29 indicators** were used (9 economic, 4 social, and 16 environmental).

	Measured parameters
Economic indicators	Net income
	Production costs
	Yield (Production)
	Productivity of N
	Productivity of P
	Irrigation water productivity
	Energy balance
	Energy efficiency
	Energy productivity
Social indicators	Working hours
	Satisfaction index
	Level of training
	Risk of abandonment of agricultural activity

	Measured parameters
Environmental indicators	Tillage rate
	Ground cover
	Erosion risk
	Organic Matter
	Crop diversification
	Crop rotation
	Natural Surface
	Biodiversity Structures
	Margins and protective surfaces
	Handling of plant protection products
	Balance of GHG emissions
	GHG emissions per kg
	N balance
	Balance of P
	N efficiency
	Efficiency of P

Both no-tillage and groundcover obtained a higher overall sustainability index and, in most cases, higher sustainability indices in all dimensions.

	Management System	Economic dimension	Social dimension	Environmental Dimension	Global index
Arable Crops	No-tillage	**56,0**	**75,1**	**58,4**	**63,2**
	Tillage	51,6	69,1	50,3	57,0
Olive grove	Groundcovers	**53,4**	**60,9**	**56,1**	**56,8**
	Tillage	47,1	60,1	46,4	51,2
Citrus fruit	Groundcovers	**73,7**	**63,5**	**54,5**	**63,8**
	Tillage	65,8	63	55,0	61,3
Fruit trees	Groundcovers	62,8	**61,5**	**58,1**	**60,8**
	Tillage	62,8	59,7	51,2	57,9

CONTRIBUTIONS TO EUROPEAN AND NATIONAL POLICIES AND INITIATIVES

Common Agricultural Policy (CAP)

- The inclusion of Conservation Agriculture as a carbon farming practice to be considered in the eco-schemes of the new CAP to be designed in Member States (https://agriculture.ec.europa.eu/common-agricultural-policy/income-support/eco-schemes_en).
- Inclusion of no-tillage in three eco-schemes of the new CAP in Spain (Practice P4).
- Inclusion of groundcover in three CAP eco-schemes in Spain (Practice P6).
- Inclusion of inert groundcovers in three CAP eco-schemes in Spain (Practice P7).
- 751.3 million for the Conservation Agriculture eco-schemes (68% of the total eco-schemes budget).
- 443.57 million euros for the eco- schemes based on no-tillage.
- 307.56 M euros earmarked for the eco- schemes based on groundcovers.
- Almost 1.4 million hectares applied under the eco-schemes based on no-tillage in Spain by 2023,
- More than 1.9 million hectares were applied under the eco-schemes based on groundcovers in Spain by 2023.
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Proposal for a Regulation on an EU certification for carbon removals (COM(2022) 672 final)

- ECAF's presence in the EU expert group for the elaboration of a framework for Carbon Sequestration Certification.
- Consideration of Conservation Agriculture practices as a Carbon Farming practice in the Communication from the Commission to the European Parliament and the Council "Sustainable Carbon Cycles (COM(2021) 800 final)".

Renewal plan for agricultural machinery 'Plan Renove' (Spain)

The agricultural machinery renewal plan promoted by the Spanish Ministry of Agriculture, Fisheries, and Food provides an opportunity to renew farmers' equipment. In recent years, direct seed drills have been the most sought-after machines, accounting for 54% of the renewal applications by 2023, which means that 72% of the program's budget will be allocated to these machines.

International carbon credit certification initiatives

Standards such as the Verra or Gold Standard include in their methodologies Conservation Agriculture as an agricultural practice that generates high-quality carbon credits. These standards are used as references by private entities operating in voluntary carbon markets.

IMPACTS

DISSEMINATION IMPACTS

The project has carried out intense communication, training, and dissemination work aimed at agents in the agricultural sector (farmers, technicians, and researchers from public administrations, professional associations, agricultural organisations, and companies related to the sector). These actions include conferences and training courses (face-to-face and online), a congress at the world level, a conference at the European level and another at the national level (Spain), press releases, radio and TV coverage, technical and scientific articles, and presentations of the project in various forums, both at national and international levels. Some of the most relevant figures resulting from project communication are as follows.

- There are more than three million estimated impacts.
- There were more than 20 events in which the project was presented.
- More than 2,000 attendees at conferences and courses were organised within the framework of the project.
- 8 TV reports.
- 6 radio interviews.
- More than 40 articles and news items have been published in print and online media.
- 19% growth in the area under Conservation Agriculture in Spain during the project years.

PRODUCTS

MAIN PRODUCTS GENERATED IN RELATION TO CARBON FARMING

- A **manual** aimed at farmers, with the main keys for the implementation of Conservation Agriculture practices, both in herbaceous crops, with direct sowing, and in woody crops, with vegetative cover.
- **Protocol for calculating the Carbon Footprint (CFT) during the agronomic phase of crops.** The protocol establishes the procedures and methodology for the determination of CFT at the product level in extensive and woody crops, limiting the calculation to the agronomic phase of the crop. The methodology developed in this study not only considers the GHG emissions associated with all the processes that occur in the establishment and development phase of the crop from sowing to harvesting but also considers the offsets that the implementation of agricultural practices that increase carbon sequestration in the soil, such as Conservation Agriculture, can have on emissions.
- **App for estimating soil carbon content and calculating GHG emissions from agricultural operations.** By taking photographs of the soil, the user obtains an estimate of its organic carbon content present in the soil. In addition, the app can calculate the GHG emissions (CO_2 eq) from agricultural operations carried out on a plot. With this tool, the farmer will know the evolution of his emissions and the organic carbon content of his plot season after that season.
- **Sustainability audits.** 35 farms were audited over four agricultural seasons, offering global sustainability values and in each of the environmental, economic, and social dimensions. These values are based on the calculation of indicators supported from a scientific perspective by articles published in high-impact journals.

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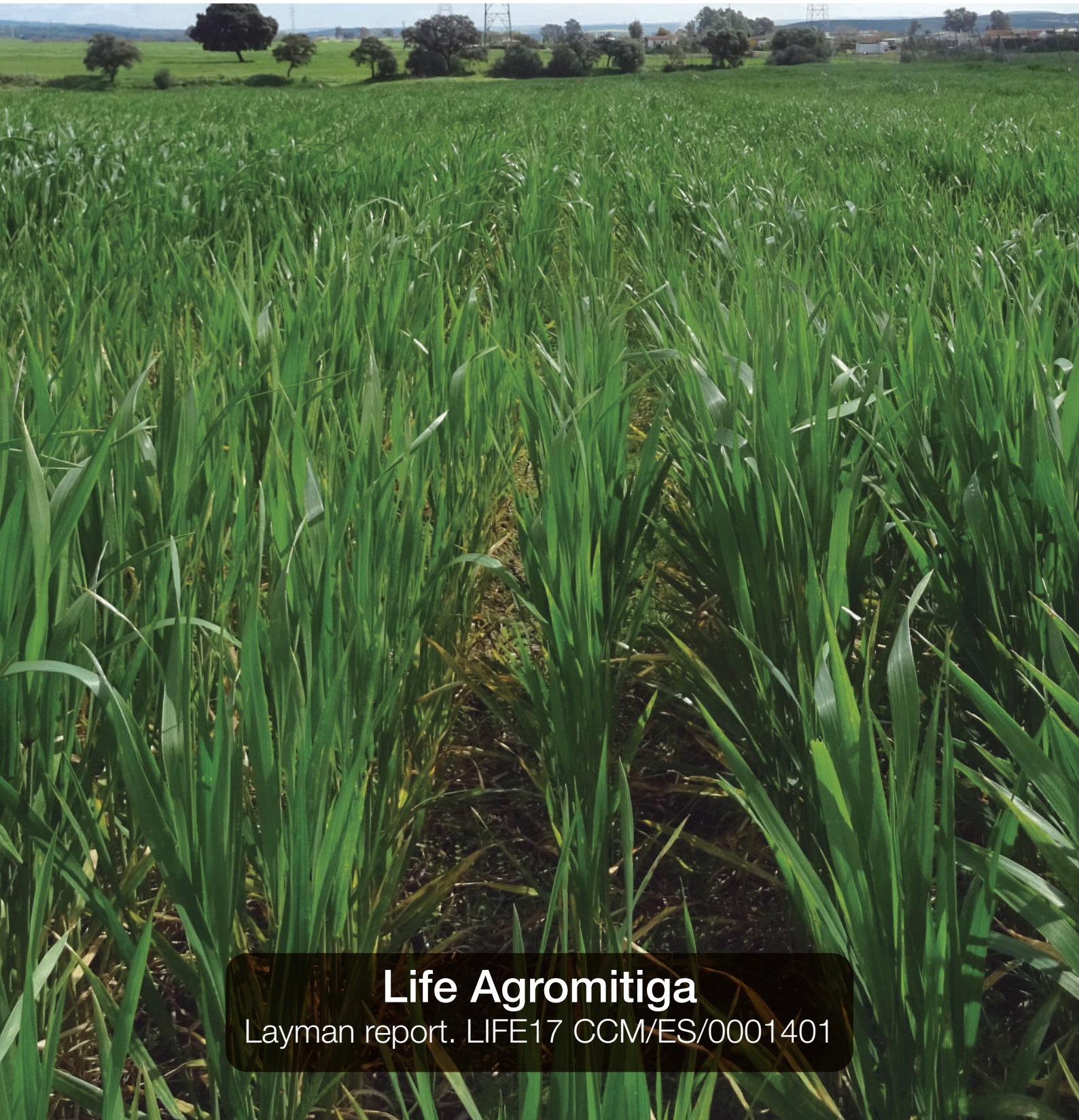

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