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BEST AGRICULTURAL PRACTICES FOR CLIMATE CHANGE:

Integrating strategies for mitigation and adaptation

LIFE+ Climagri

Layman report. LIFE13 ENV/ES/000541

INTRO—DUCTION

Nowadays, climate change is a reality. The Intergovernmental Panel on Climate Change (IPCC), an intergovernmental body of the United Nations, in its latest report, states that global warming is unequivocal and, in recent decades, it has led to extreme weather events such as heatwaves, droughts, floods, cyclones and forest fires.

If there is any sector that may be affected by climate change, it is the agricultural sector, which a consequence of the relationship between agricultural activities and the climate. The conclusions reached by a wide variety of studies covering a wide range of regions and crops show that the negative effects of climate change on crop yields have been more common than the positive effects. Therefore, in Europe, the agricultural areas mostly exposed to these impacts are located in countries with Mediterranean climate. Thus, in these regions it is expected that rainfall and river flows will be reduced, the risk of droughts and heatwave periods increased, therefore affecting crops negatively.

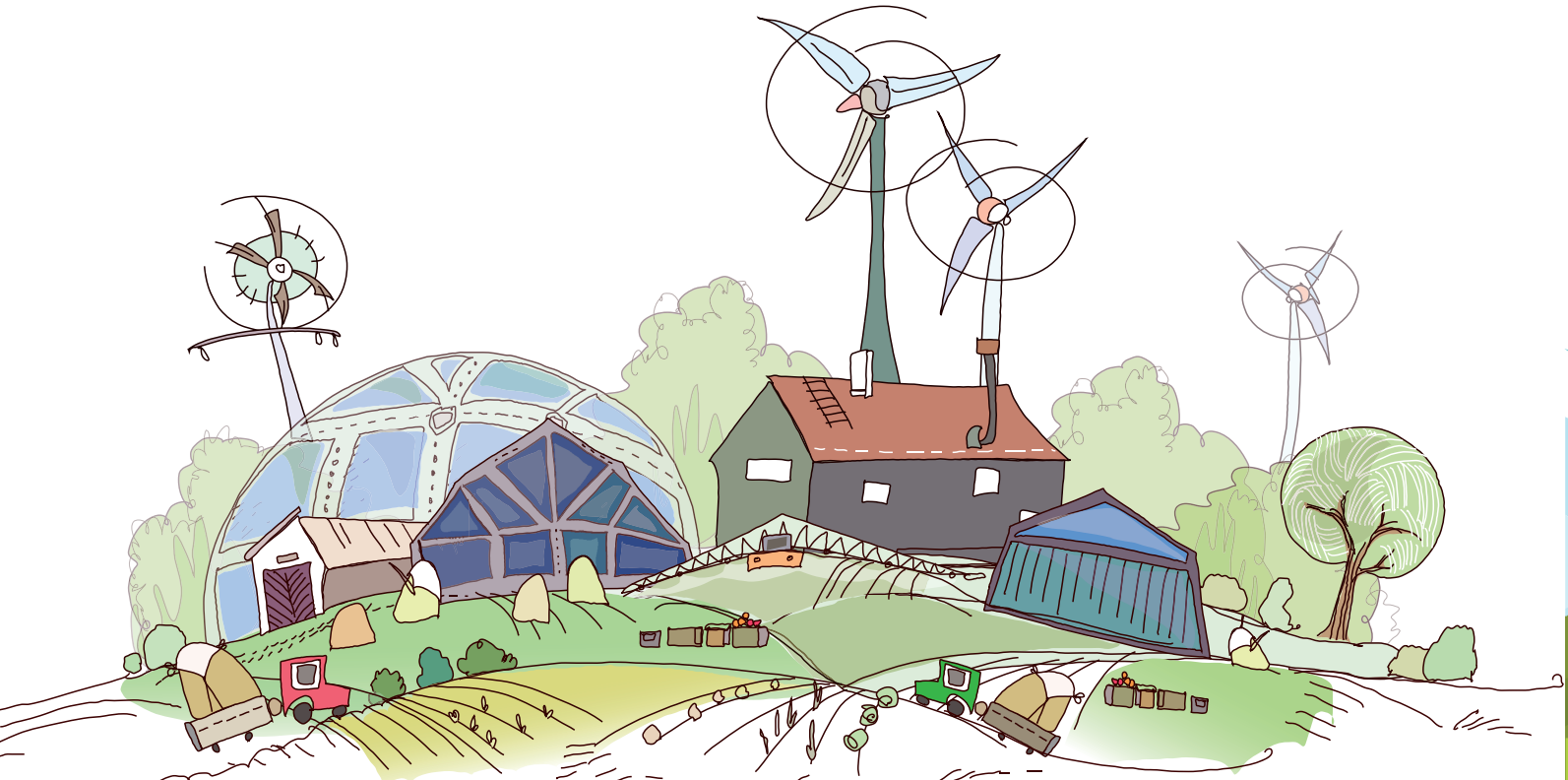
On the other hand, the agricultural sector is not only affected by climate change, but it is also a source of greenhouse gas emissions. Agriculture is responsible for 10% of the total Greenhouse Gases emissions in Europe. As a result, agriculture is faced with the challenge of mitigating climate change and adapting to the new scenarios that result from global warming, proposing solutions that contribute to this dual objective. The agreements reached at the international level urge countries to take actions that limit the rise in temperatures below 2°C (Paris Agreement - COP 21) and reduce GHG emissions by 2030 by 40% compared to 1990 emissions (The 2030 climate and energy framework - COM (2013) 169 final).

The LIFE+ Climagri Project

The LIFE+ Climagri project endorses these challenges and proposes a holistic approach to the problem of climate change in the agricultural sector, and more specifically in irrigated crops located in the Mediterranean Basin.

The general objective pursued by the project is the establishment of agronomic management strategies for extensive crops that contribute jointly to the mitigation of climate change and the adaptation of crops to both present and future climatic conditions, and that serve to boost and develop environmental policies and laws in the EU and its Member States regarding climate change. To achieve this goal, the project has established the following specific objectives:

- **Demonstrate** the viability of soil management systems based on the integration of mitigation measures and adaptation to climate change in irrigated crops in the Mediterranean Basin.
- **Globally verify** the impact of joint mitigation-adaptation strategies adopted through the creation of a European Network of Demonstration Farms (ENDF).
- **Establish an action protocol** that, based on the identified mitigation-adaptation strategies, allows technical recommendations for adoption and follow-up of its implementation, also serving to verify the application of agro-environmental measures and other programs related to climate change
- **Disseminate and transfer** the gained experience and the management philosophy to other areas with similar circumstances, strengthening communication channels between research, administration, farmers and technicians.



10 Best Management Practices to mitigate climate change and adapt to its effects

In order to mitigate climate change and make crops adapt better to its effects, a series of Best Management Practices (BMPs) have been established. They have been grouped into the following decalogue.

01 Use of permanent soil cover

02 Use of minimum soil disturbance practices

03 Perform suitable crop rotation/diversification

04 Optimisation in the use of agrochemicals

05 Appropriate management of agrochemical products

06 Use of advanced technology (decision-making aid systems, precision agriculture, fleet management, etc.)

07 Implementation of optimum and deficit irrigation strategies

08 Joint consideration of optimised agricultural, technical and financial practices to improve irrigation water management

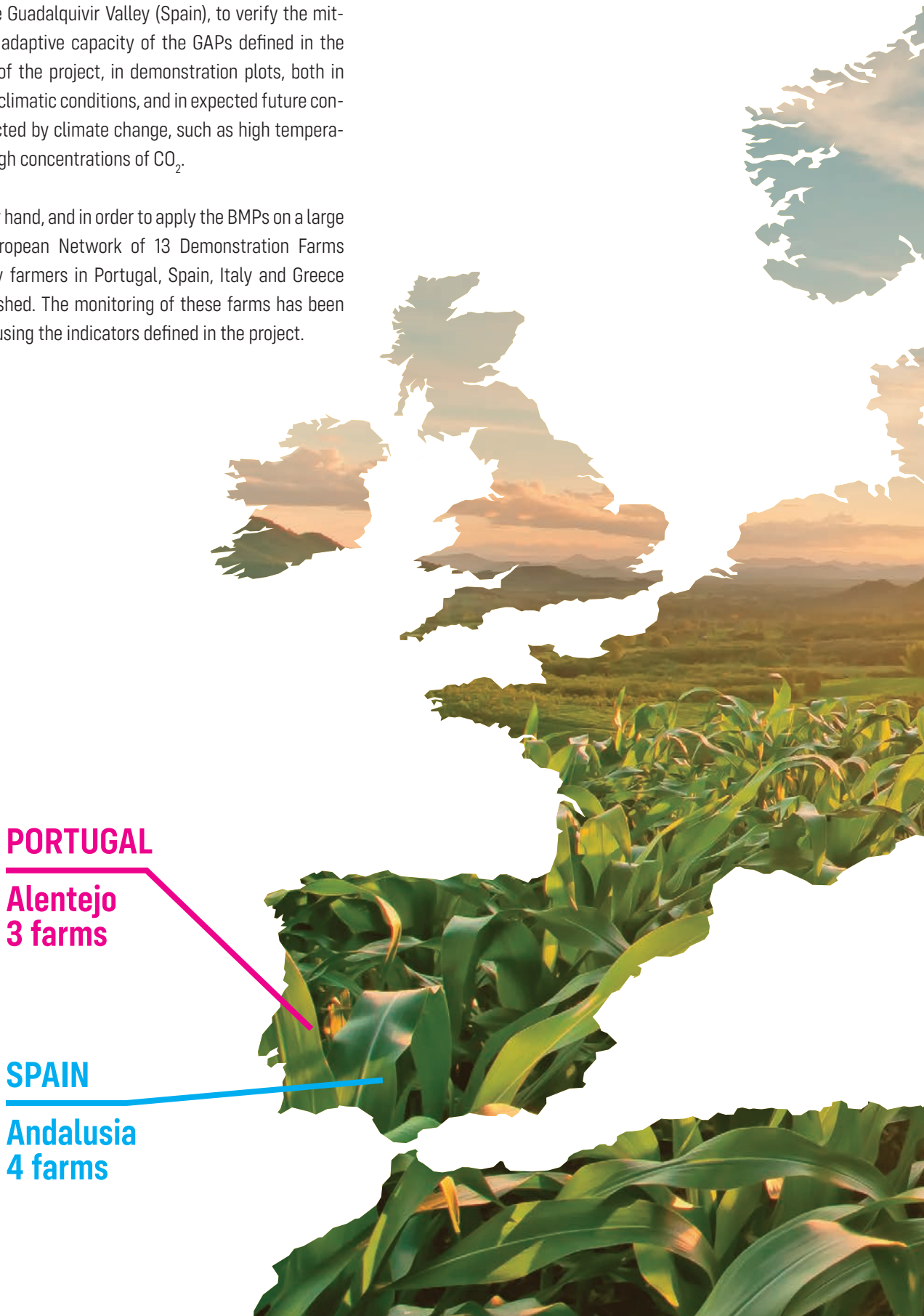
09 Implementation of multifunctional margins and retention structures

10 Measures for the promotion of biodiversity

Implantation area

LIFE+ Climagri has focused its action on irrigated crops in countries of the Mediterranean basin, since these are the ones that will suffer the most from the effects of climate change. Therefore, a series of pilot trials have been established in the Guadalquivir Valley (Spain), to verify the mitigating and adaptive capacity of the GAPs defined in the framework of the project, in demonstration plots, both in the present climatic conditions, and in expected future conditions affected by climate change, such as high temperatures and high concentrations of CO_2.

On the other hand, and in order to apply the BMPs on a large scale, a European Network of 13 Demonstration Farms managed by farmers in Portugal, Spain, Italy and Greece was established. The monitoring of these farms has been carried out using the indicators defined in the project.




ITALY
Lombardy +
Emilia-Romagna
3 farms
GREECE
Thessaly
3 farms

Results

After more than four years of project execution, and based on the results achieved both in the implementation and follow-up actions, as well as in the communication and dissemination actions, it is possible to affirm that the initially set objectives have been satisfactorily fulfilled.

Climate Change Mitigation

Reduction of GHG emissions from the ground: Plots with a greater number of implanted BMPs have reduced CO_2 emissions by **48%** and N_2O emissions by **2 to 10%** compared to plots without BMPs.

Increase in carbon sequestration: Soils in plots with a greater number of implanted BMPs (Best Management Practices) have increased their carbon content by **8%** compared to conventionally managed plots. This has meant an **average annual increase of 1.16 t/ha of carbon, which is equivalent to a 5 ha big farm** to offset the amount of CO_2 emissions equal to that one produced by a car which would make 10 round trips between Madrid to Moscow.

Reduction of CO_2 emissions linked to energy consumption: The plots in which a greater number of BMPs have been implemented have achieved annual reductions of up to **35%** compared to the plots in which no BMP has been carried out, so the average annual reduction in this case was **32%**, after 4 analysis campaigns. This means that, after four agricultural campaigns, in the plots with a greater number of BMPs, **15.11 t CO_2/ha** less have been emitted than in the plots with a conventional management system. Comparing this amount to the previous example related to the carbon sequestration, it would compensate the emissions of a vehicle that made the round trip between Madrid and Moscow 7 times.

The plots with implanted BMPs have helped to accumulate the amount of CO_2 equivalent to the amount that would be produced by a car making the round trip between Madrid and Moscow 10 times.

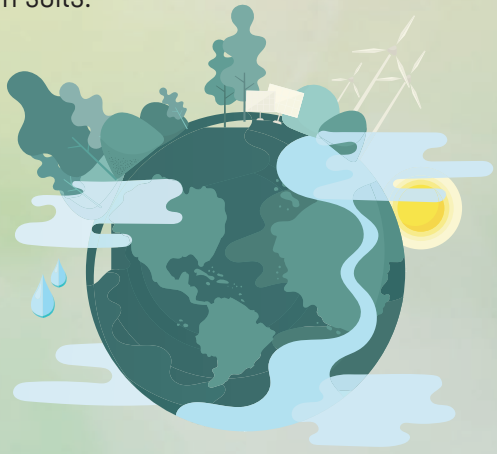
48% reduction in CO_2 emissions from soils

↓48% CO_2

↓32% REDUCTION IN CO_2 EMITTED BY FARM OPERATIONS

↓10% N_2O

Reduction of up to 10% of N_2O emissions from soils.



↑8% CO_2 SEQUESTERED

Climate change adaptation

Impacts of climate change

Demonstrative trials in which future climatic conditions have been reproduced have served to detect that, with high temperatures, there is a phenomenon of asynchrony in flowering, complicating pollination and grain formation, which leads to a drastic reduction in the number of crops.

Effectiveness of adaptation measures

Advancing the sowing date will allow the crop to avoid high temperatures while flowering and grain filling, which are the most critical periods of the crop, ensuring the correct development of the grain and therefore higher yields for the farmers.

The use of short-cycle crops, what means, crops with a shorter development period than conventional varieties, makes it possible to avoid high temperatures and high evapotranspiratory demand, especially in the most critical crop phases.

Measures based on the decrease in irrigation, if applied, should be very controlled, since it can cause crop reduction if special attention is not paid to the critical phases of the crop, such as flowering or grain filling.

Economic and energy profitability

↓ 12% COSTS

Economic profitability

In plots with a greater number of BMPs, total costs were reduced by 12.4% (€ 142 /ha) compared to plots managed with conventional management techniques without any BMP. Besides that, production increased, what meant that, on average, the profitability of the crop managed with BMPs has increased by € 358 / ha.

Energy efficiency

Energy efficiency is a balance between the energy obtained and the energy consumed in a productive process. In the case of plots with implanted BMPs, energy efficiency has increased on average compared to plots without BMPs, 15.4% in the first campaign, 41.9% in the second campaign and 63.3 % in the third campaign. That means that plots with a greater number of implanted BMPs were more energy efficient.

↑ 63% ENERGY EFFICIENCY

Energy productivity

Productivity is a parameter that measures the kgs produced per unit of consumed energy. If the energy productivity is higher, this will mean that less energy has been required to obtain 1 kg of product. In the case of corn managed with BMPs, energy productivity increased by 31%, and in the case of cotton under BMPs, energy productivity increased by 57%. This means that, for the same amount of energy, both in plots with implanted BMPs and in conventionally managed plots, 31% more production was obtained in the case of corn and 57% more in the case of cotton.

↑ 57% ENERGY PRODUCTIVITY

Dissemination and training sessions

The project has carried out an intense communication, training and dissemination sessions aimed at agents of the agricultural sector (farmers, technicians and researchers of Public Administrations, professional associations, agricultural organizations and companies related to the sector). These sessions have been seminars and training courses (face-to-face and online), a conference at European level, press and media releases, technical and scientific articles, and presentations of the project in various forums both nationally and internationally. Some of the most relevant figures resulting from the project communication are:

1,5 million
impacts

+ 4000 attendees
at conferences and courses organized within the framework of the project

+ 20 events
during which the project was presented

8 TV reports

5 radio interviews

+ 40 releases
in written and Internet media

23 articles published
in technical journals related to the sector, scientific journals and congresses

Deliverables

Therefore, LIFE+ Climagri has generated several deliverables and diverse documentation to serve as a tool for farmers, technicians and administration staff, to facilitate the implementation and monitoring of the BMPs promoted by the project and their integration into legislative support measures aimed at meeting climate change objectives at European level. The main deliverables are:

A **Manual**, edited and available in all official languages of the participating countries and in English, gathers the information about each of 10 proposed BMPs, serving as a guide to the agricultural sector agents, on their foundations, their action for the climate (mitigation and adaptation) and its methodology when applying them in farms.

In order to monitor the BMPs and measure their impacts not only on climate change, through mitigation and adaptation, but also on other environmental aspects such as the conservation and improvement of natural water and soil resources or biodiversity, or in economic and social aspects, the project has defined a set of **25 indicators** that will be used to assess the sustainability of farms.

A **Monitoring Protocol**, which constitutes a technical document that allows to assess the degree of implementation of each BMP in a farm and its influence on each of the contemplated indicators. This tool is oriented so that any technician and / or farmer is able to make a diagnosis of adaptation and mitigation capacity of the practices used in their farm, which can also serve as a monitoring tool for any climatic action measure that, from the Public Administration contemplate in any of the regulations of climate change that are generated.

A specific **GIS** of the project, which emerges as a computer tool that visualizes the information generated in the European Network of Demonstration Farms, showing for the BMPs implanted in a certain plot, the values of the monitoring indicators in a visual and graphic way. This application also allows the registration of new farms and plots, which makes it possible to expand the scope of the project, thus constituting a long-range and broad-ranging tool.

Impacts on European policies

The project has aroused the interest of some Public Administrations, both European, national and regional, therefore the information generated in it has been required several times for the preparation of reports which would recommend practices or measures to be included in the Rural Development Program. The most notable objectives achieved in this regard have been the following milestones:

- Implementation by the Ministry of Agriculture, Fisheries and Rural Development of the Junta de Andalucía, of **Operation 10.1.4 "Sustainable dryland herbaceous crop systems"**, framed in Measure 10 of Agri-environment and Climate of the **Rural Development in Andalusia Program**. This operation, with a budget of **€ 2,143,936 for the period 2019-2023**, supports those farms that acquire the commitment to implement no-tillage and multifunctional margins, two of the practices promoted by the project.

- Start-up by the Ministry of Agriculture, Fisheries and Rural Development of the Junta de Andalucía, operation 10.1.8 of the Rural Development Programme for Andalusia, **Agricultural systems of special interest for populations of steppe birds and birds of Andalusian rice paddies, Submeasure 1. Agricultural systems of special interest for steppe bird populations, Program 2: Actions in SPA.** This measure, which expressly contemplates soil conservation techniques in favor of biodiversity, such as stubble maintenance and maintenance of fallows with groundcovers, has an economic endowment for this operation which is **€ 1,000,000 for the period 2019-2023**.

- Request for information related to the project by the Thematic Group on sustainable water and soil management coordinated by the European Network for Rural Development of the European Commission. This information will serve to favor the large-scale adoption of the practices promoted by the projects through the rural development programs.

- Request for information by the European Court of Auditors on good examples of LIFE projects to classify farms based on agricultural practices carried out in their plots, with the LIFE + Climagri project being one of the projects mentioned for it.

- Written declaration in favor of Conservation Agriculture, signed by more than 100 members of the European Parliament.

Replicability

The BMPs proposed by the project do not include specific techniques linked to the agrarian practice of a particular country or region, but they have been established in response to various environmental problems, contributing to solve the problem caused by climate change in the agricultural sector. Although agricultural adaptation practices are usually linked to the climatic conditions of each area, unlike mitigation practices, whose positive effects are independent of the place where they are applied, the adaptation needs for the entire Mediterranean basin are similar, because the expected effects of climate change will be a consequence of the same climatic phenomena (high temperature and low rainfall in areas that suffer from constant water scarcity).

On the other hand, and although the LIFE + Climagri project has focused its study on extensive irrigated crops, most of the proposed BMPs are also applicable to extensive rainfed crops, such as cereals, sunflower and legumes. Thus, practices such as no tillage, crop rotation, optimized use of agrochemicals and their proper management, the use of advanced technologies, the implementation of multifunctional margins or biodiversity promotion measures, do not depend on the type of crop management related to water, and their effectiveness to mitigate and adapt to climatic change conditions is demonstrated by rainfed crops.

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LIFE+ CLIMAGRI PROJECT

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Universidad de Córdoba
www.uco.es

European Conservation Agriculture Federation (ECAF)
www.ecaf.org

Asaja Sevilla
www.asajasevilla.es