

# ESIRA – ENHANCING SOCIAL INNOVATION IN RURAL AREAS

## TRAINING MODULES

### Module 2. Green Transition in Rural Areas



## ESIRA – ENHANCING SOCIAL INNOVATION IN RURAL AREAS

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### Credits

Authors:

NBSClimate, Sara Azcona (University of Burgos) & Luis Marcos (University of Burgos).

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## Module 2. Green Transition in Rural Areas

### Objective

This training module is an educational resource created as part of the ESIRA train-the-trainers programme, which forms part of Deliverable 5.2. Training modules, included in WP5 – Community-led innovation spaces and pilot social economy initiatives. The main objective of the train-the-trainers programme is to capacity build and to strengthen the skills of Multi-Actor Platform (MAP) facilitators and rural actors to identify, support and ensure the sustainability of social economy initiatives and develop community networks in the rural territory.

The main objective of the Training Module 2 is to provide theoretical and practical knowledge and skills to training facilitators and rural actors in the areas of green transition in rural areas.

### Structure

The module is structured around six interconnected thematic areas that together provide a comprehensive framework for understanding and advancing the green transition in rural contexts. It begins by addressing clean water, living soil, and waste reduction and circularising by-products, highlighting the sustainable management of natural resources and circular economy approaches. It then focuses on clean energy, the reduction of GHG emissions, and climate change adaptation, examining strategies to mitigate environmental impacts while strengthening rural resilience. The third component, preservation and restoration of ecosystems and biodiversity, emphasises the protection of natural capital as a foundation for long-term sustainability. This is complemented by a dedicated section on organic agriculture, regenerative livestock, and sustainable forest management, which explores environmentally sound production systems tailored to rural territories. The module further incorporates methodologies and sustainability indicators in the rural green transition, equipping stakeholders involved with tools to assess, monitor, and guide sustainable change. Finally, it concludes with resources and policies to promote the green transition in rural areas, providing an overview of institutional frameworks, funding opportunities, and policy instruments that support the implementation of green and inclusive rural development pathways.

**The content of this training module is complemented by the following materials in Deliverable 5.3 “Training Modules Updated”:**

- **ESIRA Guide for supporting innovative social economy initiatives in rural areas.**
- **Practical Tools 2.1, 2.2 and 2.3 (Annex).**

## 1.1 Clean Water, Living Soil, Waste Reduction & Circularising By-Products

### 1.1.1 Challenges

In Spain's rural areas, ensuring environmental sustainability presents a critical challenge with several interrelated obstacles. Key pillars of this sustainability include access to clean water, conservation of fertile and living soils, waste reduction, and circularising by-products—all essential for productive agriculture and biodiversity that can provide associated ecosystem services. However, these areas face numerous challenges driven by both local and global factors.

On a local scale within the Spanish context, some pressing issues include the degradation of natural resources (due to agricultural overexploitation, water depletion, soil erosion, and loss of soil fertility), rural depopulation, lack of infrastructure, and limited access to education and technology. In these rural areas, sustainability is crucial due to the high dependence on the natural environment for agricultural and livestock activities. The main challenges relate to managing resources such as water and soil, as well as the need to reduce waste and make better use of by-products.

On a global scale, climate change presents a significant risk, increasing the vulnerability of agricultural production, threatening food security, and generating economic crises in rural communities that depend on the climate for their livelihoods. Spain is particularly vulnerable to the effects of climate change (Ruiz and Cantos, 2023; Allan et al., 2023).

#### **Access to Clean Water:**

One of the main problems in rural areas is the quality and availability of water. Intensive agricultural activities, which include the excessive use of pesticides and chemical fertilisers that produce nitrate as waste, have contaminated water bodies, leading to eutrophication and the deterioration of underground aquifers in Spain (MITECO, EU 1991). Additionally, the overexploitation of aquifers in many rural areas of Spain exacerbates the situation in regions where rainfall is scarce. Climate change has intensified this issue, which is expected to worsen, with more frequent and prolonged droughts reducing access to freshwater for rural populations (EEA, 2009). An additional complication is that rural areas often lack adequate infrastructure to treat and distribute water efficiently, increasing the risk of scarcity and contamination. Furthermore, inefficient irrigation methods in agriculture, such as flood irrigation, lead to water wastage, worsening the problem (Canatário-Duarte et al., 2024).

#### **Living Soils:**

The preservation of healthy and fertile soils is another critical challenge. Intensive monoculture practices and inadequate crop rotation have led to soil degradation and biodiversity loss, reducing the capacity to retain water and nutrients. Erosion and soil



compaction are common phenomena in agricultural areas of Europe, including Spain, where inefficient land management exacerbates the situation (Ferreira et al., 2022; García-Ruiz, 2010). The lack of policies that promote sustainable agricultural practices, such as agroecology, worsens this problem (Van Eynde et al., 2024).

### **Waste Reduction:**

In rural areas, the management of both organic and inorganic waste presents significant challenges. Agricultural waste, such as greenhouse plastics and animal by-products, is often managed inadequately, contributing to soil and water contamination. In many rural areas, recycling and waste treatment systems are insufficient or non-existent, leading to the accumulation of waste in local landfills (Puig et al., 2011). The lack of infrastructure and awareness regarding recycling makes sustainable waste management a difficult goal to achieve, and generally, these rural areas have poor waste management compared to urban areas.

### **Circularisation of By-products:**

The concept of a circular economy, which involves reusing by-products and waste in other production processes, is still in its infancy in many rural areas of Europe (Cueto & Escudero-Castillo, 2020). Although there are initiatives aimed at reusing agricultural waste to generate bioenergy or natural fertilisers, the infrastructure and technical knowledge necessary to implement these systems on a large scale are not yet common (Ojeda López de Uralde, 2024). Additionally, the distance between rural areas and urban centres complicates the creation of efficient networks for circularising by-products, limiting their economic viability (Cerantola, 2016).

In summary, rural areas in Spain face a series of complex challenges in ensuring clean water, healthy soils, reducing waste, and promoting the circularization of by-products. These challenges are interconnected and multifactorial, requiring a comprehensive approach that combines effective public policies, technological advances, environmental education, and increased investment in sustainable infrastructure and social innovation. Only with a holistic and collaborative approach among governments, farmers, and communities can these challenges be overcome and the rural environment preserved to move toward a more ecologically and socially resilient rural future (Adam, 2023).

## **1.1.2 Opportunities**

Spanish rural areas face environmental, social, and economic challenges that can be addressed through innovative, sustainable, and collaborative strategies, particularly within the framework of the circular economy and sustainability. The challenges to be faced are significant and have been detailed in the previous section. However, in recent years, considerable progress has been made in developing opportunities through social innovation, regenerative agriculture, soil and water restoration and conservation actions, the circular economy, and the circularization of agricultural by-products, among others,

to create a sustainable local rural economy. Below are some opportunities in various sectors related to clean water management, soil conservation and regeneration, waste reduction, and the circularization of by-products.

### **Innovation in Clean Water Management:**

- **Efficient Irrigation Technologies:** Encouraging the use of innovative technologies such as smart drip irrigation and rainwater harvesting, particularly in semi-arid areas, can optimise water use and reduce consumption in agriculture (Prado & Cuenca, 2020).
- **Wastewater Recovery:** Promoting local wastewater treatment plants and naturalised artificial wetlands that can be reused in agriculture and other rural applications (Delgadillo, 2010; Lopez et al., 2012). This approach can be managed through local authorities or community and cooperative initiatives, such as creating cooperatives to manage rainwater collection and reuse systems, leveraging local knowledge networks and new technologies.
- **Habitat Restoration Actions:** Promoting watershed restoration projects and implementing agroforestry systems to enhance water retention in soils and prevent erosion upstream in areas most vulnerable to water erosion (Iglesias et al., 2024).
- **Water Purification Innovation:** Developing decentralized technologies for water purification (natural filters, reverse osmosis technologies, phytodepuration) in rural areas with limited access to drinking water. Nature-based solutions offer a feasible alternative or combined solution to traditional grey infrastructure for water treatment (NATMED, 2024).

### **Soil Conservation and Regeneration:**

- **Regenerative Agriculture:** Promoting the adoption of regenerative agricultural practices such as the use of compost, biochar, cover crops, and reduced tillage to conserve and improve soil health (FAO, 2023).
- **Regeneration of Eroded Soils:** Implementing ecological restoration projects such as reforestation, recovery of grasslands, and wetlands can strengthen the ability of rural soils to retain nutrients and water, thereby increasing their long-term productivity (Gann et al., 2019). This is particularly important for regenerating the ecosystems of the Iberian Peninsula (Mola et al., 2018).
- **Training and Education in Sustainable Techniques:** Encouraging training programs for farmers and livestock producers in soil management techniques that improve fertility, prevent erosion, and promote soil biodiversity. For instance, creating "living soil schools" where farmers share successful practices and collaboratively develop new techniques to enhance soil health, fostering a network of learning and knowledge exchange (González, 2021; Sans, 2021).



### **Waste Reduction:**

- **Community Composting:** Fostering the establishment of community composting projects to utilise organic waste generated in rural areas (such as agricultural and livestock waste), converting it into natural fertiliser for crops. For example, in vineyard or olive-growing areas, pruning waste can be composted (Red Española de Compostaje, 2015).
- **Reusing Agro-industrial Waste:** Developing initiatives that transform agricultural by-products into value-added resources, such as producing bioplastics, biofuels, or animal feed from organic waste.
- **Zero Waste Rural Initiatives:** Implementing waste management systems that minimise the use of non-biodegradable materials (plastics) and promote the use of reusable and compostable materials in agriculture and livestock. This can be achieved through simple, low-cost technologies compatible with local practices, such as composting, biogas production, and processed animal forage in community centres for the production of fertilisers, energy, and other products (Omar, Hala & El-Haggar, Salah, 2017). It's essential to promote workshops and educational materials to raise awareness among the population and sensitise them towards reducing plastic and petroleum-derived products.
- **Cooperatives for Agricultural Plastic Recycling:** Creating local cooperatives to manage the collection and recycling of agricultural plastics (greenhouses, irrigation systems), transforming these wastes into new useful products. This offers job creation opportunities through rural recycling and reuse centres, where agricultural waste is collected, sorted, and processed.

### **Circularisation of By-products in Agriculture and Livestock:**

- **Circular Economy in Livestock:** Promoting the use of manure as natural fertilisers for crops and the generation of biogas as a renewable energy source from livestock waste. Cooperation and knowledge exchange between local agricultural and livestock cooperatives can be encouraged.
- **Circular Agro-industry:** Encouraging the use of agricultural by-products to create secondary value-added products, such as obtaining essential oils, perfumes, bioplastics from fruit peels, and olive waste, as well as using cover crops in vineyards as aromatic plants.
- **Integration of Crops and Livestock:** Promoting agroforestry and silvopasture, where the waste from one activity (such as tree pruning or crop residues) is reused in livestock or other production systems, optimising resources. Fostering local meeting spaces through the creation of rural forums and spaces where all stakeholders can share their experiences will be beneficial in promoting the establishment of circular economy clusters that maximise the use of local resources.

- **Transforming Waste into Energy:** Developing small-scale biomass plants that can generate clean energy from agricultural and forest waste, supporting the energy self-sufficiency of rural communities (Veinat Grimalt, 2013).

### 1.1.3 Success Stories

#### [Strengthening Governance for Ecosystem-based Adaptation in the Shared Sumpul River Sub-basin](#)

Location: El Salvador-Honduras.

#### **Image.**

Construction of hillside ditches in mixed agroforestry systems.



Source: ©IUCN Paul Aragón.

This project applies key concepts of nature-based solutions through the IUCN standard. The solution proposes various actions to improve water provision, soil health, and climate change adaptation. Key activities include enhancing agroforestry systems (such as crop diversification, soil conservation practices, and protection of water sources), improving training and governance, and strengthening the binational committee. For long-term sustainability of nature-based solutions, the project promoted local community training, improved coordination among key stakeholders, and developed technical support for the participating municipalities (Iglesias et al., 2024).



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[Life+ AgriAdapt Project.](#)

Location: Navarra, Cataluña, Castilla-La Mancha (Spain),

**Image.**

Use of goose for biological pest control and reduction of herbicide use in fruit crops as a soil conservation-friendly practice.



Source: ©AgriadaptEU.

The Life+ AgriAdapt Project was an initiative co-funded by the LIFE program of the European Union (2016–2020) and developed by various environmental organisations from Germany, France, Spain, and Estonia. Its main objective was to assess the impacts of climate change on European agriculture and promote sustainable and resilient adaptation measures in agricultural operations that encourage long-term resource efficiency. The project's primary goal was to adapt agricultural practices to the effects of climate change, focusing on sustainable water and soil management.

One of the key components of the project was to promote adaptation practices, which generated a positive impact on improving water use efficiency in crops and protecting soil from erosion and degradation. Customized adaptation measures were proposed based on the type of operation and its specific conditions. For example, work was done on rainfed and irrigated crops, promoting techniques such as direct seeding, the use of cover crops, and efficient irrigation methods, such as drip irrigation, to optimise water use and reduce soil erosion.

[Vercochar Project.](#)

Location: Islas Canarias (Spain)

**Image.**

Production of biochar for the improvement of degraded agricultural soils.



Source: ©ICIA Government of the Canary Islands.

The project aimed to investigate the benefits of using biochar in agricultural soils, as this material can improve soil structure, increase water and nutrient retention, reduce the need for chemical fertilizers, and promote carbon sequestration for climate change mitigation. The project encouraged the conversion of agricultural and forestry waste into biochar, thus fostering a circular economy by reusing waste rather than discarding or burning it.

The main impacts of the project included improved soil fertility and efficiency in the use of water and nutrients. It promoted increased carbon capture and storage in agricultural soils, reduced the environmental impact of agricultural activities by decreasing reliance on chemical fertilisers, and highlighted the use of agricultural waste as a valuable resource rather than a pollutant.

## 1.2 Clean Energy, Reduction of GHG Emissions and Climate Change Adaptation

In 2022, 39% of the electricity in the European Union was generated from renewable energies, and in May, wind and solar energy surpassed fossil fuels for the first time in electricity generation in the EU. Legislative targets were agreed upon for a minimum percentage of 42.5% of renewable energy in the EU by 2030, with the ambition to reach 45%. Energy efficiency targets were also increased to reduce final energy consumption by 11.7% by 2030 (European Commission, 2023).

Net greenhouse gas emissions in the EU decreased by around 3% in 2022, achieving a reduction of 32.5% compared to 1990 levels (European Commission, 2023). Under the European Climate Regulation, EU countries must reduce greenhouse gas emissions by at least 55% by 2030. The goal is to make the EU climate-neutral by 2050 (European Council, 2024).

Recent scientific reports show unprecedented changes in the global climate. Global warming is causing increasingly severe, and in some cases irreversible, changes in ocean currents and precipitation and wind patterns across all regions of the world. Rising temperatures and extreme weather events result in enormous costs for the EU economy and affect countries' ability to produce food (European Council, 2024).

According to a report by the European Commission, Spain is expected to experience a temperature increase of 4°C during the period 2070-2100 (with a greater increase in summer and less in winter) and a 25% decrease in precipitation. Spain will be one of the countries most affected by climate change (Caja Rural Burgos Foundation, 2023).

### 1.2.1 Challenges

The key challenges facing rural Spain in its path toward effective penetration of renewable energy are: the disparity of energy infrastructure between urban and rural areas; lack of access to affordable financing; population dispersion, which can increase implementation costs and hinder the creation of efficient energy networks; the need for integration with agriculture; the lack of adaptation in policies and regulations to the specific realities of rural areas; the need for education and awareness; and the need for technical training to enable the maintenance of renewable energy systems (Martínez Calleiros, J., 2024).

The agri-food sector in Spain is the second-largest emitter of greenhouse gases within the diffuse sector, behind the transport sector. In 2014, its emissions accounted for 25% of total diffuse emissions. Nearly half of the sector's emissions are generated by the use of fertilizers and soil management, while the other half is caused by livestock (enteric fermentation and manure management) (MAPA, 2023).

Climate change stands as one of the greatest challenges directly affecting rural Spain. In various regions of Spain, water resource scarcity, droughts, incessant temperature changes causing hailstorms, etc., wreak havoc on traditional crops, marking the urgent need for adaptive strategies (Caja Rural Burgos Foundation, 2023).

In agriculture, the search for seed varieties that adapt to new climatic conditions becomes essential. Promoting Research and Development (R&D) in this sector is also crucial as a tool to face climate change. On the other hand, livestock farmers face the challenge of introducing heat-resistant species and adjusting livestock diets to maintain health and productivity amid changing climatic conditions (Caja Rural Burgos Foundation, 2023).

### 1.2.2 Opportunities

Implementing clean energy technologies, such as solar panels or wind turbines, may require an initial investment but reduces operational costs for farms and local businesses, facilitating a revitalized rural economy (Redacción S.A., 2024).

Communities that adopt renewable energies increase their self-sufficiency. This means fewer service interruptions and greater energy independence (Redacción S.A., 2024).

The agricultural sector has the unique ability to produce emissions, but it can also act as a CO<sub>2</sub> sink through the capacity of soils and woody crops to capture CO<sub>2</sub> (MAPA, 2023).

Actions that can be taken to reduce emissions in the agri-food sector include (MAPA, 2023):

In agricultural soils: Appropriate use of fertilisation (soil analysis, doses adapted to crop needs, complementarity of organic and inorganic fertilisers); optimisation of fertiliser use (both organic and inorganic); crop rotation to optimise resource use (fertilisers, etc.); use of legumes; and management techniques that prevent losses of organic carbon from soils.

In livestock: Proper management of manure and slurry (alternative methods: anaerobic digestion - centralized and in small rural digesters -, slurry treatment and correct application to the soil - injection vs. broadcast spreading -) and enteric fermentation (diet modification to reduce methane emissions).

Utilising renewable energies to replace fossil fuels: replacing diesel boilers with biomass boilers and solar irrigation.

Reducing fuel consumption through improved combustion of agricultural machinery.

Eliminating the burning of agricultural waste: utilising it as biomass in boilers and incorporating it into the soil.

In the digital age, new technologies are emerging as invaluable allies in the fight against climate change. The ability to monitor real-time water conditions of crops and optimize



available resources becomes crucial to directing operations toward sustainability (Caja Rural Burgos Foundation, 2023).

### 1.2.3 Success Stories

[SAP005: Enhanced climate resilience of rural communities in central and north Benin through the implementation of ecosystem-based adaptation \(EbA\) in forest and agricultural landscapes](#)

Location: África

Most of the rapidly growing population of Benin lives in rural areas, where agriculture sustains around 70 per cent of people's livelihoods and provides about 80 per cent of export income to the economy. This strong dependence on agriculture is heavily impacted by environmental degradation and climate change.

The aim of the project is to halt the negative cycle of climate change, declining agricultural yields, and the degradation of natural resources in central and northern Benin to increase the resilience of local communities, using an ecosystem-based adaptation (EbA) approach. The EbA integrates climate-resilient agricultural techniques with the tailored restoration of degraded forest ecosystems. Therefore, the project addresses the current and future impacts of climate change through three components focused on restoring degraded forest ecosystems, increasing agricultural productivity, and improving the technical and institutional capacity of governments and communities. The project has a duration of 15 years.

[Energy Community, Castilfrío de la Sierra \(Soria, Spain\)](#) (Albendea, 2023).

Location: Castilla y León (Spain)

**Image.**

Social Center of Castilfrío de la Sierra.



Source: ©Albendea, G.L.

The Hacendera Solar Association of Castilfrío de la Sierra (Soria) has been active since 2018. It was the first rural energy community in Spain, initiated as a pilot project before the first laws regulating this activity were established. Today, it continues to grow thanks to the participation of local residents and public and private entities.

Castilfrío de la Sierra is a small village in Soria with fewer than 40 inhabitants (38 inhabitants in 2023, according to INE), a real example of the so-called "empty Spain," characterised by its sometimes cobbled, sometimes asphalted streets and large houses built in the Merino architectural style.

The Hacendera Solar Association, its official name, emerged in 2018 as a pilot project of the G100 – New Rurality initiative, created by the coworking organisation El Hueco, also based in Soria. This organisation seeks ways to promote entrepreneurship and social innovation in rural areas, contributing to sustainable development and addressing the challenge of depopulation.

This collaborative effort led to the installation of two photovoltaic solar plants on the rooftops of two municipal buildings (the social centre and the old laundry, now the water



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elevating station) and three private homes during the pandemic. The plants have capacities of 7.36 and 5.5 kilowatts peak for self-consumption. This was made possible with the support of the local city council and other organisations such as Red Eléctrica-Redeia, Caja Rural de Soria, and the Megara Energía cooperative, also located in this Castilian-Leonese province.

The project had an initial cost of 30,000 euros, plus 1,500 euros annually for maintenance, which are being covered by the savings generated by the installation itself.

These plants provide electricity not only to the public buildings where the panels are installed but also to the town hall, the medical clinic, and a renovated home. This includes the energy consumed for water pumping in the town and for the slow charging point for electric vehicles installed at the social centre. For the surplus energy fed into the grid, they have opted for the simplified compensation modality to further reduce electricity bills.

The project has not only helped awaken the commitment of some residents of Castilfrío de la Sierra but also facilitated other types of actions, such as the rehabilitation of houses. In other words, the aim is to combat depopulation by offering a much cheaper and more competitive living space and to promote citizen participation among the residents who are most interested.

[The Beefmetalist project develops an application to calculate the methane emissions from fattening calves in Cataluña](#)

Location: Cataluña (Spain)

**Image.**

Cattle.



Source: © Revista Frisona Española

One of the challenges currently faced by the cattle sector is the need to reduce emissions of gases such as methane, which significantly contribute to the greenhouse effect. Being able to easily calculate the amount of methane emitted by the animals in the Catalan fattening cattle system could be very useful for evaluating the effectiveness of measures that may be taken to reduce it.

To this end, the Beefmetalist demonstrative project has been developed, which involves creating an application aimed at farmers that functions as a methane calculator. This application is being designed using the data collected and the utilization of laser methane detectors to help industry professionals better estimate their animals' emissions.

To achieve this, researchers from the Ruminant Production program at IRTA must first gather data from farms through surveys, which will be used in the methane prediction equations. They will then compare these data with those obtained from the laser detectors installed in a representative farm in the sector. Finally, all this information will be used to create an application that allows farmers to estimate the ruminal methane emissions from their calves.

Through this tool, an inventory of ruminal methane emissions in Catalonia can also be created. This information may be very useful for evaluating the effectiveness of different actions that can be taken to reduce emissions, such as changes in livestock management or in the feeding of calves.

### 1.3 Preservation and Restoration of Ecosystems and Biodiversity

The preservation and restoration of ecosystems and biodiversity in Spain face various challenges that require an integrated and coordinated approach among different sectors of society, as well as the adoption of science-based strategies and international collaboration (Naumann et al., 2023). Spain is particularly vulnerable to climate change, desertification, soil degradation, habitat fragmentation, and the presence of invasive species (Sanz et al., 2022). Additionally, there are other significant challenges such as the overexploitation of natural resources, biodiversity loss, water management, wildfires, and a lack of environmental education and public awareness. Furthermore, there is insufficient public and private funding to address the social, economic, and ecological challenges arising from the loss of ecosystem services and biodiversity.

#### 1.3.1 Challenges

##### **Climate Change:**

Climate change is undoubtedly one of the primary challenges in conserving biodiversity and restoring ecosystems, both in Spain and globally. This phenomenon is profoundly altering ecosystems, questioning their resilience, disrupting natural balances, and putting numerous species and habitats at risk. Heatwaves, desertification, and changes in precipitation patterns are severely impacting biodiversity. Mediterranean ecosystems,



rich in biodiversity, are experiencing an increase in the frequency and severity of droughts, which reduce water availability and disrupt biological cycles (Valladares et al., 2005).

### **Desertification and Soil Degradation:**

A large part of Spanish territory, especially in the southeast regions, suffers from desertification processes due to deforestation, poor agricultural practices, and climate change. Soil degradation and desertification are two phenomena that are very difficult to reverse, severely affecting biodiversity and agricultural productivity. Therefore, it is necessary to implement conservation measures in areas that are already experiencing some degree of degradation (Jofre et al., 2003). Restoring degraded soils requires investments in improved water management, promoting sustainable agricultural practices, and actions that enhance vegetation cover. This also includes concrete actions to prevent erosion, pollution, and the loss of fertile soil (Manso et al., 2008).

### **Habitat Fragmentation:**

The construction of rural infrastructure, such as roads and communication routes, has fragmented many ecosystems, hindering the migration and reproduction of species. This generates profound ecological consequences, including problems associated with the loss of genetic diversity, a reduction in the total area available for wildlife, leading to population declines and, in some cases, local extinctions of species. Fragmented ecosystems cannot maintain the same species richness as contiguous ecosystems, resulting in biodiversity loss (Delgado Huertos, 2024). Connecting fragmented habitats through restoration efforts, for example, enhancing or creating ecological corridors and wildlife crossings, is essential to preserve biodiversity and ecosystem service provision. Large herbivores like deer and predators like wolves are the most affected, being particularly vulnerable as their hunting or migration areas are severely limited (Vidal Rettich, 2021).

### **Invasive Species:**

Spain has been affected by various invasive exotic species that compete with native species, alter ecosystems, and cause significant economic and ecological damage (EASIN, JRC). Although there has been considerable progress in raising environmental awareness regarding the issue of cultivating and importing invasive species, there are still limitations in strengthening control and prevention mechanisms through stricter policies and public awareness (Polce et al., 2023). Ecosystem restoration plans should promote the use of native species that are better adapted to the environment and contribute to maintaining biodiversity (Orellana, 2023).

### **Overexploitation of Natural Resources:**

The impacts of human activities, such as agriculture and livestock farming, have endangered many species and ecosystems, especially in rural areas (Oñate et al., 2023).

The intensification of agriculture, monocultures, pesticide and fertiliser pollution, and overgrazing are some of the negative impacts generated by these two activities in rural areas. There are multiple challenges to be addressed when it comes to regulating and managing natural resources more sustainably through more sustainable agriculture and livestock farming practices to prevent overexploitation and promote the recovery of damaged ecosystems. While agriculture and livestock farming are fundamental activities for human survival, their impact on ecosystems and biodiversity is profound. However, through the implementation of sustainable agricultural practices, habitat restoration, and the creation of conservation policies, it is possible to reduce these impacts and find a balance between agricultural production and biodiversity protection (Hernández San Juan, 2021).

#### **Loss of Biodiversity and Habitat Quality:**

The loss of biodiversity, both in terms of species and the loss derived from the decline in ecosystem quality, is a growing challenge in Spain. Protecting endangered species through conservation programs, protected areas, and habitat restoration is crucial to reversing biodiversity loss. Additionally, the resilience of ecosystems and the restoration of key ecosystems must be promoted to prepare them for the uncertain conditions of climate change, hotter summers, and harsher winters, promoting climate refuges for flora and fauna (Gann et al., 2019).

#### **Increasing Wildfires:**

Wildfires, exacerbated by climate change and rural abandonment, are a recurring threat to Spain's forests and ecosystems. The high-risk fire period is no longer limited to summer alone but extends from early spring to autumn, necessitating improvements in fire prevention policies, increased public and private investment, and the promotion of sustainable forest management (Úbeda et al., 2021). At the same time, restoring burned areas by applying principles of ecological restoration (avoiding forest monocultures) is a priority to halt habitat destruction, biodiversity loss, and rural depopulation (Cortina, 2013).

#### **Lack of Environmental Education and Awareness:**

The lack of environmental awareness and public participation in certain rural sectors hinders the implementation of conservation, restoration, and sustainable water management policies, among others. Promoting greater environmental education, both in the educational system and through public campaigns, represents a significant challenge but is vital for changing behaviours and fostering participation in biodiversity protection (Álvarez and Gutiérrez, 2019).

### **1.3.2 Opportunities**

Spain has multiple opportunities to preserve and restore its ecosystems and biodiversity, thanks to its extensive network of protected areas, the support of European funds and



the Common Agricultural Policy (CAP), the new European Nature Restoration Law that entails the obligation to develop national restoration plans, the promotion of sustainable agricultural practices, and successful species reintroduction programs. The country is in a privileged position to integrate advanced environmental policies with local community collaboration and investment in environmental education, creating incubators for nature-based solutions and ecotourism. If effectively managed, these initiatives can ensure the long-term protection of ecosystems, mitigate rural exodus, recover biodiversity, and generate economic and social benefits for future generations (MITECO).

### **Protected Area Network:**

Spain boasts a wide Network of Protected Natural Spaces, which includes national parks, biosphere reserves, Natura 2000 areas, and natural parks. These areas play a key role in biodiversity conservation as they protect critical habitats for many species, generating dispersal nuclei to other areas in worse conservation states (Becerra and Bravo, 2008). It is important to advance the conservation and expansion of these spaces while restoring degraded neighbouring habitats through the participation of rural populations and the creation of sustainable activities compatible with the conservation of these ecosystems (Martínez and Romero, 2003).

### **Common Agricultural Policy (CAP) and European Funds:**

The efficient use of these funds can promote a shift towards more environmentally-friendly agriculture, encouraging cropping systems that are compatible with ecosystem conservation, reducing pollution, and degrading water and soil. These policies promote the preservation of rural habitats, reducing the use of chemical products, and protecting threatened species (Segrelles, 2020).

### **New European Nature Restoration Law:**

The new European Nature Restoration Law represents a key opportunity for biodiversity conservation and restoration in Spain. This law, approved by the European Parliament, aims to reverse biodiversity loss and restore degraded ecosystems, marking a significant shift towards more sustainable and ambitious policies across the European Union (de Sadeleer et al., 2023). The Regulation requires member states to adopt and implement measures to jointly restore at least 20% of the EU's terrestrial and marine areas by 2030 (Europea, 2022). Nature restoration not only focuses on biodiversity but also on improving water and soil quality, which is essential for sustainable agriculture and ecosystem health. This also entails a greater capacity to mitigate floods and manage water resources more efficiently. Rural communities, especially in depopulated regions, could benefit from new jobs related to restoration and conservation while promoting ecotourism as a sustainable income source (SERE, 2024).

### **Sustainable Agriculture, Livestock, and Tourism:**

Given that Spain is a world-renowned tourist destination, sustainable tourism has the potential to represent a significant opportunity for funding biodiversity conservation and raising awareness among the rural population (de España, 2007). Promoting ecotourism in protected areas and rural regions can create local jobs and provide resources for ecosystem preservation (Duque, 2022). Similarly, sustainable agriculture and livestock farming, encouraging regenerative practices and organic farming techniques, can improve soil health, increase biodiversity, and reduce the use of pesticides and chemical fertilizers while recovering water quality. The combination of agriculture with sustainable forest management, such as agroforestry systems like *dehesa*, which combines grazing with tree and shrub conservation, offers a sustainable model that favours both productivity and ecosystem conservation (Ferrer, 2017; Rodríguez-Estévez et al., 2023).

### **Species Reintroduction Programs:**

These species reintroduction programs have shown considerable success in Spain, such as the case of the Iberian lynx (Espunyes, 2011) and the bearded vulture (LIFE 20 NAT/ES/001363; Margalida).



### 1.3.3 Success stories

#### [Water Resource Management Project in the Shullcas Subbasin, Peru.](#)

Location: Peru.

#### **Image.**

Recovered bofedales, Peru.



Source©IUCN

This project, which implemented Nature-Based Solutions (NbS), focused on various environmental actions aimed at the sustainable management of water and the conservation of natural ecosystems, such as wetlands, to ensure the supply of water to vulnerable populations. A practical case is applied in the Shullcas River basin in Junín, Peru, which faces threats such as the deglaciation of the Huaytapallana snow-capped mountain, water scarcity, pollution, and the degradation of wetlands and grasslands. These issues, exacerbated by climate change and intensive agricultural practices, jeopardize the livelihoods of rural populations and the water supply to urban areas. The solution proposes revegetation, recovery of grasslands and high-altitude wetlands (bofedales), and the promotion of sustainable practices in agriculture and livestock farming. The project includes training communities to implement mechanisms for payment for ecosystem services to ensure long-term sustainability.

## Live olive groves

Location: Andalucía (Spain)

### **Image.**

Olive groves LIFE project Olivares Vivos+.



Source:©LIFEolivaresvivos+.

Olivares Vivos is a LIFE project that promotes a sustainable olive grove model that enhances biodiversity, contributes to the fight against climate change, and increases the profitability of producers, while positioning olive oil as an organic and high-quality product. This successful project, coordinated by SEO/BirdLife and concluded in 2020, aimed to transform olive cultivation into a more sustainable production model focused on biodiversity conservation and the recovery of ecosystems in olive groves. It was primarily developed in Spain, in areas where olive oil production is a key economic activity.

Through environmentally friendly agricultural practices, the project seeks to restore and protect biodiversity in olive groves. This includes proper soil management, the introduction of native flora, and the creation of habitats for wildlife. A biodiversity certification was promoted, as the olive groves participating in the project were able to obtain certification that guarantees their commitment to environmental conservation and biodiversity. This helps producers access markets that value sustainability. The project, which has a continuation through another LIFE project, Olivares Vivos+, has generated scientific data primarily on biodiversity and the impact of sustainable agricultural practices, which have proven valuable for reinforcing the importance of conserving agricultural ecosystems.

[Mosaico Project, firebreak landscapes.](#)

Location: Castilla y León (Spain)

**Image1.**

Mosaic of traditional landscape, Sierra de Gata (Extremadura).

Firebreak landscapes. Purpose of WWF España y& ANP|WWF Portugalto adapt the Iberian territory to the fire.



Source: ©WWF. Hernández, L. & cols. (2021).

The Mosaic Project in the Sierra de Gata, an initiative covering areas of Castilla y León and Extremadura, seeks the sustainable management of rural landscapes with the main objective of preventing forest fires. However, it also has a positive impact on biodiversity and local development. The main objectives of the project are the prevention of forest fires through the creation of a "mosaic" landscape, where different land uses alternate, acting as a natural firebreak. Additionally, it aims to recover and diversify the rural landscape by promoting sustainable agricultural, livestock, and forestry activities that generate a local economy based on the conservation of the natural environment.

The activities it promotes include the encouragement of extensive agriculture and livestock farming, selective revegetation of key areas such as biological corridors and strategic zones, while also promoting agroecological practices and controlled grazing to reduce the risk of fires. The project aims to generate a series of benefits for biodiversity, such as increasing diversity through a more heterogeneous mosaic landscape that is more diverse and favourable to local flora and fauna species, which in turn contributes to fire prevention. Furthermore, maintaining the traditional landscape enhances the resilience of ecosystems against climate change. In summary, the Mosaic Project

combines fire prevention and landscape restoration with the recovery of biodiversity and the creation of sustainable opportunities for rural communities.

## 1.4 Organic Agriculture, Regenerative Livestock and Sustainable Forest Management

Currently, in Spain, almost half of the territory is dedicated to agricultural practices, covering more than 23 million hectares, of which nearly 17 million are arable land. Of this area, 76% is dedicated to rainfed crops, while 24% is used for irrigated farming. Regarding the livestock sector, Spain has over 25 million heads of pork and more than 16 million sheep (Ministry of Agriculture, Fisheries, and Food [MAPA], 2023).

According to EUROSTAT data from 2014, the Gross Value Added (GVA) of the agricultural sector amounted to 24,050 million euros, with the GVA of the agricultural and fishing sector contributing approximately 2.5% to GDP (MAPA, 2023). These figures demonstrate the importance of the primary sector in the economy, not only in rural areas but also at the national level, while emphasising that the agricultural and livestock sectors are irreplaceable in ensuring food security.

On the other hand, in Spain, forested land represents more than half of its land area. The latest consolidated figures from the Spanish Forest Map (MFE) and publications from the National Forest Inventory (IFN) indicate that just over 28 million hectares are forest areas that meet the legal condition of forests (55.8% of the total territory). Within this area, over 18.7 million hectares are wooded, representing 66% of forested land and nearly 37% of the total land area (MITECO, 2022).

Compared to Europe, Spain ranks second in terms of forest area (only preceded by Sweden) and third in terms of wooded area (after Sweden and Finland) (MITECO, 2022).

Organic production, also known as biological or ecological farming, is a management and production system that combines the best environmental practices with a high level of biodiversity and the preservation of natural resources, as well as the application of strict animal welfare standards, with the aim of producing according to certain consumers' preferences for products obtained from natural substances and processes (MAPA, 2024). For the EU, organic agriculture is considered to be based on a sustainable system that respects the environment and animal welfare, but also includes all other stages of the food supply chain (raw material supply, processing, storage, transport, distribution, and retail services) (European Parliament, 2024).

Over the last three decades, organic food and agriculture have grown year after year throughout the EU and continue to do so. The EU organic market is very dynamic, with growth rates varying from country to country. Policies can positively impact this growth, both in production and consumption (European Organic Farming Federation [IFOAM], 2024).



In 2022, the total area of agricultural land in the EU dedicated to organic production reached 16.9 million hectares. Compared to 2021, the number of organic producers in the EU increased by 10.8% to 419,112. However, the EU retail organic market did not keep pace with the significant growth in production, decreasing by 3% from 2021 data, resulting in 45.1 billion euros—still the second largest market after the United States and followed by China (IFOAM, 2024).

Between 2014 and 2022, European farmers received about 12 billion euros in support for organic farming practices under the Common Agricultural Policy (CAP) (European Court of Auditors, 2024).

In May 2020, the European Commission's "From Farm to Fork" Strategy mentions organic agriculture as a key sector for achieving the food ambitions of the European Green Deal. The strategy states, "The organic food market will continue to grow, and it is necessary to continue promoting organic farming." As part of this strategy, the Commission published the 2021-2027 Action Plan for Organic Farming, aimed at boosting both organic demand and supply (IFOAM, 2024).

Spain is one of the leading producers in terms of area in the EU and globally (MAPA, 2024). According to MAPA's 2022 organic production statistics, the useful agricultural area for organic production in Spain was 2,675,331 hectares in 2022 (10.95% of the total useful agricultural area) (the highest since 1991). In terms of certified organic livestock production in Spain in 2022, there were 45,018 (MAPA, 2022).

### 1.4.1 Challenges

Rural areas in Spain face a series of complex challenges to ensure clean water, living soils, reduce waste, and promote the circular economy of by-products (Adam, 2023), in addition to intrinsic issues such as depopulation, lack of services, scarcity of development opportunities, loss of generational turnover, profitability issues, and the need for modernization and digitalization in the primary sector, along with a sense of abandonment by administrations (Funcas, 2020).

Compliance with legislative requirements and adaptation to a new climatic reality are imperatives for the primary sector (Caja Rural Burgos Foundation, 2023).

In relation to the forestry sector, Spain's biogeographical situation and geomorphology make its territory sensitive to erosion processes and hydrological risks, and particularly vulnerable to the adverse effects of climate change. Climate change, coupled with the abandonment of many forest areas, has highlighted vulnerabilities that threaten forest conservation by weakening trees, making them more susceptible to pests, diseases, and forest fires (MITECO, 2022).

Forest fires continue to be the main element of degradation of forest ecosystems and one of the main environmental problems in Spain, which is expected to be exacerbated by biomass accumulation and the effects of climate change, especially due to rising

temperatures, more frequent, intense, and prolonged droughts, and heat waves that increase the risk of ignition and fire spread (MITECO, 2022).

National and EU policies for the organic sector have gaps. CAP (Common Agricultural Policy) funds were used to increase the area cultivated organically without sufficiently considering the environmental and market objectives set by EU organic farming policy (European Court of Auditors, 2024).

It is crucial to link the European Commission's goal of increasing the area of useful agricultural land dedicated to organic farming in the EU to 25% by 2023 to the reform of the CAP, the Biodiversity Strategy, and other agri-food policies to create a more positive environment in which farmers and food companies feel secure in making significant investment decisions to meet consumer demand for products made with care for people, animals, and the planet (IFOAM, 2024).

### 1.4.2 Opportunities:

Organic agriculture, as a production method aimed at obtaining food using natural substances and processes, tends to have a limited environmental impact compared to traditional agriculture, as it promotes responsible use of energy and natural resources, maintenance of biodiversity, conservation of regional ecological balances, improvement of soil fertility, and maintenance of water quality (European Commission, 2024a).

Regenerative agricultural systems aim to improve natural conditions while ensuring the demand for water and food for people, generating benefits such as increased climate resilience of ecosystems, enhanced conservation of biodiversity and natural resources, and greater productivity (FAO, 2020).

The European Green Deal is the EU's strategy for sustainable and inclusive growth, aimed at boosting the economy, improving health and quality of life for people, and caring for nature. In July 2023, the Commission adopted a package of measures for the sustainable use of key natural resources, which will also strengthen the resilience of European agriculture and food systems (European Commission, 2024b).

The Commission considers organic agriculture a key tool for increasing the sustainability of agriculture, and it has set a goal for 25% of EU agricultural land to be dedicated to organic farming by 2030, representing a significant leap from the 10.95% in 2022 (European Court of Auditors, 2024).

The growing demand for sustainable products from environmentally conscious consumers has propelled organic agriculture and regenerative livestock farming as viable options for the sector's survival (Caja Rural Burgos Foundation, 2023).

The forestry sector offers the following opportunities: it allows for the decarbonisation of the economy; it is an economic activity that supports the fight against demographic challenges in rural areas and promotes circular bioeconomy; construction with wood and



the use of its derived products has a positive ecological footprint compared to other materials that demand significant energy and resources in their various production, use, and valorisation phases; it presents financing possibilities through payment for environmental services, and there is a growing social demand favourable to nature conservation (MITECO, 2022).

### 1.4.3 Success stories

#### Colombian Livestock farming

Location: Colombia

This project is implemented in 87 municipalities of Colombia, located in 5 regions, and arises as a partnership between the Global Environment Facility (GEF), the government of the United Kingdom, the Colombian Federation of Cattle Ranchers (Fedegan), The Nature Conservancy (TNC), the Centre for Research in Sustainable Agricultural Production Systems Foundation (CIPAV), and the Environmental Action Fund (FA), under the supervision of the World Bank. Its objectives are to ensure that livestock farming contributes to the recovery and sustainable use of biodiversity while maintaining the profitability of the farms. More specifically, it aims to:

- Promote the adoption of environmentally friendly Colombian livestock production through pastoral systems in the project areas.
- Improve the management of natural resources.
- Increase the provision of environmental services (biodiversity, land/soils, carbon capture, and water).
- Increase productivity on the participating farms.

The project consists of incorporating pastoral systems alongside the conservation of forests and other existing natural systems, transforming farms into more productive and environmentally responsible areas. Various pastoral models exist, aimed at minimising the use of agrochemicals and improving ecosystems. A total of 18,283 hectares have been conserved, and 38,390 hectares have been sustainably used.

Agricultural Sustainability: Exploring Carbon Farming with AIVelAI

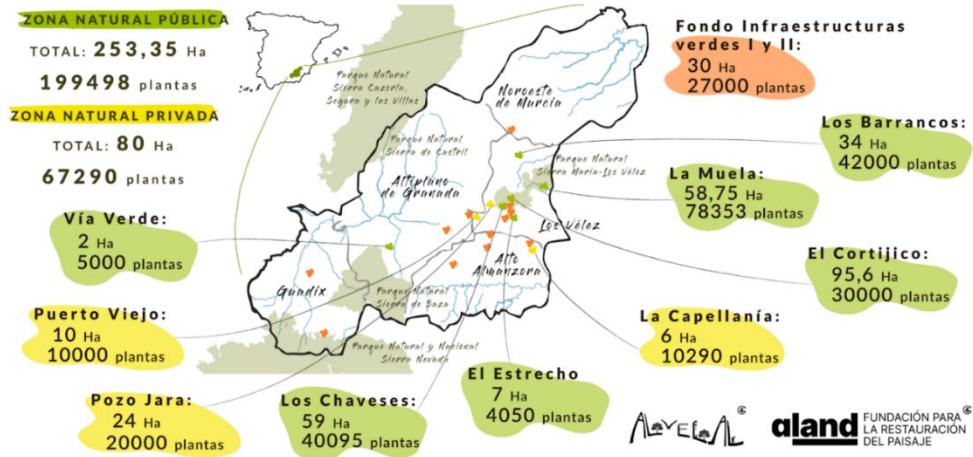
Location: Altiplano of Granada (Spain)

AIVelAI (<https://alvelal.es/>) is an association aimed at regenerating the landscape of the Altiplano de Granada (Spain) through ecosystem restoration, regenerative agriculture, and economic revitalisation, including aspects such as research, training, and awareness-raising. It has an ecosystem restoration plan that includes various actions; among them is the utilisation of farms belonging to producers who implement ecological and regenerative farming techniques, in addition to fostering cooperation among various competent administrations and private sector companies that generate jobs in the development and resource provision for its execution.

## Image.

Infographics of cumulative data on restoration of natural areas (2017-2022).

### ACTUACIONES EN ZONA NATURAL -ALVELAL (2017-2022)



Source: ©Asociación AlVelAl.

Regarding regenerative agriculture specifically, AlVelAl advises, supports, energizes, and monitors the implementation of regenerative and ecological agricultural practices, accompanying farmers in the transition to a new model, assisting them in seeking funding, promoting their products, providing a network of contacts, a shared machinery bank, etc. This is a growing community that is revitalizing the rural environment of southeastern Spain, with an interesting impact, as seen in the documentary "Cabeza, Corazón y Manos," awarded at the Green Festival in 2021 (<https://www.headheartandhands.site/>).

**Image.**

Visit to the El Pajaretillo Farm in San José del Valle (Cádiz, Spain).

Covering 475 hectares, where holistic management of livestock and agriculture is applied.  
July 2024.



Source: © Asociación AIVelAI.

[Sustainable forest management in Menorca in a context of climate change \(LIFE BOSCOS-MENORCA\)](#)

Location: Menorca (Spain)

In January 2009, the Insular Council of Menorca launched the LIFE+BOSCOS project: “Sustainable Forest Management in Menorca in a Climate Change Context.” Lasting 5 years, the main objective of the project has been to contribute to the adaptation of Mediterranean forest ecosystems to the negative impacts of climate change through sustainable forest management.

**Challenges:**

Mediterranean islands are particularly susceptible to the effects of climate change. All models agree that an increase in water stress and its associated risks for this region—drought, pests, fires, as well as those related to changes in ecological conditions (species extinction, mutualism, desynchronization, alteration of biodiversity, phenological changes)—is expected. Insularity is also a factor that will increase the vulnerability associated with these effects.

In addition to changes related to the acceleration of climate change, socio-economic factors (livestock crisis, increase in recreational activities, energy crisis, economic crisis) create a scenario of significant transformation in the forest structure of the island, which may affect the adaptive response capacity of forest communities and put at risk ecosystem services, regulation, and cultural functions.

### **Adaptation Measure Objectives:**

- General Objective: Contribute to the adaptation of Mediterranean forest ecosystems in Menorca to the negative impacts of climate change through sustainable forest management.
- Partial Objectives:
  - Demonstrate the feasibility of reducing the vulnerability of forest systems to climate change through forest management actions carried out on private farms.
  - Design forest management guidelines at the island level, with governance and participation criteria that enable the adaptation of forest ecosystems to climate change scenarios.
  - Train landowners, managers, and other social agents linked to forests on aspects related to sustainable forest management and good forestry practices.
  - Raise public awareness about the values of forests, the impacts of climate change, and the role of sustainable forest management in this context.

### **Solutions:**

- Information and analysis of the effects of climate change on Mediterranean forest areas.
- Definition of forest management guidelines at the island level.
- Development of pilot forest management plans for agricultural operations.
- Pilot testing of forest management plans on farms.
- Environmental assessment of the implementation of forest management guidelines.
- Evaluation of the profitability of actions.
- Analysis of the non-implementation of guidelines.
- Training for managers.
- Information for the general public.
- Dissemination of results.



## Image.

Demonstration Day of Good Forestry Practices in Menorca. July 2015.



Source: © Life + BOSCOS Project.

## 1.5 Methodologies and Sustainability Indicators in Rural Green Transition

According to the United Nations Environment Programme (UNEP, 2012), a green economy is “one that improves human well-being and reduces inequalities over the long term, while avoiding significant environmental risks and ecological degradation for future generations” (ENRD – European Network for Rural Development, 2017). The rural green transition refers to the transformation of economic and social activities in rural areas towards more sustainable and resilient practices that minimise environmental impact and promote community well-being (OpenIA, 2023).

To carry out this transition, it is essential to implement methodologies and use indicators that allow for measuring progress and evaluating the effectiveness of initiatives. Below are some key methodologies and indicators in this area (OpenIA, 2023).

### 1.5.1 Methodologies (OpenIA, 2023)

- **Life Cycle Assessment:** Assessment of the environmental impact of products or processes from raw material extraction to final disposal.
- **Cost-Benefit Analysis:** Economic evaluation that compares the costs and benefits of sustainability measures implemented in the rural environment.
- **Participatory Approach:** Involves the community in identifying problems, setting priorities, and evaluating solutions. This ensures that initiatives reflect local needs and values.

- **Development of Sustainability Indicators:** Identification and development of relevant indicators that measure economic, social, and environmental aspects to evaluate the sustainability of practices and policies in the rural area.
- **Technology Adaptation:** Implementation of sustainable technologies that are adapted to the rural context, such as renewable energy, sustainable agriculture techniques, or efficient water management.
- **Regenerative Agriculture and Agroecology:** Promoting agricultural practices that regenerate soils, increase biodiversity, and improve the health of rural ecosystems.

### 1.5.2 Sustainability Indicators (OpenIA, 2023):

#### Environmental Indicators:

- **Carbon Footprint:** An indicator that quantifies greenhouse gas emissions associated with production activities.
- **Water Quality:** Analysis of pollution and sustainable use of water resources.
- **Biodiversity Index:** Monitoring of species and habitat diversity in the rural area. According to the recently approved Law for Nature Restoration, the biodiversity of agroecosystems can be measured with the following indicators: the butterfly index of grasslands; the proportion of agricultural land with highly diverse landscape features; and organic carbon reserves in mineral soils of agricultural land (European Parliament, 2024).
- **Ecological Footprint:** Calculated as the amount of land needed for each person to exist. Values of the ecological footprint per person above 1.71 global hectares indicate unsustainable consumption, exceeding the planet's capacity to provide renewable resources sustainably (García, 2018).

#### Social Indicators:

- **Human Development Index (HDI):** Measurement of well-being in terms of health, education, and living standards. HDI values above 0.7 indicate high human development, meaning satisfactory levels of income, health, and education for the population of a country (García, 2018).
- **Community Participation and Satisfaction:** Degree of community involvement in decision-making and positive impact on the quality of life of residents. Notable participatory approaches for sustainable agriculture include: "Farmer-to-Farmer Movement," Participatory Rural Appraisal, On-Farm Participatory Research, Sociocultural Animation, and Socio-praxis (López García, 2014).
- **Gender Equity:** Analysis of women's participation and empowerment in the rural economy.
- **Access to Natural Resources:** Proportion of the rural population with sustainable access to water, land, and other resources.



### Economic Indicators:

- **Per Capita Income:** Income per inhabitant in rural areas.
- **Green Employment:** Number of jobs created in sustainable and low-impact activities (inventories, employment per unit of product or service, input-output analysis, and social accounting matrices, etc.) (Harsdorff & Phillips, 2013).
- **Income Diversification and Economic Resilience:** Measure of the economic capacity of rural families to generate income through various activities and adapt to changes.
- **Economic Profitability:** Return on investment (ROI) in sustainable projects.

### Governance Indicators:

- **Transparency and Accountability:** Evaluation of public management and citizen participation in environmental decisions.
- **Sustainability Policies:** Existence and effectiveness of policies and programs aimed at promoting sustainability in the rural area (Harsdorff & Phillips, 2013; López, 2014; OpenIA, 2023; European Parliament, 2024).

The green transition in rural areas presents both significant challenges and opportunities:

### Challenges (OpenIA, 2023):

- **Dependence on Non-Renewable Resources:** Many rural communities rely on traditional agricultural practices and the exploitation of unsustainable resources, which can hinder the transition.
- **Access to Technology:** Lack of access to modern and sustainable technologies limits farmers' ability to adopt greener practices.
- **Financing:** Securing investments for sustainable projects can be challenging, especially in communities with limited resources.
- **Cultural Resistance:** Changes in traditional practices may face resistance from farmers.
- **Education and Training:** The need for training in sustainable practices is fundamental.

### Opportunities (OpenIA, 2023):

- **Agricultural Innovation:** The green transition can drive the development of new technologies and more sustainable agricultural methods, such as precision agriculture and agroecology.
- **Income Diversification:** Implementing sustainable practices can open new market opportunities, such as organic food production or renewable energies.
- **Natural Resource Conservation:** Adopting sustainable practices can contribute to soil, water, and biodiversity conservation, improving ecosystem resilience.

- **Public Policies:** Increasingly, governments are implementing policies that promote sustainability, which can provide financial and technical support to rural communities.
- **Community Strengthening:** Collaboration among farmers, cooperatives, and local organisations can strengthen social cohesion and promote a sense of community in pursuing common goals.
- **Sustainable Tourism:** Rural areas can leverage their natural and cultural environment to develop sustainable tourism, generating income and employment.
- The green transition in rural areas is, therefore, a complex path but full of potential. Addressing challenges with appropriate strategies can open the door to a more sustainable and prosperous future for rural communities.

### 1.5.3 Success stories

#### [Autonomous Adaptation to Droughts in an Agro-Silvo-Pastoral System in Alentejo in Alentejo](#)

Location: Alentejo (Portugal)

Guided by the ethics of agroecology, a Portuguese farm is implementing a food production model based on respect for nature, aligned with sustainable development goals, and capable of protecting water resources in a drought-prone area.

**Herdade do Freixo do Meio** is a multifunctional landscape located in the Alentejo region of southern Portugal. It hosts a certified organic farm, a historical archaeological area, and a protected natural area covering 584 hectares. The region is characterized by multifunctional and dynamic agro-silvo-pastoral systems of cork oaks and holm oaks. The farm managers implement concepts of agroforestry, agroecology, regenerative agriculture, holistic management, permaculture, and food sovereignty. This farm employs about 30 people and primarily produces sweet acorns, vegetables, fruits, wine, olive oil, cork, and herbs. It also houses animals such as sheep, cows, pigs, and chickens. This farm has been implementing various sustainable agriculture techniques while maintaining economic viability. It is particularly committed to raising awareness about sustainable agriculture and has autonomously implemented adaptation measures to cope with a changing climate, especially needed due to the increasing intensity and frequency of drought episodes. It has also been recognized as a Private Protected Area, belonging to the Portuguese Network of Protected Areas.

**Montado do Freixo do Meio** promotes a space for cooperation, inclusion, personal development, work, and community building. It seeks to create a community that harmoniously integrates the ecosystem to which it belongs, one that is autonomous, resilient, peaceful, and ecumenical. The objective of the various initiatives carried out by the agricultural enterprise is to improve the relationship between human actions and resources: water, soil, biodiversity, energy, science, and culture.



**Image.**

Agro-Silvo-Pastoral System Alentejo.



Source: © Herdade do Freixo do Meio.

[MEDACC: Innovative Methodologies for Climate Change Adaptation in the Mediterranean Basin](#)

Location: Cataluña (Spain)

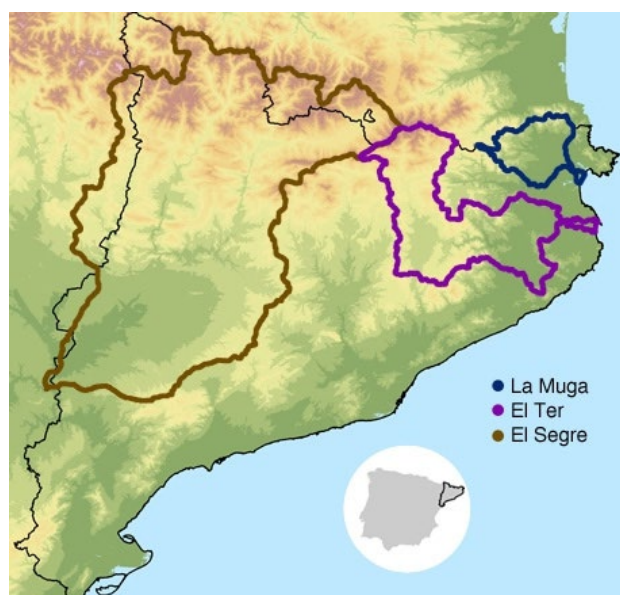
The LIFE MEDACC project develops innovative solutions for climate change adaptation in Mediterranean agroforestry and urban systems. Implemented in the Catalan watersheds of the Muga, Ter, and Segre rivers, it evaluates how adaptation measures reduce vulnerability while considering economic and environmental costs. The applicability to the Mediterranean region as a whole is a key focus.

The objective of the LIFE MEDACC project is to develop innovative solutions aimed at adapting our agroforestry and urban systems to the impacts of climate change in the Mediterranean area. A series of adaptation measures have been implemented in the fields of agriculture, forestry management, and water management. The project's results help quantify how adaptation can reduce the vulnerability of natural systems and human activities to climate change and assess the economic and environmental costs associated with the implementation (or non-implementation) of these adaptation measures.

The project is carried out in three representative watersheds of Catalonia: The Muga, Ter, and Segre. The goal is to ensure that the results and methodology are applicable for designing similar experiences throughout the Mediterranean area.

## Image.

Geographical Scope of the MEDACC Project. 2013.



Source: © MEDACC project.

[Phytodepuration System for Wastewater Treatment in a Rural Environment in Errigoiti. Nature-Based Solutions in Euskadi. 20 Success Cases for Adapting to Climate Change Using NBS.](#)

Location: Basque Country (Spain)

The Errekalde neighbourhood, a rural area of dispersed farmhouses in Errigoiti, had a problem with the management of wastewater and sewage. The septic tank in the neighbourhood, buried in a sloped area and not connected to the municipal sewage system, was deteriorating due to land subsidence, which had caused several cracks in the septic tank. In light of this situation, the Errigoiti Town Hall decided to address the problem through a combination of different Nature-Based Solutions (NBS) and the application of circularity criteria.

In the civil works portion of the intervention, bioengineering techniques were used for land stabilisation, and the cracked septic tank was repurposed to establish a phytodepuration system and mechanical-biological filtration of the wastewater and sewage from the neighbourhood. As a result of the intervention, the generated effluent is discharged into a nearby stream, meeting all legal parameters for discharges into public hydraulic domain.



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## 1.6 Resources and Policies to Promote the Green Transition in Rural Areas

In Spain, rural areas occupy 85% of the territory—428,010.9 ha out of the 50,599,000 that the country has—but their inhabitants represent only 16.5% of the total population. However, these individuals coexist in key ecosystems to address the current ecological emergency and often sustain essential activities in the territory to confront this crisis (Nuche, 2021).

The green transition in rural areas not only contributes to environmental sustainability but can also strengthen the local economy and improve the quality of life for communities. It is essential to develop integrated policies and provide adequate resources to facilitate this transition, promoting community participation and the use of sustainable technologies (OpenIA, 2023).

### 1.6.1 Challenges

The ecological crisis includes two major global challenges that we must face: the climate emergency and biodiversity loss (Nuche, 2021). We are witnessing a global loss of biodiversity so significant that the scientific community compares it to the previous five mass extinctions in Earth's history, dubbing it the sixth extinction. The difference with this extinction from previous ones is its cause: human impact (Nuche, 2021).

The challenge facing society, in general, and rural areas, in particular, is to achieve a low-carbon economy. One of the primary reasons for undertaking this transition is to strengthen contributions to climate change mitigation, an issue in which all sectors have a role to play (European Network for Rural Development, 2017).

The low-carbon economy involves developing economic activities with minimal greenhouse gas (GHG) emissions to the biosphere. It is one where companies, people, and the environment thrive through carbon management and administration, more efficient fuel use, carbon storage in soils and biomass, and the use of low-carbon technologies to generate products, services, and energy. However, it is important to note that the term "low-carbon" refers not only to carbon dioxide (CO<sub>2</sub>) but also to the reduction of emissions of all greenhouse gases (GHG), such as nitrous oxides or methane (European Network for Rural Development, 2017).

Therefore, in the rural world, we must focus on the urgent need to address demographic challenges, climate emergency, and nature deterioration, as well as the current crisis in the agricultural sector (rising production costs, low food prices, and lack of public policy support) (Econoticias.com, 2022).

Regarding the agri-food system, a basic activity in rural areas, its value is undeniable. It provides food, sustains the economy, and shapes cultural identity. However, the hidden

environmental, social, and health costs associated with it must also be considered (FAO, 2023).

### 1.6.2 Opportunities:

Local and indigenous communities play a key role in maintaining biodiversity (Nuche, 2021).

Unlike other sectors, those that use land provide an opportunity to offer a positive carbon balance through carbon capture and conservation in soils and biomass (European Network for Rural Development, 2017).

The natural ecosystems of rural Spain, such as forests, pastures, or wetlands, can become our great allies as CO<sub>2</sub> sinks if we protect them (Nuche, 2021).

Promoting green jobs is considered one of the pathways to achieve the success of the United Nations Agenda 2030 for Sustainable Development. The greening of the rural economy is a primary aspect to promote decent and sustainable job opportunities, improve labour productivity and resources, and foster poverty eradication and social inclusion (ILO, 2019).

True Cost Accounting (TCA) allows estimating the hidden costs generated by market inefficiencies, institutions, and policies. It provides decision-makers with the objective data necessary to correct hidden environmental, social, and health costs and improve agri-food systems (FAO, 2023).

The rural environment, which houses most ecosystems, plays a key role in supplying essential environmental goods and services, which are the benefits that people obtain from nature, such as food, clean water, and air, among others. Ecosystems, in addition to helping mitigate climate change, provide many other environmental services to society (Nuche, 2021).

Improving resource use efficiency and generating renewable energy offers excellent opportunities for the rural world (European Network for Rural Development, 2017).

Rural Development Programs (RDP) can assist rural businesses in conducting low-carbon activities through measures such as advice and training, development of agricultural enterprises, afforestation and forest management, and promoting investment (European Network for Rural Development, 2017).

The EU Nature Restoration Law, part of the European Green Deal and agreed upon with the Member States, aims to regenerate degraded ecosystems in their territories, contribute to achieving the EU's climate and biodiversity goals, and improve food security. In this sense, it is a good opportunity for rural areas to enhance the biodiversity of agroecosystems (European Parliament, 2024).



In Spain, the Plan of Measures to Tackle Demographic Challenge, particularly its Axis 1 for promoting ecological transition, is a significant opportunity to achieve the following objectives (Ministry for Economic Transition and Demographic Challenge, 2024):

- Promoting an energy transition adapted to local communities, fostering the development of innovative and sustainable initiatives.
- Promoting bioeconomy for economic diversification based on biodiversity and environmental quality.
- Guiding environmental protection to design more resilient and sustainable local communities.
- Ensuring a Just Transition in the territory that contributes to combating depopulation, especially in small municipalities included in Just Transition agreements.

### 1.6.3 Success stories

#### [Subsidised drought insurance for farmers in Austria](#)

Location: Austria

The subsidised public-private drought insurance system adopted by the Austrian government combines indemnity-based insurance with climate index-based products. Its goal is to prepare farmers to cope with extreme events, reduce their reliance on subsidies, and therefore promote their well-being and mental health, while enabling better financial planning through public-private partnerships.

Agriculture is highly sensitive to extreme weather phenomena, such as droughts, floods, storms, hail, and heat. Drought, in particular, poses a significant challenge for farmers and governments due to its potential negative impact on crop yields. Climate change amplifies the frequency and severity of droughts, increasing the risk of agricultural losses. In Austria, recent drought-induced crop losses and impacts on agricultural production led the government to adopt a subsidised drought insurance system for farmers. This system replaces the traditional approach of providing ad hoc compensation to farmers for economic damages caused by droughts.

The public-private insurance system combines indemnity and index-based products for drought-related agricultural damages to:

Provide fairer and quicker coverage of damages to farmers, which should lead to farmers relying less on public subsidies, experiencing fewer mental health issues due to economic concerns, and being more sustainably prepared to cope with extreme events.

Create a risk management and financing instrument that allows the government to work with a programmable annual budget (as opposed to crisis management with unforeseen and ad hoc compensations) based on a combination of public funds, contributions from the private sector, and payments to individual farmers.

## Image.

Crops affected by agricultural and meteorological droughts.



Source:© Osman Kartal, Climate Change PIX/EEA.

### [A modern dairy farm that efficiently uses resources in Dâmbovița County: GREEN ECONOMY. OPPORTUNITIES FOR RURAL EUROPE](#)

Location: Romania.

Of the 2,000 dairy producers in Dâmbovița County, only seven are considered modern industrial farmers. The nature of these small-scale farms, focused on subsistence or semi-subsistence, means that the management of manure and the composting processes used represent a problem for the region. Ammonia emissions cause pollution that affects nearby populations. Recognising the importance of integrating environmental, economic, and social activities within a green economy framework, the project aimed to achieve results in several related areas. A new dairy farm was created with facilities for the production of cheese and other dairy products. At the same time, a renewable energy production unit (biogas) was integrated into the farm's development to process both the waste generated by the dairy production process (manure, waste milk, etc.) and to produce energy (about 250 kW) to support the operation of the farm and the processing plant. Traditional physical labour on the farm was reduced through automation processes in production, including manure management and forage supply. In turn, other less physically demanding jobs were created in milk processing and the operation of the new facilities. This generated job opportunities for a broader range of local residents.

### [Reforestation with Native Species through Land Stewardship Mechanisms in Bakio. Nature-Based Solutions in the Basque Country. 20 Success Cases for Adapting to Climate Change through NBS.](#)

Location: Basque Country (Spain)

The climate change adaptation plan for the municipality of Bakio establishes the need to adapt the territory and its productive management to the new expected climate scenarios



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as one of its intervention axes. In the forestry sector, it proposes identifying the risks and vulnerabilities of Bakio's forests and promoting the adaptation of their management in response to the expected increase in temperatures and decrease in precipitation. In this context, the Bakio City Council promotes the recovery of municipal forest land, historically dedicated to forestry plantations, and its reforestation with native tree and shrub species. This initiative aims to restore the ecological functionality of the forest, minimise soil erosion processes, and enhance carbon absorption by both plant biomass and soil. To carry out this intervention, the Bakio City Council signs a land stewardship agreement with a stewardship entity (in this case, Lurgaia Fundazioa), which provides technical advice on restoration and forestry facilitation, ensuring the sustainable use of the lands under stewardship at all times. The reforestation was carried out over 5.7 hectares divided into two plots previously harvested for eucalyptus (*Eucalyptus globulus*) forestry.

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