ResAlliance

A resilient future for Mediterranean landscapes

Landscape resilience blueprint for the wider Mediterranean region

Co-funded by the European Union

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Contents

Preface

The Landscape Resilience Blueprint for the Mediterranean Region, developed under the EU-funded ResAlliance project, outlines a strategic framework to bolster the adaptive capacity of agriculture and forestry systems facing escalating climate threats such as droughts, wildfires, and biodiversity loss.

Coordinated by ELGO DIMITRA and involving 16 partners across the Mediterranean, the Blueprint emphasizes four pillars—governance, management practices, technology, and finance—to drive systemic change. It promotes inclusive policies, climate-smart land use, digital monitoring tools, and accessible funding mechanisms. Key achievements of the project included development of an online Mediterranean-wide network of knowledge and active citizens called the LandNet, organization of five regional LandLabs, preparation of 120 best-practice factsheets, and launch of educational Massive Open Online Courses (MOOCs). Looking ahead, the project advocates scaling agroecological and forestry transitions, reforming governance, expanding precision agriculture, and innovating financial instruments to ensure long-term resilience and sustainability across Mediterranean landscapes. The Blueprint describes the overall approach and highlights the main ideas, aiming in a few pages to familiarize the reader with the concepts and to prompt further reading of available material on the project website (https://www.resalliance.eu/), or, for the long-term, on the EU-FarmBook platform.

Further information from ResAlliance project

- ResAlliance project (2025). A resilient future for Mediterranean landscapes - Policy brief on the final policy forum of the ResAlliance project. https://www.resalliance.eu/publications/
- Pingault, N., Martius, C. (2024). Resilience thinking: a brief overview. https://www.resalliance.eu/publications/
- Pingault, N.; Martius, C. (2025) Resilience thinking for the Mediterranean basin: How to respond to fire, drought, and flood at the landscape level. https://www.cifor-icraf.org/knowledge/publication/9380/
- ResAlliance project (2025). ResAlliance factsheets collection. https://www.eufarmbook.eu/en/projects/1b68a1141da1e17bbe272408222a68a9f48cc9b8e00443c3dd1548fe06d20c9f/contributions
- ResAlliance project (2025). A resilient future for Mediterranean landscapes - Landscape resilience blueprint for the wider Mediterranean region. https://www.resalliance.eu/publications/

Well maintained olive groves that can act as fuelbreaks on Kythira island Greece (author: Gavriil Xanthopoulos, © NC SA).

1

SETTING THE SCENE

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The project

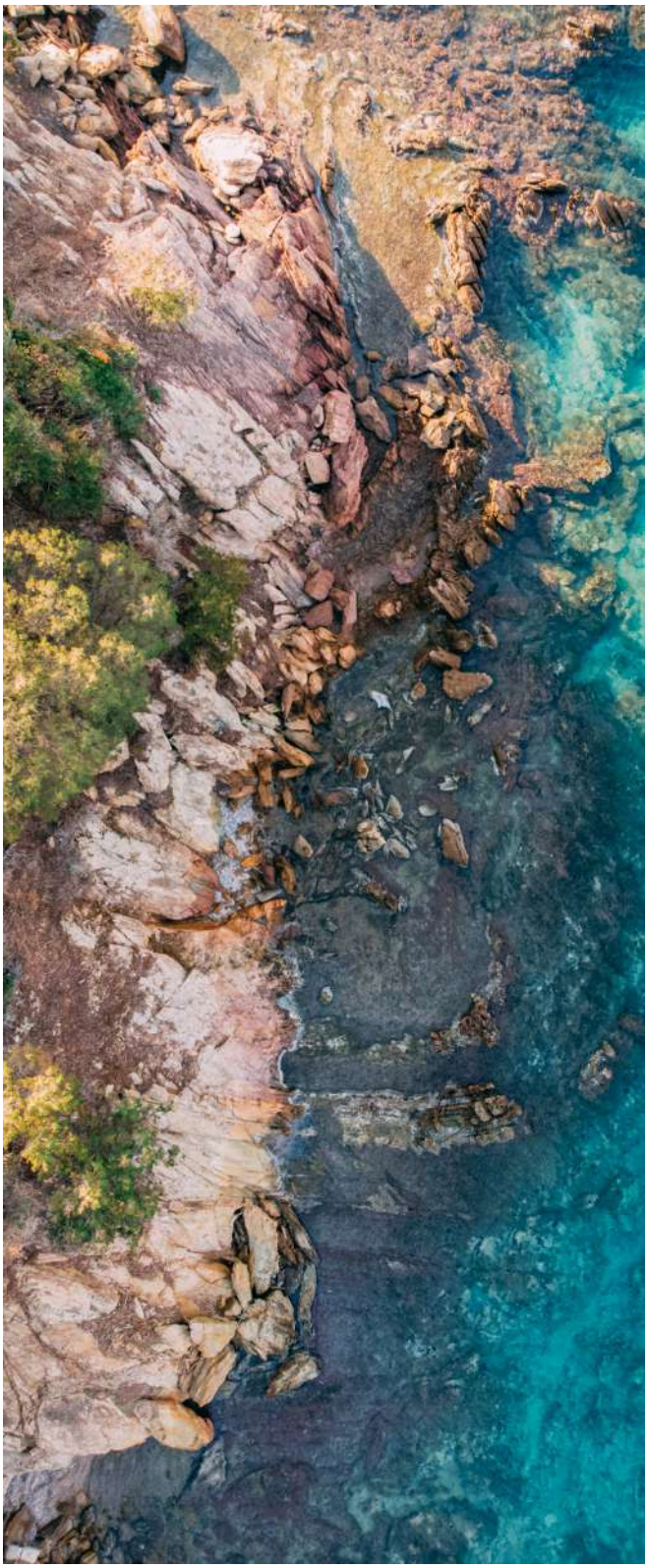
The objective of the *"Landscape resilience knowledge alliance for agriculture and forestry in the Mediterranean basin"* project with acronym *"ResAlliance"* was to facilitate information and knowledge flow and increase the awareness, understanding, and capacity of farmers and foresters on landscape resilience in Mediterranean countries.

More specifically, ResAlliance gathered and assessed knowledge and practice needs, gaps, barriers, solutions, and good practices to achieve resilient landscapes, with special emphasis on measures against hazards caused by climate change. It also prepared and facilitated stakeholder engagement through interactive and innovative participation methods.

It finally transferred the knowledge and activated regional landscape resilience governance, with special emphasis in five Mediterranean regions. ResAlliance created and animated a Mediterranean thematic network on landscape resilience ("LandNet") for forestry and agriculture. The LandNet continuously identified, engaged, and grew new cooperation and networks to access, improve, and increase the knowledge of solutions and good practices.

The LandNet prepared context-specific knowledge and engaged and trained farmers, foresters, and other key stakeholders for knowledge transfer of managerial, technological, financial, or governance solutions through five LandLabs in five Mediterranean countries (Greece, Portugal, Spain, Italy and Cyprus).

Moreover, the ResAlliance project produced 120 factsheets which present best practises concerning multiple threats of climatic changes in agriculture and forestry landscapes (drought; fires; floods; pest and diseases etc). Lastly Massive Open Online Courses were produced and disseminated through the LandNet to educate multiple members.



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The context

The Mediterranean is one of the most vulnerable regions to climate change, warming 20% faster than the global average. This rapid rise in temperature has led to more frequent and intense heatwaves, which pose serious health risks, especially to vulnerable populations, and increased energy demand. Water scarcity is becoming a critical issue, with declining rainfall, shrinking mountain snowpacks and over-exploitation of freshwater sources threatening agriculture, drinking water supplies and hydropower generation.

The region is also facing a sharp increase in wildfires, which are longer and more destructive due to hotter, drier conditions and land degradation. Coastal areas are increasingly threatened by sea-level rise and erosion, with saltwater intrusion threatening major cities, infrastructure and freshwater systems. Agriculture, a key economic sector, is under pressure from changing growing conditions, reduced yields and more frequent droughts, with staple crops such as olives, grapes and wheat particularly affected. Biodiversity is also under threat as unique ecosystems and species struggle to adapt to rapid environmental change, exacerbated by habitat loss and pollution.

These environmental challenges have wider social and economic implications, including climate-induced migration, urban stress and potential declines in tourism. In addition, shared natural resources are becoming a source of tension, increasing the risk of political and security instability. Drought, heatwaves, and wildfires were identified as the most impactful extreme events, significantly affecting agricultural and forestry activities.

Addressing these interlinked threats requires urgent, coordinated action across borders, focusing on sustainable resource management, climate adaptation and building resilience in both rural, agroforestry and urban areas.

The Gorge of Samaria, Crete, Greece (author: Gavriil Xanthopoulos, © NC SA).

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DEFINITION OF RESILIENCE AND FOUR THEMATIC AREAS COVERED

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Definitions

This section presents the definitions of resilience, as previously described in other documents such as; *"Resilience thinking: a brief overview"* and the *"LandNet Roadmap"*, both available at https://www.resalliance.eu/publications/.

The word 'resilience' (from the Latin verb resilire) means the capacity to bounce back, recover or spring forward in the face of adversity. This concept has infused many disciplines over the last century, including psychology, mechanics and material science. Holling (1973) introduced the concept in ecology science and defined it as *"the persistence of relationships within a system"*, i.e., *"a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist"*. Three main definitions of resilience have progressively emerged and currently coexist in the literature; Engineering; Ecological and socio-ecological resilience. In the context of ResAlliance, we understand resilience as the *"ability of a system to cope with disturbances, bounce back, and maintain its state and functionality"*.

ResAlliance focuses on disturbances influenced or exacerbated by climate change, notably (but not exclusively) wildfires, droughts and flooding, that spread at landscape scale and may impinge on both forests and agricultural land. Furthermore, ResAlliance is not only interested in biophysical systems within the Mediterranean region but also in the social actors and institutions associated with them, which result in coupled socio-ecological systems. Thus, ResAlliance examines and pursues socio-ecological resilience, which is defined as *"the capacity to adapt or transform in the face of change in socio-ecological systems, particularly unexpected change, in ways that continue to support human well-being"* (Folke et al., 2016, p.2). This resilience is the project's main focus, which has made a strong effort to identify, understand, explain and promote a broad set of good practices that lead to it. One example is agroforestry landscapes, which can provide adequate and stable income to rural populations, are tolerant to drought, offer alternative income sources, facilitate fire suppression efforts, and, when burned, are affected by reduced fire intensity and severity, thus easily recovering, offer a good demonstration of socio-ecological resilience (Xanthopoulos, 2023).

The ResAlliance project focuses on four thematic areas, that help to create a typology of the different identified solutions, namely (i) Governance, (ii) Management practices, (iii) Technology and (iv) Finance (Figure 1).

- Governance is the management of countries or organizations through structures ensuring accountability, transparency, rule of law, stability, equity, inclusiveness, and participation. It is separated from the finance element because governance tools can also operate in the absence of significant economic resources. Governance practices shape power dynamics, policy-making, resource use, decision-making, and accountability, setting the framework for management and administration.

- Management practices in agriculture and forestry aim to produce crops and livestock while conserving soil, water and biodiversity. In the face of climate change, climate-smart methods arise as highly strategic, such as drought-resistant crops, drainage systems, wildfire mitigation, and vegetation mosaics. These are known to boost environmental sustainability and resilience in different ways.

- Technology applies science to solve practical challenges in agriculture and forestry. It often refers to digital tools, although it is not limited to them. It helps overcome biological, chemical, and socioeconomic limits and hindrances in crop systems and forestry operations. Tools like advanced machinery, remote sensing, Geographic Information Systems (GIS), drones, and digital sensors support climate adaptation and mitigation, disease detection, and efficient resource use.

- Finance involves managing money through investing, lending, budgeting, and forecasting. Whereas it can sometimes be considered as a policy instrument, in the ResAlliance project it is considered as a separate element, which deals specifically with economic resources. In the realms of agriculture and forestry a financial tool can support production, storage, processing, and marketing, as well as infrastructure like irrigation and machinery. Key instruments include subsidies, insurance, contract farming, and secured lending.

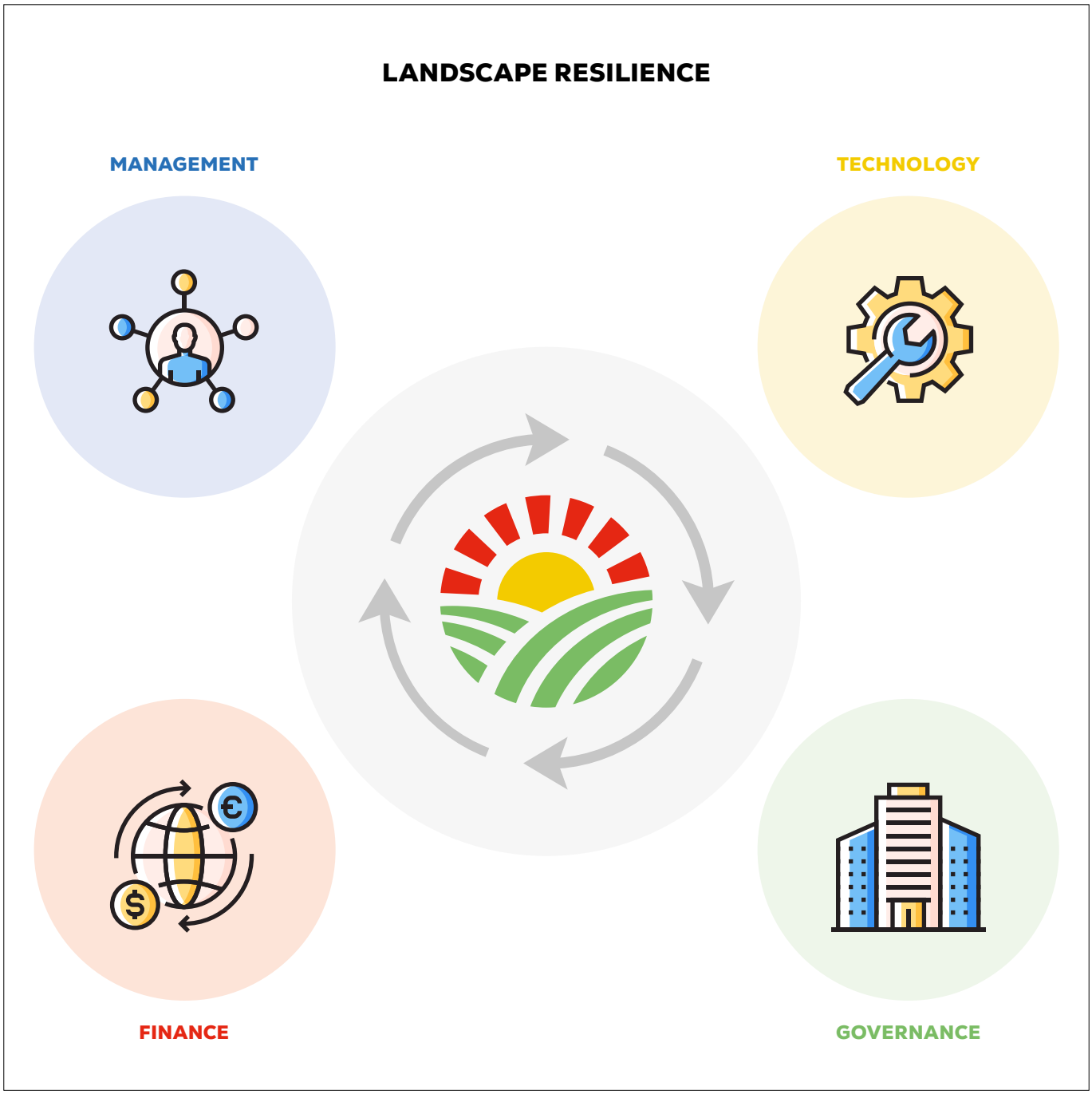

Figure 1: Four thematic areas, that help to create a typology of the different solutions provided in the ResAlliance project.

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CLIMATE-RESILIENT LANDSCAPES SOLUTIONS REVIEW

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Governance

Governance: Involves managing entities (countries, organizations) through structures and processes that ensure accountability, transparency, rule of law, stability, equity, inclusiveness, empowerment, and participation. It defines power relationships, policy formulation, resource allocation, and decision-making mechanisms. A survey identified a lack of political stability and long-term policies as the primary socioeconomic factor affecting activities (https://www.resalliance.eu/publications/).

Regulatory Frameworks & Policies (Laws, land-use planning, ecosystem protection)

For example, in France, landowners in high-risk zones must clear vegetation around buildings to prevent wildfires. Within 200m of forests, a 50m buffer around each property and clearing of 10m along roads are required by July 1st of each year (Figure 2). Called Compulsory Brush Clearing, it reduces biomass to lower fire risk. Clearing beyond property lines needs neighbor consent, and non-compliance can lead to fines. Councils enforce rules, and forestry companies can be hired to help (Mapping compulsory brush clearing zones and strips).

Figure 2. Compulsory brush clearing strips around buildings and access roads in France (© Mairie de Saint Christol lez Alès).

Stakeholder Engagement & Community concerning public-private partnerships, governance models

ResAliance included various examples such as the Forest Sharing platform in Italy. It was developed and launched in 2020 by the innovative start-up and spin-off of the University of Florence Bluebiloba, to implement new strategies for forest management, enhancing multi- functionalities and re-boosting communities. The platform aims to overcome one of the weaknesses of the Italian forestry sector: the fragmentation of forest ownership and the abandonment of rural areas. The fragmentation of forest properties in Italy and in all Europe is one the most challenging obstacles to overcome when managing forests. The Forest Sharing methodology has been implemented in public administrations in Friuli Venezia e Giulia, thanks to the *"Consorzio Boschi Carnici"*, aiming to aggregate public and private landowners for a sharing and collaborative management (Figure 3). The Forest Sharing methodology and platform has shown to have the capability to be scaled-up outside Italy, in other countries that have similar problems of fragmentation and abandonment. Forest Sharing is currently applied in H2020 and Horizon Europe projects such as SMURF (Forest Sharing: the platform for taking care of forests).

Figure 3. Managing forests with a shared and virtuous approach to create value to the land with people (© BlueBiloba).

Risk Management & Crisis Response for fire governance, water security, disaster preparedness, climate change adaptation

A good solution was developed by a government initiative for fire governance was the Mosaic Landscape of Gran Canaria Island (Spain), "Gran Canaria Mosaico". Gran Canaria Mosaico" promoted wildfire resilience in the island through the recovery of diverse ecosystems, including traditional activities linked to the primary sector, leading to less risky territories (Figure 4). The government of the Grand Canaria island implemented a more holistic approach to wildfire risk reduction compared to traditional wildfire prevention plans (The Mosaic Landscape of Gran Canaria Island).

Figure 4: Mosaic Landscape in Gran Canaria (Spain) (© Cabildo de Gran Canaria).

Institutional & Cross-Border Cooperation
(EU policies, regional governance)

The ResAlliance project presented many initiatives that are based on cooperation between different stakeholders, such as government agencies, NGOs, academic institutions, local communities, and the private sector. For example, the co-management agreement for forest resources in the Oued Zeen village, a local community in Tunisia involves the participation of authorities (Directorate General of Forests) and local communities, through Agricultural Development Groups - GDAs. The success of such agreements depends on the fulfilment of commitments by both parties. The adoption of this management model by the local population stems from the increased trust between certain GDAs and their members, and between the GDAs and the forestry administration. This local community management model focuses on the sustainable exploitation of Non-Wood Forest Products (NWFP) resources (Figure 5), and it is a perfect example of regional governance regarding the preservation of forest landscapes through local communities (Enhancing the resilience of forest landscapes: a pilot experience through the active participation of the Oued Zeen village local community in Tunisia).

Figure 5: Involvement of the local community in cleaning and planting carob trees in degraded forests in the Siliana region, northwestern Tunisia (© Sondes Fkiri).

Common Agricultural Policy (CAP) Strategic Plans regarding Agroforestry in five Mediterranean countries, members of the European Union

Each of the European Mediterranean countries has its own CAP plan regarding agroforestry. For example, the Greek CAP Strategic Plan gives a detailed definition of agroforestry: Systems with scattered trees or trees in rows, or on the margins of plots. They can be either forest trees (oaks, pines, poplars, cypresses) or fruit trees (citrus, apple and stone fruit trees, acacia trees), olives, carob and mastic trees. They can be combined with the cultivation of cereals, horticultural crops, fruit and vegetables and/or grazing (Figure 6). Agroforestry also includes partially forested areas (sparse forests) of pasture with the tree cover up to 40% and understorey with herbaceous woody vegetation. There are no specific payments in Greece to support new agroforestry, but hedgerows, trees in line, groves/copses, individual trees are mapped in farmers annual returns and are eligible for basic payments, and a small ecoscheme pays 100€ hectare/yr to improve existing silvoarable or silvo-pastoral areas (Agroforestry in the Greek Agricultural and Climate Plans).

Figure 6: Olive agroforestry in western Greece (author: Hellenic Agroforestry Network, © NC SA).

Management Practices

This chapter comprises a collection of indicative innovative and traditional land management practices, derived from real-world examples, that highlight how farmers, foresters, communities, and scientists are working together to conserve soil and water, restore biodiversity, adapt to climate hazards, and build circular, sustainable land-use models. From regenerative agroforestry and erosion control to fire-smart silvopastoral systems and waste valorization, the solutions highlighted by ResAlliance demonstrate the power of place-based knowledge blended with modern tools. The practices are organized into four key general topics, presented below, that reflect the most essential and interlinked domains of climate-resilient landscape management.

Figure 7. Rehabilitation of Metsovitikos torrent catchment - the same site in 1960 and 1985 (author: Greek Forest Service, © NC SA).

Figure 8: Drystone walls creating plateau's for agriculture (vineyards), Greece (© Antonia Theodosiou).

Soil & Water Conservation Strategies

Agroecology, regenerative practices (e.g., no-tillage, cover crops, mulching, compost application), hydrological solutions (e.g., natural barriers, jessour systems, check-dams), sustainable land management, irrigation best management practices (e.g., deficit irrigation, precision agriculture, wastewater reuse), integrated water resources management, terrace cultivation, decision support systems, monitoring networks, and phenomics. For example, rainfed agriculture, which accounts for over 75% of global arable land and is predominant in Tunisia, faces significant challenges due to climate change and water scarcity. Traditional water harvesting techniques like individual cuvettes, "Jars" for olive trees, and berms/dikes offer untapped potential. These methods, along with the ancient "Jessour" technique, are crucial for mitigating drought risks, controlling runoff, reducing soil erosion, and preserving nutrients, making rainfed agriculture a key sustainable approach for Tunisia's future (Enhancing Rainfed Production of Smallholder Agriculture by Managing Water Harvesting in Tunisia). Another nature-based solution for land resilience in Cyprus, is stabilizing soil for the ancient Drystone Walling technique (Figure 8) which can manage humidity, and improve microclimate for agriculture, prevent erosion retain soil and aid water management (Drystone Walling: an ancient practice and a nature-based solution to build land resilience). Furthermore, the rehabilitation of the Metsovitikos torrent catchment by the Greek Forest Service in the 1950s and 60s, has proven highly effective (Figure 8) improving the resilience of the affected areas (Restoration of degraded areas for flood risk mitigation).

Biodiversity & Ecosystem Restoration

Approaches include Nature-Based Solutions (NBS), adaptive silviculture and agroforestry (e.g., selective thinning, undergrowth removal, agroforestry reducing fire hazards), land stewardship initiatives (e.g., digital tools for water retention, soil conservation), ecosystem services integration, and best practices for biodiversity management (e.g., maintaining species diversity, preserving dead trees, local landraces, low-input farming, rotational grazing) (Figure 9). For instance, an agroforestry pilot site in Lebanon's semi-arid Jabbouleh region, launched by Jouzour Loubnan, offers a strategic solution to economic and environmental challenges. It revitalizes neglected community land by planting locally adapted trees, aromatic plants (thyme), and green cover (vetch, barley). This project combats soil erosion, improves soil fertility, mitigates climate change effects, and creates employment for local communities. It also serves as a demonstration and learning hub to inspire farmers to adopt sustainable agroforestry practices, enhancing land productivity and food security (An agroforestry pilot site in the Jabbouleh semi-arid region of Lebanon). Another example in Mediterranean agroforestry systems involves biodiversity enhancement and pest control by supporting bat populations. From Montado in Portugal to Cyprus, bats provide valuable ecosystem services by suppressing insect pests, including agricultural pathogens, significantly reducing the need for chemical pesticides and offering substantial economic savings (e.g., $188-248/hectare/year in Chilean vineyards). Habitat-rich agroforestry provides alternative food sources and refugia for bats. Expanding bat-friendly landscapes, developing decision support tools, offering financial incentives, and promoting research are crucial for leveraging bats' role in climate change adaptation, biodiversity protection, and sustainable agriculture. (Bat-tling for biodiversity: harnessing nature's pest control with trees).

Figure 9: Biodiversity in ungrazed phryganic vegetation on the island of Paros Greece (author: Gavriil Xanthopoulos, © NC SA).

Climate Adaptation & Hazard Mitigation

Transition from fire suppression to integrated fire management, fire-smart solutions (e.g., inter-sectoral cooperation, European knowledge exchange), role of livestock farming in wildfire prevention (grazing as natural firebreak), prescribed burning, use of modern technological tools (e.g., remote sensing), citizen involvement, and policy/research integration. This also includes drought-resistant crops and water management strategies (e.g., GIS-based vulnerability analysis, biostimulants, cover crops in vineyards, precision irrigation, agroforestry integration). For example a solution which was created in northeastern Algeria developed a fire risk sensitivity map using GIS, remote sensing, and the Analytical Hierarchy Process (AHP) and identified areas most prone to forest fires by analyzing factors like vegetation, topography, and climate (Forest Fire Risk: Mapping vulnerable areas in northeastern Algeria). Moreover, a prescribed burning project on Chios Island (Figure 10), Greece showed that this nature-based solution reduces fire risk, promotes ecosystem health, and positively impacts plant diversity without significant changes to soil properties or vegetation functions (Prescribed burning on the island of Chios, Greece: results from a two-year pilot project).

Figure 10: Prescribed burning on Chios Island (© Andrea Bonetti).

Sustainable Land-Use & Circular Economy

Organic farming, waste valorization, regenerative forestry, sustainable forest management (SFM), and sustainable grazing. SFM core practices include adaptive management, natural regeneration, promoting multiple species, biodiversity conservation, fire-smart landscapes, forest landscape restoration (FLR), promoting tree growth and carbon stock, and collaborative forest management. For example, in northern Portugal, the Rebanhos+ and LIFE Maronesa projects used GPS collars for remote livestock monitoring and guided grazing, managing understorey, preventing fires, and restoring degraded areas (Figure 11, up). Collars provide real-time animal locations via Digitanimal app, boosting shepherd productivity by reducing search time and freeing them for farm tasks like hay harvest. (GPS collars: remote monitoring of mountain grazing). Another smart solution for olive production are the Multifunctional Olive Systems (MOS), that have been applied and tested in Italy and Greece. MOSs constitute an advanced agroforestry model that combine olive farming with other land uses for ecological, economic, and social gains. Applied practices included livestock grazing (Figure 11, down), intercropping with cereals, legumes, or wild asparagus, and innovations like climate-resistant olive grafts and avocado intercropping; they restored biodiversity, improved soil fertility, reduced water loss, and raised farmer income while tackling soil erosion, water scarcity, and climate change for sustainable olive production (Multifunctional Olive Systems: a cutting-edge approach in agroforestry).

All the above, constitute clever Sustainable Land-Use & Circular Economy practices that can make a profound contribution to landscape resilience to the challenges of climate change, while improving the life and income of the people living in the countryside (Figure 12).

Figure 11: (up) Applying GPS collars in goats (© Unidentified); (down) Multifunctional Olive Systems in Italy combining olive trees with livestock (silvopastoral) (© Andrea Pisanelli).

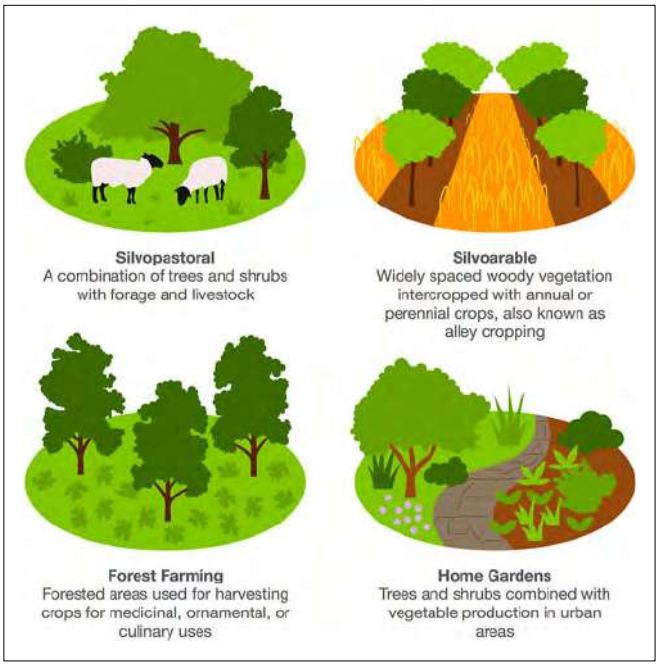

Figure 12: Sustainable Land-Use & Circular Economy best practices.

Technology

In the context of ResAlliance, technology refers to the application of scientific knowledge for practical purposes, including technological tools, machinery, and innovations that improve yield, efficiency, profitability and sustainably. Specifically, digital advancements such as remote sensing data, GIS analyses, drones, predictive models, and digital sensors are crucial for early warning, informed response, resource optimization, and damage reduction, thus improving socio-ecological resilience. It is important for practitioners to consider key technological areas that include.

Monitoring & Early Warning Systems

These include satellite remote sensing, AI for predictive modeling, risk assessment tools for agricultural drought monitoring, drought indices, precision agriculture, and advanced sensing technologies (e.g., spectroscopy, thermal imaging, LiDAR). For example, in the field of forest fire management, an advanced solution was developed in Mediterranean Turkey where the FireAId is an AI/ML-powered fire risk mapping system developed by Koç Digital for the Ministry of Agriculture and Forestry. The tool predicts wildfire ignition by combining weather forecasts, human activity, and past fire data–since most ignitions are human-caused. The model provides mapping in four classes of risk twice per day (Figure 13) (Artificial intelligence to predict wildfire ignition and support response).

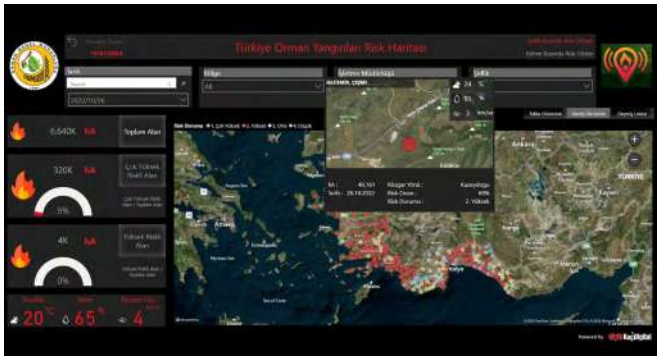

Figure 13: The FireAId system of the Turkish General Directorate of Forestry (© Turkish General Directorate of Forestry).

Smart & Precision Agriculture

IoT sensors for real-time monitoring (soil moisture, temperature), drone-based monitoring for crop health, irrigation (Figure 14) and pesticide application, and precision soil analysis. Challenges include high costs, technological complexity, and regulatory gaps. A clever solution is used in Sardinia, Italy, where a mechanical cork debarking machine was developed to replace labor-intensive manual methods that risk damaging the phellogen (Figure 15). Using a reciprocating blade and hydration sensors, it precisely separates cork from the tree, improving efficiency, safety, and cork quality. Tests showed 30% higher daily capacity despite slower cutting speed, making it useful for new plantations and areas lacking skilled workers Innovative solutions in cork harvest operations: Mechanical cork debarking).

Figure 14: Monitoring water status through combined use of meteorological station and drone (© Agricultural University of Athens).

Figure 15: The cork debarking machine tested in Sardinia includes sensors capable of guiding it by measuring the different hydration of phellogen and cork (© The publication "The cultivation of cork oak").

NBS & Low-Impact Technologies

They include solar irrigation, bio-based materials (e.g., natural plant biostimulants), and desalination technologies. For instance, in the driest areas of Cyprus, a great NBS solution is applied by the EU LIFE-AGROASSIS project, which implements resilient hedgerows to combat desertification. Using the Deep Root Training Tubes (DRTT) system, drought-adapted, deep-rooted seedlings are produced in nurseries with reduced care requirements after planting, aiming to save irrigation water and ensure successful establishment in barren and arid lands. These hedgerows improve soil conditions, microclimate, support pollinators, and capture carbon, offering long-term benefits despite the extra cost of deep-rooted plants and the need for specific drilling equipment for planting (Installation of hedgerows in areas prone to desertification using drought adapted deep rooted plants).

Data Management & Digital Platforms

These include GIS mapping for land use analysis and fire risk assessment, blockchain for supply chain traceability, and open-source tools for optimizing water use. A meaningful example was developed in Catalonia, Spain where Digital Twin (DT) technology created virtual replicas of irrigation systems using data from weather, sensors, remote sensing, and farmers. It simulated scenarios to optimize water use, boost yields, and support sustainable management (Figure 16). Projects like DIGIREG give tailored irrigation advice for vineyards and orchards, to improve efficiency and reduce water use (The usage of digital twins for data-based irrigation management).

Moreover, across the EU, the RESIFARMS project developed a free, open toolkit and training, to help farmers and agricultural technicians conserve non-productive agricultural lands (semi-natural habitats). This enhances ecosystem services like pollination, pest control, and water purification, supporting agricultural production and biodiversity. The initiative addresses a lack of understanding regarding the benefits of these areas, fostering sustainable farming practices despite past budget constraints and a lack of detail in some tools (The Resifarms toolkit: a tool for promoting education to enhance ecosystem services and build resilient landscapes).

Overall, current technological advances offer great potential for improving resilience of the landscape, mitigating climate change threats, increasing safety, achieving better results in agriculture and forestry and conserving resources such as soil and water. Smart & Precision Agriculture offers some of the best examples (Figure 17).

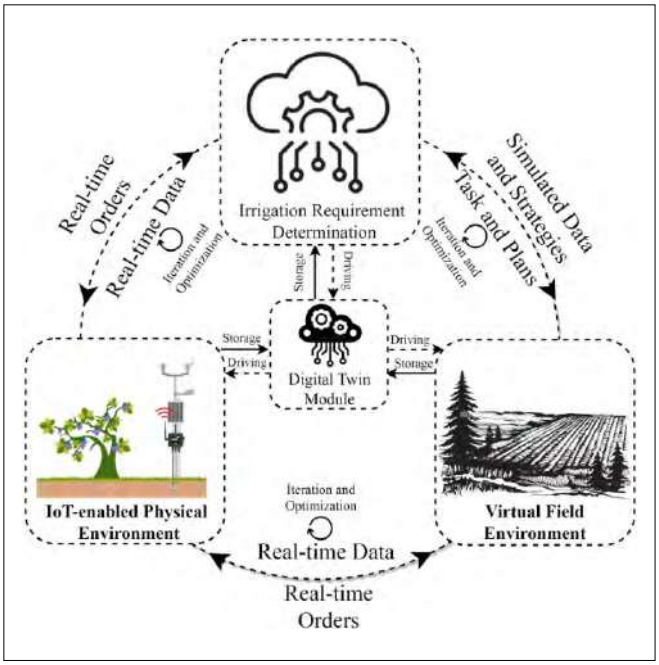

Figure 16: Conceptual architecture of an irrigation determination framework (authors: Manocha, A., Sood, S. K., & Bhatia, M. (2024)).

Figure 17: Smart & Precision Agriculture example (© iStock).

Finance

Involves the management of economic resources by any actor, either individual or collective, encompassing activities like investing, borrowing, lending, budgeting, saving, and forecasting. Agricultural and forestry finance covers inputs, production, storage, processing, marketing, and infrastructure investment. The EU provides various financing tools which can play a critical role for climate resilience adaptation practices that require significant initial investment. Such financial opportunities are less widely available to non-EU countries. Practitioners should consider finding available financial resources through various channels such as:

Public Funding & Policy-Driven Investment

EU Green Deal, Common Agricultural Policy (CAP) funds, and resilience grants. A good solution was implemented with the LIFE Brenta 2030 project in the Veneto region, Italy. The project aimed at establishing an innovative Payment for Ecosystem Services (PES) scheme for the protection of biodiversity and water conservation. The innovative financing scheme applied Article 9 of the EU Water Framework Directive (WFD, 2000/60/EC) and the polluter-pays principle, allowing the environmental and resource costs (ERCs) of drinking water consumption to be internalised in the water tariff (Figure 18). The contributions collected through this system will allow the creation of an Environmental Fund for the Brenta River, which will be used to finance measures to protect water resources and mitigate the environmental impact of water consumption (Integrated water services and nature-based solutions in the Brenta river watershed).

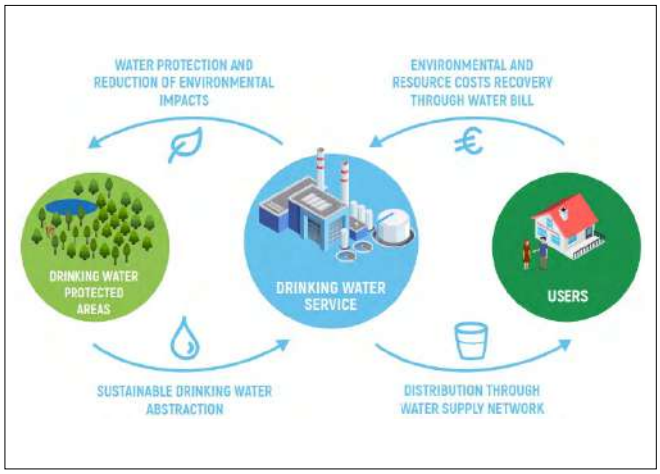

Figure 18: Infographic of the innovative funding mechanism: internalisation of Environmental and Resource Costs in the drinking water service (© Parco Fiume Brenta).

Private Sector & Market-Based Incentives

Carbon credits, ESG (Environmental, Social, and Governance) investments, and private financing. There is a variety of such incentives. Among them, the FSC certification that is awarded by the non-profit Forest Stewardship Council (FSC), stands out. This certification ensures that forest products like wood and paper come from sustainably managed forests that protect biodiversity, respect workers' rights, and benefit local communities. A good example of actively applying the FSC Ecosystem Services Procedure, is offered by Portugal, which established a structure that allowed FSC-certified forest managers to verify the impact of their forest management on ecosystem services, making it possible for external organizations to support them, demonstrating their commitment to responsible forest management. A platform was developed to boost relations by making it possible to consult all the FSC-certified ecosystem service projects implemented in Portugal. The procedure is continuously revised to maintain its relevance for both forest managers and potential sponsors, especially in light of increasing demands for high-integrity, reliable, and verifiable information in new Environmental and Social Governance policies. The initiative provides a structured mechanism for forest managers to monetize the ecological value of their forests and attract private capital and ESG-driven investments to support sustainable forest management (The FSC® Ecosystem Services Procedure).

Blended Finance & Community-Led Models

Mixing public and private funds (e.g., micro-financing, cooperatives, crowdfunding). For example, in Catalonia, Spain, a unique initiative to support the conservation of the endangered Montagu's harrier (Circus pygargus) led to the creation of "Urpa," a special beer made from barley harvested from fields where the birds nest (Figure 19). The project was primarily funded through the crowd-funding platform Verkami, collecting over 300 donations in 2023. This funding not only helps finance the conservation efforts but also aims to promote awareness of the bird's challenges and encourage similar conservation initiatives in other regions of Spain (A beer that protects the Montagu's harrier nests in Catalonia).

As a result of the great concern regarding climate change and its consequences, there exist significant public funding opportunities and private sector incentive aiming to support practices that may improve landscape resilience (Figure 20). As new opportunities arise, managers and practitioners in agriculture and forestry should keep current with changes and emerging opportunities that will help them to achieve better results while ensuring financial stability.

Figure 19: The final product: URPA, the nest saving beer (© Limonium Natura).

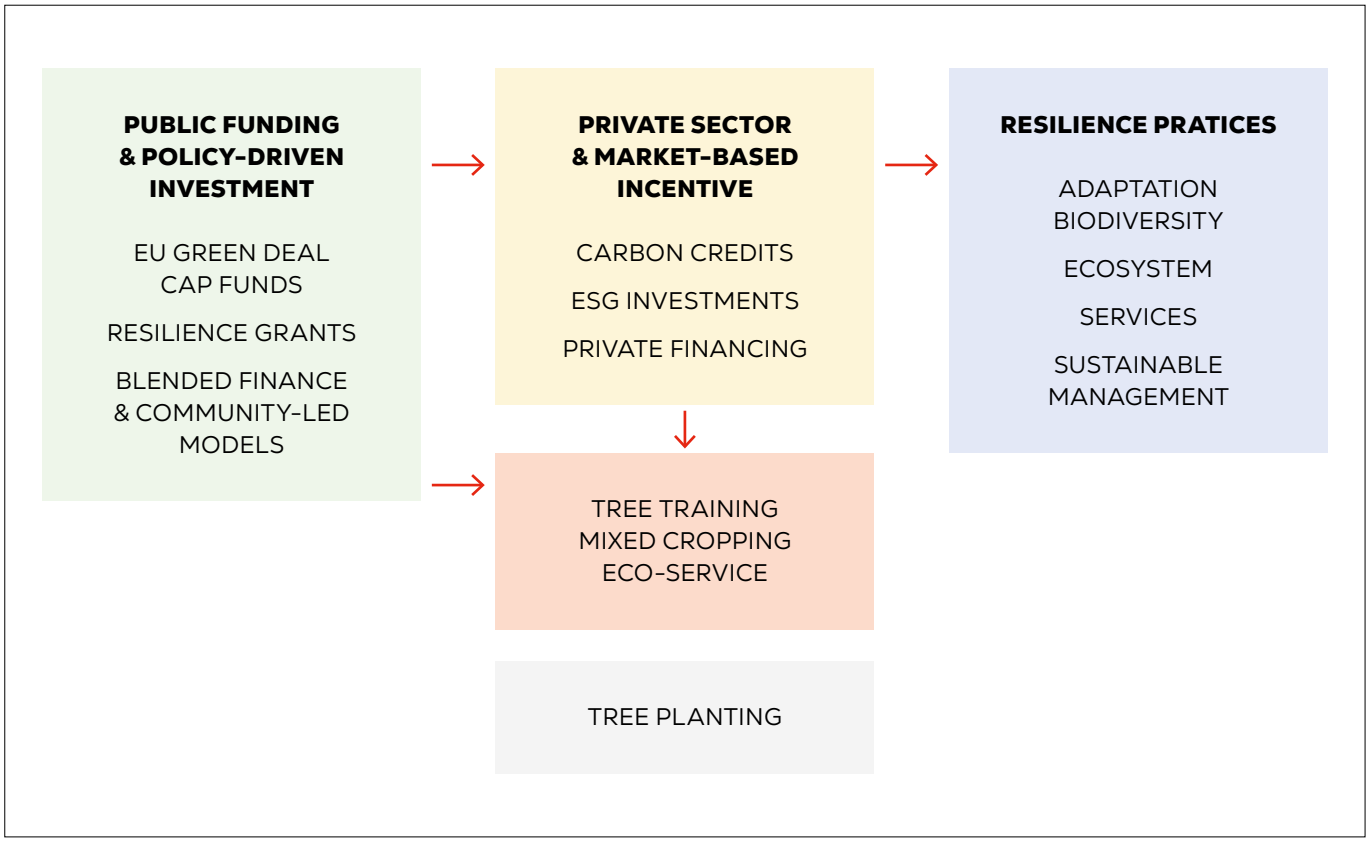

Figure 20: Summary of financial tools for resilient landscapes in the fields of agriculture and forestry.

4

FUTURE STEPS FOR RESILIENT MEDITERRANEAN LANDSCAPES

Mosaic of forest and agricultural vegetation helps improve resilience to wildfire in Crete Greece (author: Gavriil Xanthopoulos, © NC SA).

Future

The good practices highlighted through the efforts of the ResAlliance partners and the contributions of the stakeholders reveal that great solutions exist, are freely available and can truly help to make agriculture and forestry landscapes more resilient to the challenges of climate change. A subset of the most representative examples of solutions are included in this ResAlliance Blueprint. All of them are included in the extended Blueprint version and are available in their entirety on the website and on EU-Farmbook, as described earlier. However, most of these solutions are examples that need to be disseminated broadly, to be repeated multiple times across the Mediterranean. In many cases, the support of specialized motivated scientists is needed to provide inspiration and guidance, while in other cases existence of seed money or long-term support is required, usually justified by the expected outcome. In some cases, the State needs to play a central role with the provision of financial tools, the availability of public employees to promote and support wide application of good practices, or even the development of appropriate legislation that will facilitate efforts like reorganization of the spatial arrangement of cultivations such as vineyards, olive groves and fruit orchards, so that they can act as fire control belts.

To foster resilient landscapes in the Mediterranean context, future efforts must involve a comprehensive, multi-faceted approach, integrating advancements across four key thematic areas: management practices, technology, governance, and finance, as highlighted by the ResAlliance project (Figure 21).

- For management practices, future steps should prioritize promoting and facilitating alternative, climate-smart approaches such as the widespread adoption of drought-resistant crops and tree species, updating traditional cultural and silvicultural techniques, and implementing rigorous soil and water conservation strategies like contour plowing and mulching, alongside integrating diversified land-use systems like agroforestry and silvopastoralism; crucially, this requires overcoming existing social constraints, misconceptions about necessary interventions, and the current lack of public administration incentives for transitioning away from conventional systems.

- In terms of technology, the emphasis must be on developing and widely deploying effective monitoring and early warning systems utilizing satellite remote sensing, AI for predictive modeling, and GIS mapping for risk assessment, coupled with smart and precision agriculture tools such as IoT sensors and drone-based monitoring; concurrently, efforts are needed to address significant barriers like high costs, complexity, and limited accessibility for small property owners and those in remote territories.

- Strengthening governance necessitates modifying cadastres to formally incorporate agroforestry systems, implementing regional plans for climate change mitigation and adaptation that include updatable risk valuation and zoning allocation, improving subsidy frameworks for agroecological practices, simplifying sanitary livestock regulations to promote extensive farming, and fostering institutional and cross-border cooperation through EU policies; this also means streamlining excessive bureaucracy and administrative formalities to facilitate the adoption of good practices and ensuring the implementation of long-term sustainability programs.

- Finally, finance is critical and requires the development of innovative and accessible mechanisms, moving beyond traditional public funding (e.g., EU Green Deal, CAP funds) to integrate private sector and market-based incentives (e.g., carbon credits, ESG investments), establish robust climate insurance systems and direct compensation for losses, and expand blended finance and community-led models such as micro-financing and cooperatives; these financial instruments must overcome complicated bureaucratic procedures, insufficient funding, and biases towards large-scale production to adequately support diverse and often non-conventional farming practices and investments in new infrastructure. By synergizing these four thematic areas, the European context can cultivate socio-ecological systems that are robust, adaptive, and capable of supporting human well-being amidst climate change and socio-economic pressures.

The ResAlliance project has made a substantial contribution by developing the factsheets. It has showcased examples on its website, among them many submitted by stakeholders that participated in the call launched by the project, but also in webinars, workshops, showrooms and on-site visits. Virtual participation in the project's LandNet kept the members up to date about the results, such as the factsheets and the Massive Open Online Course (MOOC) that were made available to them. They could also participate in the project's forum and could watch, read and vote for the submissions to the open call for innovative practices.

However, beyond these, the ResAlliance project highlighted that resilience across the Mediterranean agriculture and forestry landscapes is, above all, an issue of maintaining a healthy population in the countryside. Healthy, regarding numbers, age distribution, availability of infrastructures, financial support and stability, long-term planning and guidance, and policies that do not ignore the needs and the opinions of this population. Such policies will require some generosity from the side of the policy makers, at least regarding devoted time and effort for a deeper understanding of the problems and the needs of these specific constituents, that have to cope with climate change effects on their land.

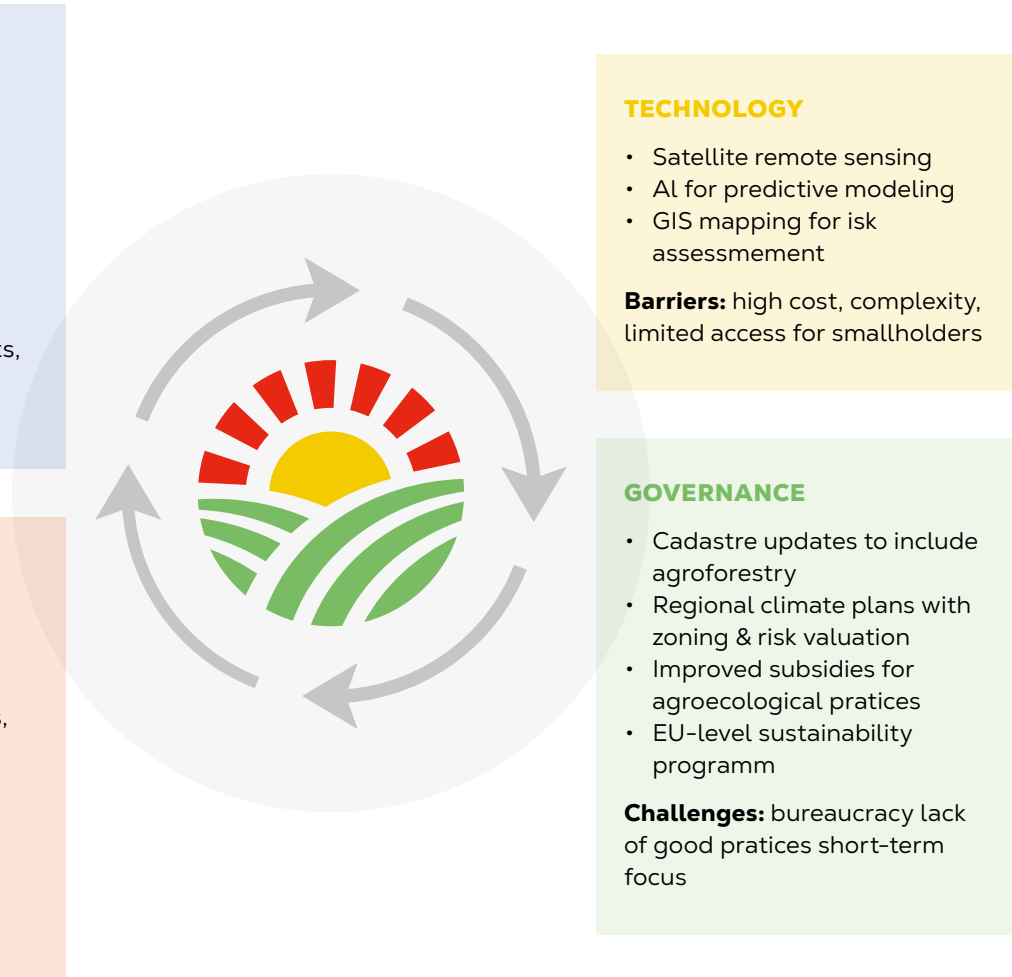

Figure 21: Schematic presentation for sustainable and resilient landscapes.

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