Ecological restoration of areas under desertification

by Rafael da Silveira Bueno

Table of contents: – 1. Desertification and deforestation. – 2. Restoration of degraded ecosystems. – 3. Natural vegetation dynamics. – 4. The role of seed dispersal by animals in ecological restoration. – 5. The LIFE Desert Adapt project.

1. *Desertification and deforestation*

According to the United Nations[1], desertification is defined as: "land degradation in arid, semi-arid, and dry sub-humid areas resulting from many factors, including climatic variations and human activities". The first global discussion on desertification took place at the UN Conference on Desertification in Nairobi, Kenya, in 1977. However, due to a general lack of interest and financial support, the United Nations Convention to Combat Desertification (UNCCD) became effectively active only in December 1996 and is currently the main international framework established to address the problem of desertification, involving 180 countries. Although the UNCCD definition of desertification is concentrated on arid, semiarid and dry sub-humid regions, which are indeed under higher risk, land degradation and consequent loss of soil productivity capacity are global phenomena, and desertification can occur even in more humid regions, including those that were once covered by forests (Figure 1). This paper aims to provide an overview of desertification at global and Mediterranean levels, the critical role of forests and public policies, the importance of integrated ecological restoration strategies while illustrating practical examples of projects aiming to address this global challenge.

[1] *www.unccd.int.*

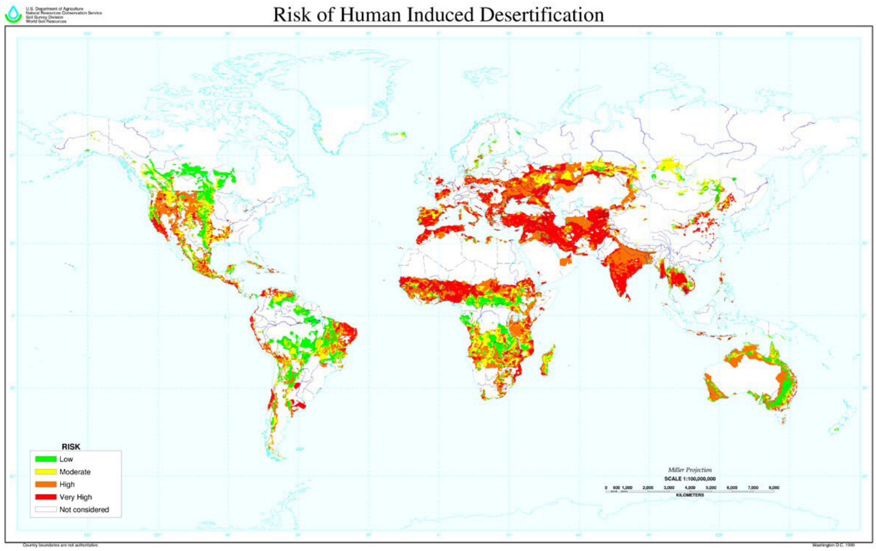

Figure 1. Global **m**ap of the risk of human induced desertification. Source: US Department of Agriculture, Natural Resources Conservation Service, Soil Survey Division, World Soil Resources 1999.

Forests today cover about 31% of the global surface, but they harbour most of the world's terrestrial biodiversity and provide essential ecosystem services, such as carbon sequestration, flood and drought regulation, and influence on temperature and rainfall patterns, which affect global climate [2],[3]. Therefore, removing forest cover inevitably increases susceptibility to desertification. Tropical regions exemplify this, as land use conversion is currently happening rapidly and on a large scale, especially in the Amazon, South-East Asia, and Central Africa. In the Amazon, the largest tropical forest in the world, it is well known that once the forest is cleared, soil degradation and disruption of hydrologycal cycle begins, with some areas losing their productive capacity within a few years – a

[2] M.C. Hansen et al., *High-Resolution Global Maps of 21st-Century Forest Cover Change*, in *Science*, 342, n. 6160, 2013, 850-853.

[3] T.E. Lovejoy and C. Nobre, *Amazon Tipping Point: Last Chance for Action*, in *Science Advances,* 5, 2019, 2949.

desertification process that has been documented previously[4]. However, some lesser-known forest areas have almost completely vanished, such as the Atlantic Forest in Brazil, one of the world's top biodiversity hotspots, where less than 15% of the original cover remains, with only a few sites still containing relatively preserved forests[5],[6]. Within this biome, it is not difficult to see areas undergoing desertification, particularly those on hilly terrain that have experienced long monocultural agricultural cycles, such as coffee and sugarcane, now suffering from overgrazing and severe erosion caused by heavy rainfall.

Although these tropical areas indeed present desertification risk, the Mediterranean is among the most vulnerable regions to desertification caused by human activities[7],[8]. On one hand, the Mediterranean experiences greater climate warming compared to other regions, leading to severe droughts and extreme weather events such as intense rains with high erosion potential. On the other hand, intensive agriculture, overgrazing, and past historical deforestation worsen climate change effects and result in serious soil erosion, compaction, salinization, and a decline in biological activity and overall soil productivity[9]. In Italy, desertification has already been recognised as a major issue, prompting the establishment of the "Comitato Nazionale per la Lotta alla Desertificazione[10]" (DPCM 26.9.97, GU n. 43 del 21.2.98), which is responsible for implementing UNCCD directives.

However, desertification risk in Italy is not uniform, and Sicily is the

---

[4] I. Friedman, *The Amazon Basin, Another Sahel?* , in *Science,* 197, 1977, 7-7.

[5] N. Myers et al., *Biodiversity Hotspots for Conservation Priorities*, in *Nature,* 403, 2000, 853.

[6] R.A.F. de Lima et al., *The Erosion of Biodiversity and Biomass in the Atlantic Forest Biodiversity Hotspot*, in *Nature Communications,* 11, 2020, 6347.

[7] R. Prăvălie, C. Patriche, and G. Bandoc, *Quantification of Land Degradation Sensitivity Areas in Southern and Central Southeastern Europe. New Results Based on Improving Dismed Methodology with New Climate Data*, in *CATENA,* 158, 2017, 309-320.

[8] A. Mirzabaev et al., "*Desertification,*" in *Climate Change and Land: An Ipcc Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*, 2019.

[9] T. Yang, K.H.M. Siddique, and K. Liu, *Cropping Systems in Agriculture and Their Impact on Soil Health-a Review*, in *Global Ecology and Conservation,* 23, 2020, 1118.

[10] Comunicazione Nazionale per la Lotta alla Siccità ed alla Desertificazione, Deliberazione del CIPE n. 154 del 22 dicembre 1998 – *www.mase.gov.it/portale/documents/d/guest/desertificazione-pdf-1*

region with the highest risk (Figure 2)[11]. Sicily was almost entirely covered by forests in recent history, but from the mid-19th century, a significant deforestation process occurred, with about half of the forested area being cut mainly for use in mining ovens[12]. At the beginning of the 20th century, the forest cover in Sicily was around 100.000 hectares, but this area was further reduced after the Second World War, reaching just 3.3% of its original extent[13].

Such cover loss was followed by severe negative environmental consequences. For example, Sicily was once very rich in water, with many springs, streams, and rivers widely distributed across the territory, some of which were large and deep enough to allow ships to navigate dozens of kilometres from the sea. Today, Sicily is one of the Mediterranean regions with the highest drought risk, and most of the streams and rivers have become extinct or are reduced to seasonal flows. This loss of forest cover also has other key implications, such as on carbon storage. Currently, forest and woodlands in Sicily cover around 258.000 hectares, although only less than 90.000 hectares constitute closed and well-structured forests, and only a very small percentage of this cover can be characterised as old-growth forests, accordingly to the last Forest Act n° 34/2018[13,14]. Recent studies have confirmed that the carbon sequestration service provided by old-growth forests (e.g. > 100 y) is much higher than that provided by plantations, shrublands and especially agricultural fields[15], thus deforestation has largely contributed to increasing climate change.

---

[11] F. Calvi et al., *Carta Della Sensibilità Alla Desertificazione in Sicilia, Scala 1:250000* in *Assessorato Regionale del Territorio e dell'Ambiente, Palermo*, 2016.

[12] D. Mack Smith, *A History of Sicily.* , Medieval Sicily: 800-1713. Modern Sicily: After 1713, London, 1968.

[13] B. Massa and T. La Mantia, *Forestry, Pasture, Agriculture and Fauna Correlated to Recent Changes in Sicily*, in *Forest@ – Rivista di Selvicoltura ed Ecologia Forestale*, 2007, 418-438.

[14] E. Badalamenti et al., *Old-Growthness Level Assessed by Structural Heterogeneity Indices in Mediterranean Quercus Pubescens Forests*, in *Forest Ecosystems,* 14, 2025, 100365.

[15] E. Badalamenti et al., *Carbon Stock Increases up to Old Growth Forest Along a Secondary Succession in Mediterranean Island Ecosystems*, in *PLOS ONE,* 14, 2019, 220194.

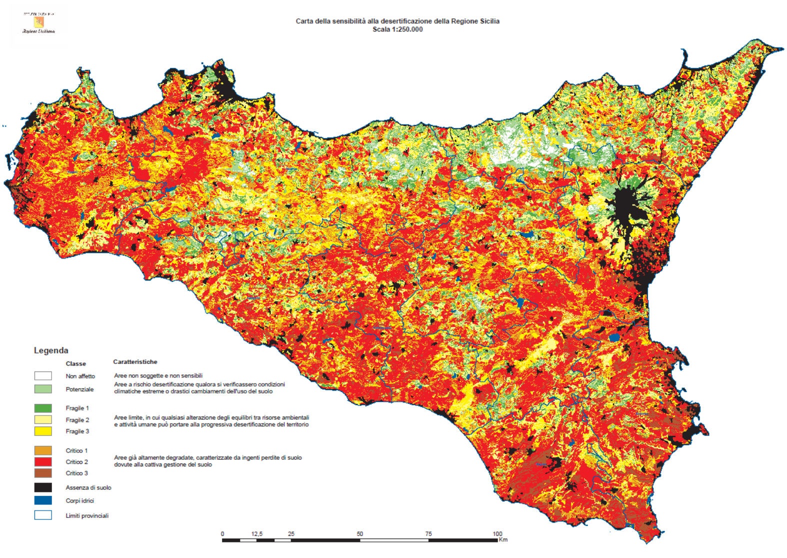

Figure 2. Map of the desertification risk in Sicily[11].

Finally, despite forest cover increasing after the II world war, it is constantly threatened by recurrent human-provoked fires, a threat that is unfortunately widespread in the Mediterranean[16]. Forest fires cause severe environmental damage, including greenhouse gas emissions, habitat destruction, and loss of fauna and vegetation, which accelerates land degradation. In particular, Sicily is the most at-risk Italian area (Figure 3), where, according to data from the "Sistema Informativo Forestale della Regione Siciliana"[17], more than 11.500 hectares of woodlands and forests were burnt in 2023, most of them with high-intensity fires that completely destroyed the forest cover. These repeated fires pose a significant disturbance factor that start regressive vegetative phases and worsens the problems of land degradation and desertification. Burning not only removes the soil's vegetation cover but can also sterilise the soil surface within minutes, creating an impermeable layer. It can take decades for the ecosystem to recover, and without vegetation protection and nutrient

[16] J.G. Pausas and M.M. Millán, *Greening and Browning in a Climate Change Hotspot: The Mediterranean Basin*, in *Bioscience*, 2019, 143–151.

[17] *https://sifweb.regione.sicilia.it/portalsif/apps/webappviewer/index.html?id=5d6a5d41a8134a9092f20d9566bd07dd*

cycling, soil organic carbon decreases while erosion rates increase, two key processes leading to desertification.

Therefore, in this context, promoting the ecological restoration of degraded areas by increasing the area covered by forests and maquis, as well as the presence of woody cover in agricultural areas, is of paramount importance for mitigating and counteracting climate change and desertification[18].

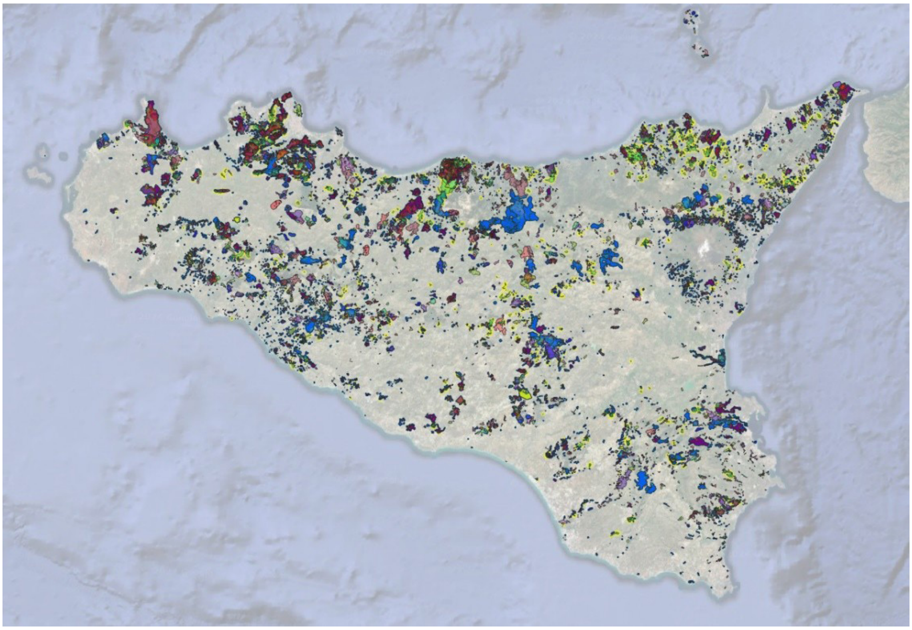

Figure 3. Map elaborated by the author showing the burnt areas in Sicily from 2007 to 2023, accordingly to the data available on the Command of the Forestry Corps of the Sicilian Region website (https://sifweb.regione.sicilia.it).

2. *Restoration of degraded ecosystems*

Many global and European commitments state the need to plant billions of trees and restore millions of hectares of degraded ecosystems to

[18] R. SALVATI et al., *Estimating the Sensitivity to Desertification of Italian Forests*, in *iForest – Biogeosciences and Forestry,* 8, 2015, 287-294.

contrast biodiversity loss, desertification and climate change.

For example, the UN decade on Ecosystem Restoration[19], coordinated by the United Nations Environment Programme and the Food and Agriculture Organization, is a call to scale up protection and restoration of degraded ecosystems all around the world. The Decade started in 2021 and will end in 2030, corresponding to the end of the Sustainable Development Goals program as well as to the deadline scientists have identified as the last chance to prevent catastrophic climate change. So far, the reports indicate that 44.410,219 ha are under restoration, involving 132.650 people distributed over 84 countries.

Another example of global commitment is the Bonn Challenge, which aims to promote restoration initiatives to cover 150 million hectares of degraded and deforested areas by 2020 and 350 million hectares by 2030. The challenge was proposed by the Government of Germany and IUCN in 2011, and currently, more than 60 countries are involved in promoting restoration actions across more than 210 million hectares[20].

At the European level, a recent example of commitment is within the European biodiversity strategy, first published in May 2020[21]. The strategy has the main objectives to increase resilience against climate change, forest fires, food insecurity, disease outbreaks, and to protect wildlife. In this strategy, restoration and reforestation are key aspects, and the actions include expanding the network of protected areas on land and at sea, establishing a European nature restoration plan, and introducing measures to conserve biodiversity. For instance, the strategy establishes the need to protect at least 30% of the Union's marine and terrestrial areas, including forests, peatlands, grasslands, coastal ecosystems, and ensure that at least 10% of the Union's marine and terrestrial areas, including existing primary forests and other carbon-rich ecosystems, remain undisturbed.

An important outcome of such a strategy is the Nature Restoration Law (Regulation 2024/1991), approved in February 2024[22]. This law mandates that all European countries must submit and implement a national restoration plan by June 2026, that addresses their most urgent issues concerning habitat conservation and restoration. As general measures,

---

19 *www.decadeonrestoration.org.*

20 *www.bonnchallenge.org.*

21 *www.environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en.*

22 *www.environment.ec.europa.eu/topics/nature-and-biodiversity/nature-restoration-regulation_en.*

each country in the European Union will commit to: remove non-native plants from their lawns, wetlands, and forests; restore dried peat bogs; improve connectivity between habitats; reduce or eliminate the use of pesticides and chemical fertilisers; and promote the conservation of wilderness areas. To achieve this, the law sets some objectives at the EU level, including restoring 20% of land and sea areas by 2030. For individual Member States, the goals include restoring at least 30% of terrestrial, coastal, marine, and freshwater habitats in poor condition by 2030, 60% by 2040, and 90% by 2050. EU countries will also need to ensure there is no significant deterioration in areas subject to restoration. Additionally, it was decided that EU countries would commit to planting an extra 3 billion trees by 2030.

In Sicily, the need for restoration is also broadly recognized, including as a measure to mitigate desertification, expressed for example in the Sicilian Regional Action Strategy to Combat Desertification[23]. The main objective of the strategy is: "to define a unitary governance model based on multisectoral and multilevel approaches that ensures a framework of orientation and reference for sectoral and territorial policies and planning and programming with particular reference to the priority sectors of agriculture, forestry, water resources, spatial planning and hydrogeological risks". In this strategy, after the analysis of different environmental indicators, it becomes possible to visualize Sicily's critical situation, where more than 56% of the territory is at critical risk and over 35% is considered fragile (Figure 2). The only areas with no risk (1,6%) or potential risk (5,8%) are those few that are still covered by forests and mature Mediterranean maquis. This strategy clearly recommends the promotion of sustainable management of all types of forests, halting deforestation, restoring degraded forests, and significantly increasing reforestation.

The Mediterranean region, including Sicily, has seen a surge in reforestation initiatives over the past century, with a focus on combating hydro-geological risk and overall environmental degradation[24]. Like many other regions worldwide, these efforts often involved seeding or planting seedlings of a few select species, such as pines, or with a heavy reliance

[23] *www.regione.sicilia.it/istituzioni/regione/strutture-regionali/presidenza-regione/autorita-bacino-distretto-idrografico-sicilia/siti-tematici/pianificazione/desertificazione.*

[24] J. Rühl et al., "*Afforestation and Reforestation: The Sicilian Case Study*", in *The Greenhouse Gas Balance of Italy: An Insight on Managed and Natural Terrestrial Ecosystems*, Berlin, Heidelberg, 2015, 173-184.

on non-native species such as eucalyptus and acacias. Although this approach has indeed brought benefits, such as reducing soil erosion and fragmentation, often such reforestation presents low levels of biodiversity and generally the secondary succession process is arrested or too slow[25],[26], especially if the thinning and maintenance cares are not performed. While these active restoration initiatives are the best option to start or speed up restoration in many cases, it is essential to consider how natural vegetation dynamics work[27].

3. *Natural vegetation dynamics*

Across Europe, after a widespread territorial occupation with agriculture, over the past few decades, many areas have been abandoned due to a combination of social, economic, and environmental factors[13,28]. As a result, the secondary succession process has been set in motion, opening the space to the gradual return of native vegetation.

However, there's still a lot to learn about how woody vegetation grows back over time in Mediterranean regions, once the natural resilience capacity of each area can vary significantly, even on a small scale, and human intervention often continues[29],[30], therefore is not easy to predict whether these abandonments will lead to a restored ecological state, deviate to an alternative state, or regress to a degraded state. Key issues to address include the speed and intensity of vegetation recovery in abandoned areas, local-scale spatial patterns, and potential factors influencing this recovery and shaping these patterns.

---

[25] R.S. Bueno et al., *A Crop for a Forest: Opuntia Ficus-Indica as a Tool for the Restoration of Mediterranean Forests in Areas at Desertification Risk*, in *Frontiers in Forests and Global Change,* 7, 2024, 7:1343069.

[26] M. Méndez et al., *More Ecology Is Needed to Restore Mediterranean Ecosystems: A Reply to Valladares and Gianoli*, in *Restor Ecol,* 16, 2008, 210-216.

[27] P. Meli et al., *A Global Review of Past Land Use, Climate, and Active Vs. Passive Restoration Effects on Forest Recovery*, in *PLoS One,* 12, 2017, 171368.

[28] T. Plieninger et al., *The Impact of Land Abandonment on Species Richness and Abundance in the Mediterranean Basin: A Meta-Analysis*, in *PLOS ONE,* 9, 2014, 98355.

[29] E. Bianchetto et al., *Fitting the Stocking Rate with Pastoral Resources to Manage and Preserve Mediterranean Forestlands: A Case Study*, in *Sustainability,* 7, 2015, 7232-7244.

[30] P. Lopezosa, M. Berdugo, and S. Soliveres, *On the Relative Importance of Land Use, Landscape Characteristics, Bird and Plant Assemblages as Drivers of Mediterranean Ecosystem Functioning*, in *Landscape Ecol*, 2023, 3605–3619.

Research suggests that natural regeneration can be just as effective, if not more so, in promoting biodiversity recovery and ecological restoration than active interventions, while the combination of both can be effective even in sites with long history of land use, deforestation and presence of extensive grazing by domestic and wild animals[31],[32]. Several factors influence secondary succession, although one key driver is the seed dispersal services provided by animals.

4. *The role of seed dispersal by animals in ecological restoration*

Seed limitation is among the primary filters affecting plant demography and subsequent ecological restoration[33],[34]. Seed limitation can be triggered simply by the absence or low production of viable propagules (source limitation), for example, due to inefficient fecundity, high abortion, or pre-dispersal seed predation or to seed dispersal limitation[35]. Seed dispersal is a crucial process shaping the demographic and evolutionary patterns of many plants, creating the pathway for the physical and genetic flow of the species[36]. Seed dispersal is the only means by which plants can colonise new areas, a vital step in restoring degraded areas. In particular, seed dispersal by animals is a widespread phenomenon in many environments, for instance, up to 98% of plant species depend on animals to move their seeds in tropical forests[37] (Almeida-Neto et al. 2008). In the

---

[31] R.S. Bueno et al., *Past Cover Modulates the Intense and Spatially Structured Natural Regeneration of Woody Vegetation in a Pastureland.*, in *Plant Ecol,* 221, 2020, 205-218.

[32] R. Crouzeilles et al., *Ecological Restoration Success Is Higher for Natural Regeneration Than for Active Restoration in Tropical Forests*, in *Science Advances,* 3, 2017, 1-7.

[33] E.W. Schupp, P. Jordano, and J.M. Gómez, *Seed Dispersal Effectiveness Revisited: A Conceptual Review*, in *New Phytol,* 188, 2010, 333-353.

[34] T. La Mantia et al., *Vertebrate-Mediated Seed Rain and Artificial Perches Contribute to Overcome Seed Dispersal Limitation in a Mediterranean Old Field*, in *Restor Ecol,* 27, 2019, 1393-1400.

[35] J. Terborgh et al., *Decomposing Dispersal Limitation: Limits on Fecundity or Seed Distribution?* , in *Journal of Ecology,* 99, 2011, 935-944.

[36] B.C. Wang and T.B. Smith, *Closing the Seed Dispersal Loop*, in *Trends Ecol Evol,* 17, 2002, 379-385.

[37] M. Almeida-Neto et al., *Vertebrate Dispersal Syndromes Along the Atlantic Forest: Broad-Scale Patterns and Macroecological Correlates*, in *Global Ecology and Biogeography,* 17, 2008, 503-513.

Mediterranean, seed dispersal by animals is also very relevant, in general reaching up to 65% of plant species, but with higher proportions in some particular contexts, with most plants relying on birds and mammals for seed dispersal[38]. However, seed dispersal services by birds and mammals are not homogeneous (see for example Figure 4), once beyond the typical variances in their diet preferences (trophic level), mammals and birds respond differently to the landscape configuration, for example mammals tend to be less restrictive regarding open matrix or degraded habitats, while birds tends to heavily concentrate their activity in woody perches . In turn, domestic animals may eat fruits and disperse seeds, and present low restrictions in habitat use and often spillover from pasturelands to forests.

The best way to visualise the intricate relationship between seed dispersers and plants is through networks, where species are nodes and their interactions are represented by links (Figure 4). Such networks can include both qualitative data (e.g., presence or absence of an interaction) or quantitative data (e.g., the number of seeds dispersed), and their analysis can reveal different metrics such as connectance, specialisation, and modularity[39]. Therefore, quantifying the seed dispersal services provided by animals and analysing the structure of trophic and spatial networks are essential for understanding the effectiveness of passive and active restoration of woody communities based on rewiring ecological interactions, for example, to optimise plant species selection, predict the effects of the absence of a specific seed disperser, or the potential impacts of reintroductions[40].

---

[38] P. Jordano, "*Fruits and Frugivory*," in *Seeds. The Ecology of Regeneration in Plant Communities*, Wallingford, UK, 2014, 18-61.

[39] J. Bascompte and P. Jordano, *Mutualistic Networks*, Princeton, USA, 2014.

[40] R.S. Bueno et al., *Trophic and Spatial Complementarity on Seed Dispersal Services by Birds, Wild Mammals, and Cattle in a Mediterranean Woodland Pasture*, in *Global Ecology and Conservation,* 31, 2021, 1880.

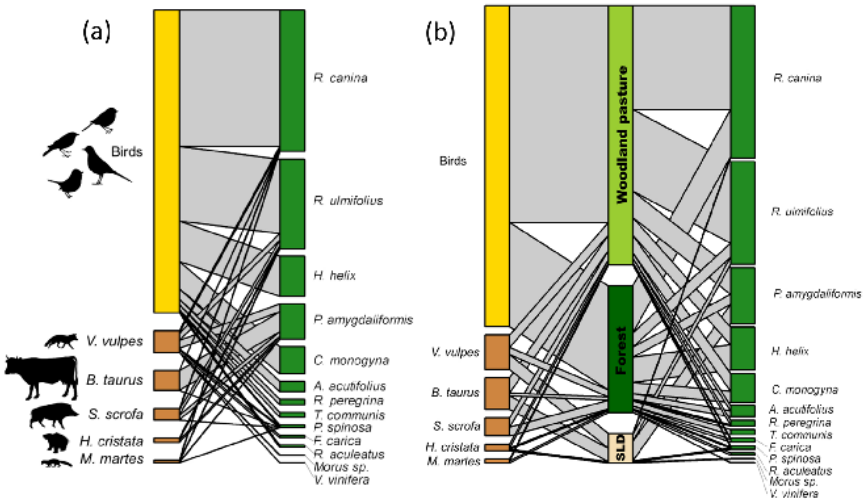

Figure 4. Example of an empirical quantitative trophic (a) and spatial (b) seed dispersal network in a natural reserve of Sicily. The trophic network proportionally shows the overall (column height) and species-specific (grey link width) density of seeds from all fleshy-fruited plants dispersed by mammals and birds (left column) in FBCD. b) The spatial network illustrates the proportionate density of seeds (grey links) dispersed by mammals and birds (left column) and the density of seeds for each plant species (right columns) in three different habitats: woodland, pasture (WP), forest, and roads (SLD – central columns) in FBCD (from Bueno et al. 2021).

5. *The LIFE Desert Adapt project*

A recent example of the application in the Mediterranean of the concepts mentioned above is the LIFE Desert Adapt project[41]. Coordinated by the University of Campania "Luigi Vanvitelli", this project brings together 19 partners, including ten Italian (Sicily), Spanish (Extremadura), and Portuguese (Beja) public and private landowners. With the support of technical partners, these landowners have made approximately 1,000 hectares available to test the project's proposed model (Desertification Adaptation Model). The DAM is an integrated ecosystem approach that combines environmental sustainability and climate change adaptation

[41] *www.desert-adapt.it/index.php/en.*

objectives with measures aimed at improving socio-economic conditions. Each partner has developed a tailored DAM, meeting all three pillars: Economic – maximising natural functions and potential agro-silvo-pastoral functions to diversify income sources and enhance the property. Environmental – working to increase naturalness, biodiversity, and territory quality to make it less vulnerable to extreme weather and desertification. Social – offering solutions that engage civil society to make their land a valued asset, thus protected by all. In doing so, the project fully supports the EU's climate policy priority of Climate Change Adaptation.

Implementing various adaptation measures, such as erosion control measures, reduced soil disturbance, selecting native pioneering and resilient species based on natural secondary succession principles, and diversifying crops with a wide range of species to suit current local conditions (Figure 5), has helped increase production and income while also reducing environmental impact and boosting resilience. Additionally, regenerative soil management techniques are being implemented, and various types of 'growing aids' are being tested to support the growth of tree species by optimising water supply, ensuring a healthier and more sustainable environment.

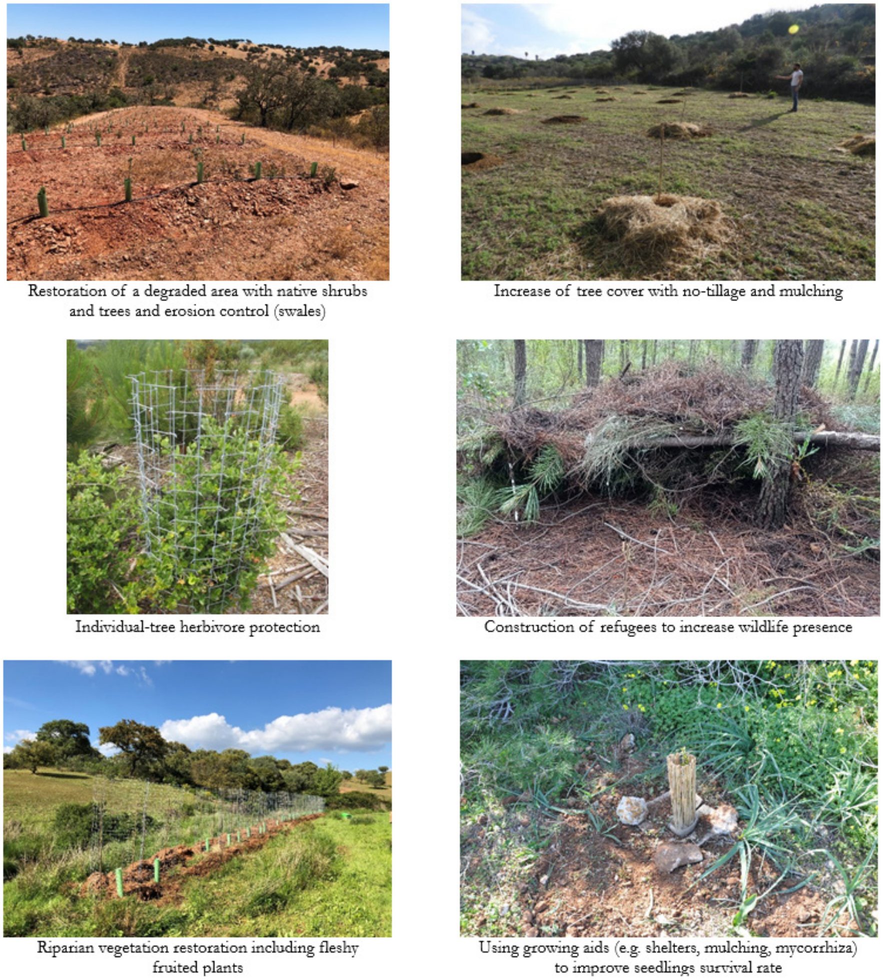

Figure 5. Some examples of actions and adaptation measures implemented in the LIFE Desert Adapt. Photos: Rafael da Silveira Bueno

The project's restoration efforts have concentrated on increasing woody plant cover, developing diverse agroforestry systems that blend mosaics of woody and herbaceous crops, and encouraging the spread of natural endemic herbaceous species. Noticeable progress is already apparent in soil biological diversity, as the enhanced complexity of these new systems provides more ecological niches, supporting a wide variety of animal species including invertebrates, amphibians, reptiles, birds, and mammals. Recent findings from this project have demonstrated significant positive impacts on both soil physico-chemical properties and soil bacteria, with further analysis of other indicators still in progress. The ongoing recovery and restoration of these areas are expected to help rebuild vital aspects of the ecosystems' structure and functions, such as reconnecting seed dispersal networks, therefore contributing to the landscape's adaptation to and mitigation of desertification.

Abstract

Desertification, driven particularly by human activities, is a pressing global challenge, especially in arid and semi-arid regions, although land degradation also impacts humid zones. Forests, which cover about 31% of Earth's surface, are vital for ecosystem health, and their loss accelerates desertification, leading to drought and soil erosion. To address these issues, international and regional policies and legislation emphasize the need for ecological restoration. Initiatives such as the UN Decade on Ecosystem Restoration and EU regulations demonstrate increasing commitments to landscape recovery. Combining active reforestation, natural regeneration, and sustainable forest management is crucial for restoring degraded land, conserving biodiversity, and protecting ecosystem services from the threats posed by desertification and climate change. In this paper, I provide an overview of desertification at global and Mediterranean levels and the roles of public policies, legislation, forests, and ecological restoration in combating desertification, including practical examples from research projects.

Ripristino ecologico delle aree in fase di desertificazione

La desertificazione, in gran parte causata dall'attività umana, rappresenta una sfida globale urgente, specialmente nelle regioni aride e semi-aride, anche se il degrado del suolo interessa anche le zone umide. Le foreste, che coprono circa il 31% della superficie terrestre, sono essenziali per la salute degli ecosistemi, e la loro perdita accelera la desertificazione, portando a siccità ed erosione. Per affrontare queste sfide, le politiche e le leggi internazionali e regionali evidenziano l'importanza del ripristino ecologico. Iniziative come il Decennio ONU per il Ripristino degli Ecosistemi e le normative UE mostrano un impegno crescente nel recupero del paesaggio. È cruciale combinare rimboschimento attivo, rigenerazione naturale e gestione forestale sostenibile per riparare le terre degradate, conservare la biodiversità e proteggere i servizi degli ecosistemi dalle minacce di desertificazione e cambiamento climatico. In questo articolo, offro una panoramica della desertificazione a livello globale e mediterraneo, e dei ruoli delle politiche pubbliche, della legislazione, delle foreste e del ripristino ecologico nella lotta a questa sfida, includendo esempi pratici di progetti di ricerca.