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Seventh Mediterranean Forest Week

21-25 March 2022

Antalya, Türkiye



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Preface

Ümit Turhan

Deputy head of Department

General Directorate of Forestry

Tackling climate change, reversing biodiversity loss, restoring ecosystems, combatting desertification and environmental protection are directly related to human and natural health and well-being and to prosperity. With increasing interest in the role of forests in tackling these threats, there is a growing trend to promote the expansion and protection of forests at the international and regional levels. In the light of the increasing risks, it is of crucial importance to protect and restore forest ecosystems.

Besides the social and cultural dimensions of Mediterranean forests, and their relationship with sustainable food systems and non-wood forest products, forest-based opportunities focusing on young generations and gender employment provide opportunities for youth for green jobs by using Mediterranean forests.

However, Mediterranean forests face global challenges and threats including climate change, deforestation, forest degradation, desertification, biodiversity loss and forest fires. Solutions for these challenges and threats require effective communication strategies, capacity building, transferring knowledge, sharing experiences and raising awareness in the Mediterranean region.

With the framework of handling these emerging concerns as a forum for boosting regional cooperation in the sustainable development and management of Mediterranean forests, the Committee on Mediterranean Forestry Questions *Silva Mediterranea* develops solutions to address hotspot issues in the Mediterranean region with the purposes of poverty alleviation and food security through the provision of multiple goods and services.

Moreover, forest and ecosystem restoration through nature-based solutions restores degraded forests and enhances the resilience of forests against climate change, deforestation, forest degradation, desertification, biodiversity loss and forest fires.

Furthermore, innovations, case studies, calls for action and environmental opportunities such as the European Union Green Deal, ecological transition and the New EU Forest Strategy play a crucial role in forest and ecosystem restoration for managing Mediterranean forests given post-pandemic scenarios.

The Seventh Mediterranean Forest Week, entitled "Forest and Ecosystem Restoration for the Next Mediterranean Generations", took place from 21 to 25 March 2022 in Antalya, Türkiye. The Mediterranean Forest Week gathered more than 150 public and private sector representatives, national and local governments, technical and scientific organizations, forestry experts and managers, environmental organizations, non-governmental organizations, young professionals, media, scientists and academics, and stakeholders from forest-related sectors from 14 countries, all of which will contribute to creating a shared vision for the Mediterranean forests through this event.



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The Antalya Declaration adopted at the end of the event emphasized the main points emerging from the meetings as follows:

- It underlines that restoration can create employment and reconnect Mediterranean people to their landscapes.
- It highlights the importance of youth empowerment and engagement in building climate resilience in the Mediterranean region.
- It calls for countries and stakeholders to scale up restoration efforts and reinforce regional cooperation to address common environmental and climate challenges.
- It supports the submission of the Mediterranean region represented by four countries – Lebanon, Morocco, Tunisia and Türkiye – as a World Restoration Flagship in the context of the United Nations Decade on Ecosystem Restoration.

In this context, and under the title "Forest and Ecosystem Restoration for the Next Mediterranean Generations", we invite you all, forest administrators and policymakers, the scientific and academic community, the private sector, donors, civil society, environmental agencies, NGOs and other relevant stakeholders in the Mediterranean region to this platform in order to highlight the role of forests and ecosystem restoration for the next Mediterranean generations.

Embracing this unified global issue will result in a significant output. Only with cooperation can we make a difference.

I hope we will successfully continue to cooperate on the welfare of the populations and nature of the Mediterranean region in a sustainable and integrated manner by believing in the power of solidarity.

On a final note, let me extend my best wishes to Tunisia for hosting the Eighth Mediterranean Forest Week in 2024.

THEMATIC SESSIONS

THEMATIC SESSION 1

**Improving the value-chain of
Mediterranean wild food: special
insights into how certification,
branding and labelling can upgrade
the economic value of edible non-
wood forest products**

Eating wild food products in the Mediterranean area: What is behind certification, branding and labelling?

Marta Rovira^{1*}

Ibtissem Taghouti^{2,4+} | Susete Marques³ | Issam Touhami⁴ | Davide Pettenella⁵

¹Forest Science and Technology Centre of Catalonia (CTFC), Crta. Sant Llorenç de Morunys km 2, 25280 Solsona, Spain

²Center for Agro-Food Economics and Development (CREDA-UPC-IRTA), 08860 Castelldefels, Spain;

³Forest Research Center and Laboratory TERRA, School of Agriculture, University of Lisbon, Tapada da Ajuda, 1349-017 Lisbon, Portugal

⁴The National Research Institute of Rural Engineering, Water, and Forestry-INRGREF, Tunisia

⁵Department of Land, Environment, Agriculture and Forestry, University of Padova, Italy

* Corresponding author

+ These authors contributed equally to this work.

Abstract:

Certified labels are an important asset for meeting consumer expectations and addressing information asymmetry about product features. It is an important factor in making decisions about buying a food product. However, wild forest products (WFPs) show many specificities, linked to product origin, the harvesting process and consumers awareness, among other things, that can complicate the certification process. The aim of this article is to highlight the distinctiveness of WFPs compared to agrifood products and identify the most relevant barriers and opportunities related to WFPs certification, labelling and branding, based on the data collected in the WILDFOOD project. Three main solutions were identified to improve certification schemes for WFPs within the project: (1) national initiatives; (2) group certification; and (3) process certification.

Keywords: Wild food products, certification, branding, labelling, marketing strategies, Mediterranean area

Introduction

Based on a bioclimatic definition of Mediterranean forests, the Mediterranean region included more than 25 million hectares (ha) of forest and about 50 million ha of other wooded lands in 2015, representing 2.20 percent of the world's total forest area. In addition, the forest area in Mediterranean countries has increased since 1990. Mediterranean forests and agroforestry systems harbour a vast array of wild and semi-wild food products (WFPs) with unique and exclusive properties. These WFPs are strongly connected to key issues for local economies, such as food security, rural livelihoods, the provision of ecosystem services, biodiversity conservation, traditional knowledge, local identity, gastronomy and other cultural values (Mutke *et al.*, 2019; Weiss *et al.*, 2020; Taghouti *et al.*, 2021). A significant share of the population harvests and consumes WFPs and, as demand continues to grow, aspects such as local production, sustainability and added social value attract more and more attention from conscious consumers (Martínez de Arano *et al.*, 2021). In this respect, enhancing the operation of existing and developing new WFP value chains, products, processes and services, taking into account the principles of sustainability, would improve the competitiveness of the Mediterranean agrifood sector in accordance with local values and heritage. Moreover, marketing strategies and new communication tools aimed at increasing Mediterranean WFP trade and sustainable consumption awareness can contribute to achieving an increased value and market access for the local products. Certification, branding and labelling are considered key strategies and tools for promoting the sustainable use of WFPs and enhancing their markets (Corradini *et al.*, 2018; Pettenella *et al.*, 2019; Martínez de Arano *et al.*, 2021).

Recently, there has been an increasing appreciation and use of natural, traditional and wild resources (FAO, 2019). This is evident in the proliferation of popular culture around “wild foods” and “foraging”, the resurgence of interest in traditional crafts, and the emergence of “back-to-nature” lifestyles, which are consciously chosen (Amici *et al.*, 2020). For example, many traditional WFPs, such as nuts, mushrooms and forest herbs, are no longer seen as subsistence food, but are part of healthy “superfoods” and stylish gourmet foods served in the finest restaurants. They are becoming highly appreciated and in demand at least in some high value-added market segments. Homemade, handmade or one-of-a-kind artisanal products based on WFPs, such as specialty liqueurs and berry jams, produced by small manufacturers that incorporate the use of traditional methods and materials, successfully capture growing consumer segments who are willing to pay high prices for high quality, unique, organic or locally produced goods (Weiss *et al.*, 2019). To refer to these producers and consumers, the idea of “innovative nostalgia” is suggested by several authors to define a market trend that connects traditional products with this new consumer and leading to new labelling systems based on rigorous certification standards, innovative packaging and improved product information (Sheppard *et al.*, 2020).

The shift towards high quality and unique food production can help capitalize on the richness of Mediterranean biodiversity with its abundance in WFPs while at the same time enhancing economic activity in rural areas, thereby contributing to “inclusive growth” and the development of the bioeconomy in Europe and in the Mediterranean area. Moreover, wild food chains can benefit from improved cooperation with other actors in food supply chains, as well as novel solutions to trace origin and identity, ensure safety and exploit digital opportunities through the development of innovative certification, branding and labelling tools (Taghouti and Daly-Hassen, 2018).

The certification of WFPs can have a significant impact on forest management, as it has the potential to raise awareness among consumers and industry about the conditions under which forestry goods are collected and marketed to push for increased transparency and improved policies and practices (Shanley *et al.*, 2008). Product certification activities, labelling and brand development, together with networking activities and an increase in sales in the specialized distribution channels, are key aspects of the development of new WFP markets (Wiersum *et al.*, 2018; Martínez de Arano *et al.*, 2021). At the global level, certification of forest products was developed primarily for timber through certification standards such as the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification Schemes (PEFC). These standards can also be applied to WFP certification. Specific certification

schemes that can be applied to WFPs have been established more recently (Sheppard *et al.*, 2020). They include those standards dealing with geographical provenance, organic food products, social aspects (e.g. fair trade products) and nutritional properties (Corradini *et al.*, 2018; Pettenella *et al.*, 2019; Vantomme & Walter, 2003).

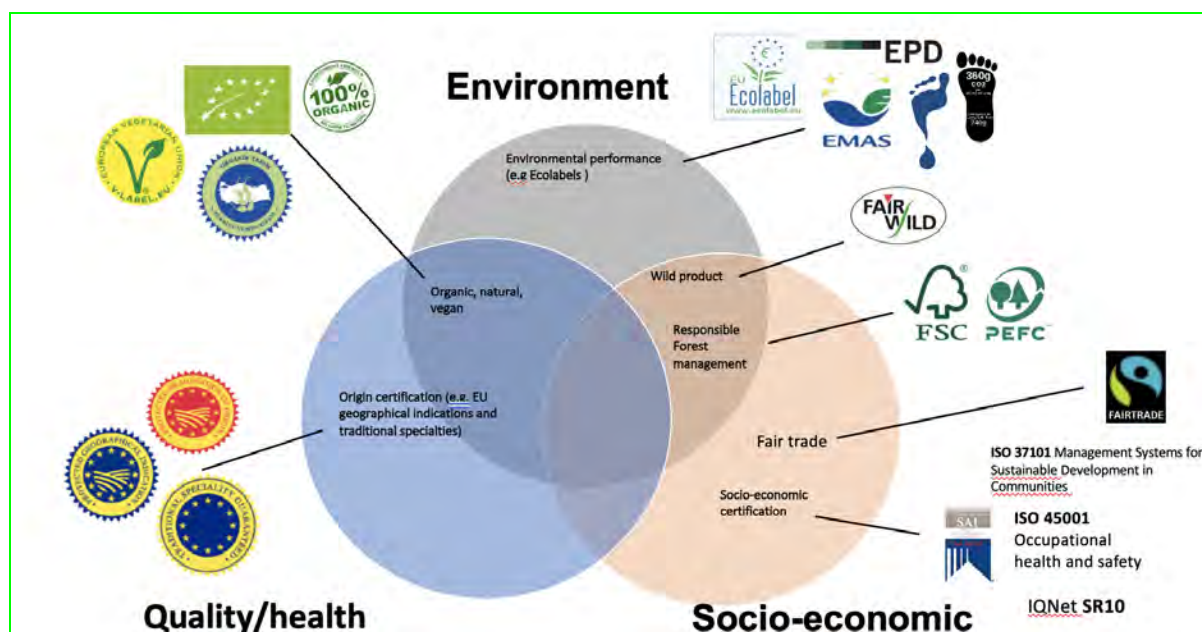


Figure 1. Certification schemes

Source: Pettenella, D., Corradini, G., Da Re, R., Lovric, M., Vidale, E. 2019. *NWFPs in Europe - consumption, markets and marketing tools*. In: Wolfslehner B., Prokofieva I., Mavsar R., (eds). *Non-wood forest products in Europe: seeing the forest around the trees*. Joensuu, Finland, European Forest Institute, p. 31–53.

Some schemes are developed by public entities, such as the European Union’s “origin, geographical indications and traditional specialties schemes” with the labels Protected Designation of Origin (PDO), Protected Geographical Indication (PGI) and Traditional Speciality Guaranteed (TSG). These types of certification schemes promote and protect the names of products that come from a specific region. Several WFPs, such as mushrooms, nuts and berries, have been certified with these schemes (Weiss *et al.*, 2020; Brotto *et al.*, 2018).

Branding and certification of WFPs in terms of sustainability, quality and origin are important tools for differentiating wild products from industrial mass-produced products (Pettenella *et al.*, 2019). These marketing strategies and tools allow to connect the producer and the consumer. Through certification, the consumer can be better informed about the precedence of the product and the production system. It allows the consumer to choose according to their criteria and preferences, and it enables product traceability and more transparency along the value chain stages (Brotto and Pettenella, 2018). Regarding the overall production of wild products, data are scarcer than data on trade, although some figures on certified products are available. Even if Europe represents the second largest area in organic certification, it produces a relatively small amount of certified wild products (Wong and Wiersum, 2019). Innovation in WFP branding can include standard development, certification and labelling (e.g. with reference to a traditional product designation), area of origin, naturalness and sustainable system of production, thus meeting the consumer's demand for more natural and healthy foods.

Materials and methods

This paper was developed under the WILDFOOD project, funded by the Foundation for the Partnership on Research and Innovation in the Mediterranean Area (PRIMA), whose overall aim is to promote the

implementation of joint innovative strategies by the different actors in the value chains based on WFPs in the Mediterranean area, to improve their quality, safety and sustainability. Among its objectives, the WILDFOOD project seeks to facilitate market access by Mediterranean companies and increase the added value of local products by implementing innovative marketing strategies and targeted dissemination activities – including certification, branding and labelling – and integrating local key stakeholders in the implementation process, thus ensuring their participation and achieving a joint marketing action.

Based on the WILDFOOD project and the results from previous projects (e.g. INCREDIBLE and STARTREE), certification, branding and labelling are considered relevant strategies and tools to boost the potential of WFPs around the Mediterranean and promote sustainability, quality and safety along the WFP value chains. The WILDFOOD project includes data collection, analysis and synthesis of state-of-the-art WFP value chains. Workshops and questionnaires with the actors of selected WFP value chains (e.g. truffles, pine nuts, aromatic plants and acorns) were carried out. Collected data were analysed to produce consumption information through the analysis of market flows and estimate current and potential future trends for WFP demand. The questionnaires included information at the level of production, especially on cultivation and harvesting management models, as well as wild food processing (including handling processes), maintenance of facilities, storage and packaging; business model aspects and marketing strategies were tackled with special attention to certification, branding and labelling. Among the workshops' objectives were the identification of the most relevant difficulties in reaching international markets, tools for increasing stakeholders' visibility, and certification and labelling innovations. This information will be made available to producers and other actors to help them integrate certification and ensure adequate labelling of Mediterranean WFPs, with a clear indication of the product and area of origin, and emphasizing their naturalness and sustainable production. In addition, the project includes the implementation of pilot projects and case studies to develop innovative activities and methods for addressing quality, safety and sustainability throughout all the stages of WFP value chains.

Results and discussion

In recent decades, there has been a substantial change in WFP consumption patterns in the Mediterranean area (Amici *et al.*, 2020; Martínez de Arano *et al.*, 2021). The commercialization of WFPs involves various actors who are increasingly aware of the effectiveness of certification for providing safe food, improving working conditions, protecting forests and biodiversity, and improving transparency surrounding product attributes (Girmay *et al.*, 2013). Consumers are also not just looking for higher levels of safety and quality in their food, they have started to pay more attention to other attributes as well, ranging from the local and social embeddedness of purchased products, sustainable harvesting methods and societal concerns (Burgener, 2007).

In various developing Mediterranean countries, edible WFPs are harvested and consumed not only as subsistence products, but also because they form part of the cultures and traditional lifestyles of local communities. Moreover, there is an increasing interest in these products considering their potential commercial value among non-traditional consumers, like those living in urban centres or export countries (Taghouti *et al.*, 2021). Therefore, WFPs should not be considered as any other conventional food, and the economic characterization of these products would benefit from a differentiation strategy based on the uniqueness of the product. Effective differentiation of WFPs is built on the fact that there is no product on the market that could substitute these goods, as this can create brand loyalty in consumers and better profit margins for companies.

The experience to date shows that many factors were identified behind successful certification. Many lessons can be drawn in the case of WFPs and should be considered by private enterprises to reshape their marketing strategies and policymakers to readjust their priorities (Kaczorowska *et al.*, 2021). Edible WFPs supply various industry sectors with raw materials that are consumed as medicines and food products. Various stakeholders are involved in the production and transformation system of WFPs, which could make the certification process very long and difficult (Corradini *et al.*, 2018). In this sense, more communication

and networking processes among the stakeholders involved in the certification and labelling processes are needed. Moreover, producers and harvesters should predict the costs and benefits of available certification schemes (e.g. wild food, fair trade and organic) for WFPs to find out whether the selected certificate is suitable for their product, consumer base and organizational capacity. Available information on the costs and requirements are very scarce, and this can be a challenge for making the transition to certified products.

Another factor is related to standards recognition in markets of different countries or organizations. Producers should focus on the most common certification schemes to avoid a variety of challenges related to land tenure of harvesting areas, standards variability of accredited certification bodies, and insufficient technical and organizational skills at the company level to comply with certification requirements. Different certification schemes have many standards and requirements, which can confuse consumers and producers at the same time. There is an urgent need to set up better collaboration across different certification schemes (ecological, organic and fair trade) to avoid overlapping. To do so, implementing a holistic approach has become a political priority to improve the certification process and schemes for WFPs; training forest managers and certifiers on the specificities of WFPs (ecology, use and market trends) can be an important step in making the certification process easier, more efficient and more transparent (Wolsfleher *et al.*, 2019; Amici *et al.*, 2020).

Moreover, the perception and understanding of certification and labelling among consumers should be taken into consideration to identify to what extent people are willing to pay higher prices for better qualified products, which can vary among different countries (Kaczorowska *et al.*, 2021). According to Schunko and Volg (2020), consumers know, gather and have positive attitudes with respect to WFPs, although they are hardly aware of their market relevance. Therefore, consumers need to be better informed about the wild origin of food ingredients and the added value of certification.

Certification is also an important asset for the restoration of agroforestry models in the Mediterranean area. An example is in Montado de Freixo do Meio, Portugal (Box 1). Many species could undergo certification given their nutritional, economic and cultural value. Certifying WFPs is considered a relatively recent and promising marketing tool employed by private enterprises to take into consideration WFP particularities (e.g. taste, quality conformity and size). In this regard, further studies and research on WFP certification, labelling and branding are needed to provide appropriate information to policymakers.

Box 1. Portuguese case study. The Portuguese *montado*, like the Spanish *dehesa*, is one of the oldest and richest living models of agroforestry on our planet. This system of cooperation between man and nature was adopted at the beginning of the 1990s as a way of obtaining food while regenerating the ecosystem. As the *montado* consists essentially of oaks – holm oak (*Quercus rotundifolia*), cork oak (*Q. suber*), kermes oak (*Q. coccifera*), Portuguese oak (*Q. faginea*) and Pyrenean oak (*Q. pyrenaica*), besides other less represented species – it is only natural that the acorn, a product common to all of them, became one of the most used resources in this system. The acorn is a kind of dry nut, akin to the hazelnut, made of one seed covered by a woody shell with a dome-shaped capsule. The acorns of many species can be eaten raw right after the harvest, but some are too bitter for general consumption, having surprising nutritional and functional features. With high fibre and protein content, it has a fat profile similar to olive oil, is gluten free and has high levels of antioxidants. The acorn for human consumption is the emblem of Montado do Freixo do Meio.

Montado of Freixo do Meio (MFM) is a 584 ha farm located in Foros Vale Figueira, Montemor-o-Novo, 100 kilometres (km) east of Lisbon. It is privately owned, It has been privately owned by the same family for 70 years, with a focus on agroecology for the last 30 years, the farm has been producing foods without chemicals, pesticides or herbicides, obtaining an organic farming certification in 2018 as certified by Kiwa Sativa (PT-BIO-03). MFM has 12 microfactories for on-site production of 370 food products, 12 of which are acorn products, as a pioneer in the use of this superfood and the main champion of the reintroduction of this fruit in the everyday diet by creating unique products like acorn coffee, acorn breads, acorn-shaped biscuits, and acorn hamburgers and sausages. "Cozido de bolota do Montado do Freixo do Meio", a meat stew with acorns made in clay pots on an open fire, is one of the dishes visitors can taste when visiting the

farm. MFM has created their own brand “Montado Freixo do Meio”, and they sell their products online at <https://loja.freixodomeio.pt/>.

Wild aromatic plants are very appreciated by consumers in the Mediterranean area. However, there is an urgent need to upgrade certification schemes for these products to improve the working conditions of people harvesting wild plants from forests and to meet consumers' expectations. A good example of WFP certification can be found in Tunisia where the aromatic plants sector is of great importance (Box 2).

Box 2. Tunisian case study. Herbéos is a brand of natural cosmetics created in 2015. The mission of Herbéos is to develop ethical cosmetic care and natural remedies for women, men and children, developed with respect for humankind and the environment, while promoting Tunisian medicinal plants. Herbéos works principally on four aspects:

- extraction of vegetable oils by cold pressing;
- distillation of floral waters;
- cold process soap manufacturing; and
- development of specific care ranges for each type of skin.

The laboratory is based in Sahline, Monastir, and relies, among other things, on organic family crops in the region of Zéramdine, Monastir. A factory for processing cactus fruit has been established in Zéramdine, with 68 ha of organic growing.

Organic agriculture is a method of production and processing that respects the environment, animal welfare and biodiversity. Organic food is produced from ingredients grown without synthetic chemicals and without genetically modified organisms (GMOs). They do not contain flavour enhancers, colourings or synthetic chemical aromas. Organic products are controlled at all stages. In addition to the controls carried out on all agrifood products, specific controls are carried out on organic products by an independent organization approved by the public authorities. Organic agriculture is at the heart of sustainable development. It is a commitment to the well-being of future generations.

The organic label helps consumers identify organic products. Its presence on the packaging ensures compliance with the European Union's organic farming regulation. The logo can be applied to products that contain at least 95 percent organically produced ingredients.

Wild food products are strongly connected to local traditions and culture, especially in marginal areas where they are used for local subsistence as in the case of the Nogué herbalist shop (Box 3), owned by a producer located in a remote area of the Catalan Pyrenees in Spain, with a long tradition of herbal use and marketing. While the producer finds it challenging at times to follow certification schemes, these are considered an important tool for selling their products.

Box 3. Spanish case study. The Vansa and Tuixent valley in Catalonia is a landscape of great natural interest harbouring a variety of aromatic and medicinal plants, forests of pines, oaks and other trees along with shrubs for domestic use, and with beautiful panoramic views of the valley. The valley has a long tradition of wild plants, and during the nineteenth century and much of the twentieth century, a group of women called “trementinaries” (turpentine workers) collected plants with medicinal properties, which, once properly processed, were sold throughout Catalonia. In this valley is Ossera, an artisan village located on top of a hill, where since the 1980s, producers and artisans have been making various products in their workshops. One of these workshops is the Nogué herbalist shop, which has been cultivating and collecting aromatic and medicinal plants on its farm (Ossera, La Vansa Fornols and Tuixent) in the Catalan Pyrenees, for more than 30 years. The mountain climate and the careful workmanship in planting, harvesting, drying and handling ensures that plants retain all their aromas and properties. The herbalist's products include aromatic and medicinal plants, dried flowers, cosmetics, ointments, tinctures and essential oils. The plants are grown in accordance with the rules of organic farming, and some wild plants are also collected in the

surrounding mountains, always respecting the environment. To provide quality assurance for their products, the herbalist is on the Register of the Catalan Council of Ecological Agricultural Production (CCPAE), a health register, and undergoes bacteriological testing. Its labelling is simple; it mentions the origin, connects with the consumer who seeks authenticity, uniqueness and biobased products, and promotes an awareness of nature and sustainability.

According to the information collected under the WILDFOOD project, several challenges and opportunities should be highlighted. Certifying WFPs is a very challenging task for all involved stakeholders in the certification process. Challenges can be categorized in three groups: social, economic and legal. Social challenges affect mainly small producers and are linked to the lack of organization and bargaining power of these stakeholders; small firms have inadequate or insufficient market information, legal knowledge and negotiation skills to undertake the certification process for their products. Besides, these enterprises face real difficulties in the certification process because they are not able to comply with administrative and institutional requirements to ensure quality control. Producers should not overestimate opportunities behind certification and avoid unrealistically high expectations. Externally driven certification is often poorly understood by small producers who often also underestimate limitations and obstacles. From another perspective, there is a difficulty in striking a balance between the need to improve the existing working conditions of WFP harvesters and overregulation.

When talking about WFP certification, there is an important question: is certifying WFPs similar to the certification of agrifood products? The value chains of WFPs involve many stakeholders from forests to market. The certification of WFPs could be hampered by the complexity of their value chains and the poor interaction between the forest and agrifood sectors. Indeed, there is a lack of capacity to address this issue in the forest sector, and certifying bodies do not consider the specificity of WFPs before defining certification standards. For instance, the quality of WFPs is highly variable, leading to obstacles in processing and marketing, and this specificity should be considered when defining and adapting certification schemes.

The perception of food quality by the consumer depends on previous experience, product knowledge and sensory sensitivity. Meanwhile, demand for WFPs is changing rapidly, exposing producers to significant risk, meaning that they often have problems meeting consumer expectations and marketplace specifications (e.g. for quality control and volume). It has become necessary to raise awareness about the implications of purchasing WFPs, and producers need to put more effort into marketing and raising awareness among consumers.

Other challenges were pointed out related to the legal and institutional framework. Laws regulating access, use and marketing of WFPs can already overburden harvesters and processors. Certification has the potential to exacerbate this problem. Standards need to be adapted to fit different scales of land ownership. The complexity of products, harvesting rights and forest types requires not one set of standards, but a variety of instrument types. Moreover, certification should address legal and policy advances in recognizing the rights of local communities to control the use of their traditional knowledge, images and resources.

Despite many challenges affecting WFP certification and labelling, there are still very important opportunities behind these powerful marketing tools. Local forest communities are among the main beneficiaries of certification. Certification by internationally recognized bodies has been seen to help communities who are sustainably harvesting WFPs, and they can gain recognition within their own country for their responsible stewardship of natural resources. Performing certification, labelling and branding can consolidate community forest management and add importance to best management practices for WFPs. Certification can be an efficient tool to address information asymmetry and restore strategic partnerships between public bodies, industries and communities. People living within forest areas can benefit from certification because it supports collaboration and organization among community members to strengthen community institutions.

Certification can open access to new marketing channels and ensure that enterprises have better access to emerging markets; certifying WFPs may allow communities to tap into new niche markets for their

products, particularly in areas where consumer concerns over forest conservation and equity in trade are well developed. Globalization is creating niche markets that provide potential avenues for certification. Opportunities are created for smallholders to increase their competitiveness, meet new consumer demands for “green” and sustainably sourced products, and to receive higher prices. Wild forest product certification through local marketing and branding strategies can enhance positive perception and increase their recognition among other products. Moreover, third-party certification can separate responsible companies from companies that engage in marketing hype, alleviate consumer confusion and reward sound management and marketing. In some areas, new measures have already positively impacted producer livelihoods and species management. Certified WFPs can easily have greater recognition nationally and internationally. Furthermore, donors have shown strong support for certification as a market-based tool to achieve conservation and development objectives. Certification can provide background and conceptual frameworks for better policy and can catalyse national dialogues.

Conclusion

The work carried out under the WILDFOOD project has advanced the knowledge and understanding of WFP certification, as well as branding and labelling. Integrating certification; ensuring the proper labelling of Mediterranean WFPs, with clear information on the product and its origin; and highlighting its naturalness and sustainable production can contribute to enhancing WFP markets and consumption. These tools can help improve the visibility of WFPs and better meet the requirements of more selective, conscious consumers. However, the sector faces several challenges that need to be overcome to enable producers and processors to adapt to new forms of certification and labelling. Challenges include: competitive and unstable markets with frequent changes in demand; an industry mainly made up of small producers with little capacity to innovate and comply with market and certification specifications; and the complexity of the sector due to the wide range of existing products and collection rights, which requires the development of different standards and tools.

In this sense, three main solutions were identified to develop an alternative action plan:

- National initiatives should be implemented to streamline procedures, reduce both direct and indirect costs of certification, and create a more practical evaluation process for small producers and WFP harvesters. These initiatives could be implemented to adjust requirements for certification by smallholders, including shorter, more concise reports, and options for fewer evaluators, desk audits and peer reviews.
- Group certification is used by several certification systems, including organic certification and fair trade certification, to reduce certification costs (e.g. evaluation, planning, management and other implementation costs) per member to increase opportunities for accessing new markets.
- Chain of custody certification is necessary at all stages of the processing and supply chain if the certified product is to eventually carry a label that informs the consumer of its certified origin.

Summing up, each country should have a different “awareness” about certification performances related to WFP production and consumption. Forest sector operators should show a different perception of the labelling and certification strictly connected to market conditions, regulatory frameworks and consumer trends. It is more challenging for smaller companies to comply with certification procedures than for larger companies. The WFP sector as a whole needs a massive capacity-building effort to increase the skills of their workforce and be ready to meet the challenges of future labelling and certification schemes.

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References

- Amici, A., Beljan, K., Coletta, A., Constantin, I., Da Re, R., Ludvig, A., Marčeta, D., Nedeljković, J., Nichiforel, L., Nonić, D., Pettenella, D., Posavec, S., Riedl, M., Šišák, L., Stojanovska, M., Vidale, E., Weiss, G., Živojinović, I. 2020. Economics, marketing and policies of NWFP. In: *Non-Wood Forest Products in Europe. Ecology and Management of mushrooms, tree products, understory plants and animal products*. BoD – Books on Demand GmbH.
- Bansal, A.K. 2020. *Conservation of Non-Wood Forest Resources for Sustainable Livelihoods. Network for Certification and Conservation of Forests (NCCF)*. Working Paper No. 1/2020.
- Brotto, L., Florian, D., Vidale, E., Pra, A., Andrighetto, N., Chavarria, A., Leonardi, A. 2018. Certified forest products and services. *Forest Management Auditing: Certification of Forest Products and Services*, 57.
- Burgener, M. 2007. *Trade measures - tools to promote the sustainable use of NWFP? An assessment of trade related instruments influencing the international trade in Non-Wood Forest Products and associated management and livelihood strategies*. FAO Non-Wood Forest Products Working Document No 6. Rome, FAO.
- FAO. 2019. *State of Mediterranean Forests 2018*. Rome, FAO and Plan Bleu. www.fao.org/3/CA2081EN/ca2081en.PDF
- Girmay, Z., Abebe, G., Tillahun, A. 2013. *Non-Timber Forest Products in the Context of Sustainable Forest Management and Redd+*. Hawassa University Wondo Genet College, of Forestry and Natural Resources, Ethiopia. www.forestcarbonpartnership.org/sites/fcp/files/fcp-docs/2015/October/NTFPs_Manual.pdf
- Corradini, G., Vidale, E., Pettenella, D. 2018. Certification standards applicable to Non-Wood Forest Products. In: *Forest Management Auditing: Certification of Forest Products and Services*. Earthscan Studies in Natural Resources Management. <https://doi.org/10.4324/9781315745985>
- Kaczorowska, J., Prandota, A., Rejman, K., Halicka, E., Tul-Krzyszczuk, A. 2021. Certification Labels in Shaping Perception of Food Quality – Insights from Polish and Belgian Urban Consumers. *Sustainability*, 13, 702. <https://doi.org/10.3390/su13020702>
- Martínez De Arano, I., Maltoni, S., Picardo, A., Mutke, S., et al. 2021. *Non-wood forest products for people, nature and the green economy*. Recommendations for policy priorities in Europe. A white paper based on lessons learned from around the Mediterranean. Series Knowledge to Action No 5, 85 pp. European Forest Institute (EFI) and FAO. <https://doi.org/10.36333/k2a05>
- Mutke, S., Bonet, J.A., Calado, N., Calvo, J., Taghouti, I., Redondo, C., Martínez de Arano, I. 2019. Innovation networks on Mediterranean non wood forest products. *Journal of Innovative Science and Engineering (JISE)*, 3(1), pp. 1–10. <http://hdl.handle.net/10459.1/68300>
- Pettenella, D., Corradini, G., Da Re, R., Lovric, M., Vidale, E. 2019. NWFPs in Europe - consumption, markets and marketing tools. In: B. Wolfslehner, I. Prokofieva, R. Mavsar, (eds). *Non-wood forest products in Europe: seeing the forest around the trees*, pp. 31–53. Joensuu, Finland, EFI.
- Schunko, C., Volg, C. 2020. Erratum: Factors determining organic consumers’ knowledge and practices with respect to wild plant foods: A countrywide study in Austria. *Food Quality and Preference*, 85, 103960.
- Shanley, P., Pierce, A., Laird, S., Robinson, D. 2008. *Beyond Timber: Certification and Management of Non-timber Forest Products*. Center for International Forestry Research (CIFOR), Bogor, Indonesia.

- Sheppard, J.P., Chamberlain, J., Agúndez, D., Bhattacharya, P., Chirwa, P.W., Gontcharov, A., S., Willie, C.J., Shen, H., Tadesse, W., Mutke, S. 2020. Sustainable forest management beyond the timber-oriented status quo: transitioning to co-production of timber and non-wood forest products – a global perspective. *Current Forestry Reports*. 6(1): 26-40. <https://doi.org/10.1007/s40725-019-00107-1>
- Taghouti, I., Daly-Hassen, H. 2018. Essential oils value chain in Tunisian forests: Conflicts between inclusiveness and marketing performance. *Arabian Journal of Medicinal and Aromatic Plants*, 4(2), 15-41.
- Taghouti, I., Ouertani, E., Guesmi, B. 2021. The Contribution of Non-Wood Forest Products to Rural Livelihoods in Tunisia: The Case of Aleppo Pine. *Forests*, 12, 1793. <https://doi.org/10.3390/f12121793>.
- Vantomme, P., Walter, S. 2003. Opportunities and challenges of non-wood forest products certification. World Forestry Congress, 21–28 September 2003, Québec, Canada.
- Weiss, G., Emery, M.R., Corradini, G., Živojinović, I. 2020. New values of non-wood forest products. *Forests*, 11, 165; doi:10.3390/f11020165.
- Wiersum, K. F., Wong, J. L. G., Vacik, H. 2018. Perspectives on non-wood forest product development in Europe. *International Forestry Review*, 20(2), 250–262.
- Wong, J.L.G., Wiersum, F.K. 2019. A spotlight on NWFPs in Europe. In: B. Wolfslehner, I. Prokofieva, R. Mavsar (eds). *Non-wood forest products in Europe: seeing the forest around the trees*, pp. 31–53. Joensuu, Finland, EFI.
- Živojinovic, I., Weiss, G., Wilding, M., Wong, J.L.G., Ludvig, A. 2020. Experiencing forest products – An innovation trend by rural entrepreneurs. *Land Use Policy*, 94, 104506.

THEMATIC SESSION 2

The use of new technologies and open data to better support restoration and sustainable management of forests

The use of new technologies and open data to better support the restoration and sustainable management of forests

Virginia Garcia Millan¹

Nelly Bourlion¹ | Annemarie Bastrup-Birk² | Cécile Roddier-Quefelec² | Issam Touhami³
| Alessio Martinoli⁴ | Nizar Hani⁵ | Dania Abdul Malak¹

¹ European Topic Centre on Spatial Analysis and Synthesis, University of Malaga, Spain

² European Environmental Agency, Copenhagen, Denmark

³The National Research Institute of Rural Engineering, Water, and Forestry-INRGREF, Tunisia

⁴ Medforval network, Istituto Oikos, Italy

⁵ Shouf Biosphere Reserve, Lebanon

Abstract:

The Mediterranean region hosts some of the most biodiverse ecosystems on the planet, as well as some of the most threatened. The complexity of the region's ecosystems, particularly its forests, comes from a combination of different meteorological and topographic circumstances that have existed in the area for millennia together with the shaping of humans. High population density and intense human activity cause loss, degradation and fragmentation of habitats. In the last century, one of the most important impacts is climate change, which adds drought, fires and plagues to the list of ecosystem impacts.

In line with the Euro-Mediterranean policy context, the new EEA-Eionet Strategy 2021–2030 and the new EEA-UNEP/MAP Barcelona Convention strategic partnership 2022–2030, the Mediterranean is a strategic imperative for the European Union (EU) and the European Environment Agency (EEA). Mediterranean forest conservation and restoration are necessary to protect the ecosystems and the services that they provide to humans, such as wood and non-wood resources and environmental services. The effective management of Mediterranean forests draws on the collaboration and coordination of institutions at all scales. For example, at the transnational level, partnerships on forests can rely on the European Environment Agency (EEA) and its Eionet network, the *Silva Mediterranea* committee hosted by the Food and Agriculture Organization of the United Nations (FAO), and the Medforval network to assess the state and trends of forest resources, their sustainable management and biodiversity. At the local level, the role of protected areas, such as the Shouf Biosphere Reserve, is very important to understand the particularities and needs of each forest type in order to manage forests properly.

Forest maps are an essential tool for identifying the distribution, status and changes occurring in forests and their multidimensional context to understand the drivers of degradation and potential variables for recovery, and to support policies and prioritize actions for restoration and conservation. In line with one of the EEA-Eionet strategic objectives for 2021–2030 on the “full use of data, technology and digitalization”, an improved map of Mediterranean forest types (based on dominant species) was presented to provide a better tool for forest management to the Mediterranean community. The use of big data (such as satellite images) and artificial intelligence helps generate high-quality maps with similar accuracies across regions and at higher frequencies while creating job opportunities for younger generations. In particular, the forest maps presented are intended to support with information on those areas where field data is scarce and to fill the temporal gap between forest inventories. The development of the forest database was achieved with the support and collaboration of more than 20 researchers and institutions who shared their data on forests.

Background

The Mediterranean region is the second largest biodiversity hotspot on the planet (Mittermeier *et al.* 2004). Based on a bioclimatic definition of Mediterranean forests, the Mediterranean region includes more than 25 million hectares (ha) of forest and about 50 million ha of other wooded lands (FAO and Plan Bleu, 2018). Compared to boreal and temperate forests, a prominent characteristic of Mediterranean forests is a higher spatial and temporal heterogeneity at multiple geographic scales in terms of physical and biological components. The diversity of its flora is outstanding with 15 000 to 25 000 species, 60 percent of which are unique to the region. About one-third of the Mediterranean fauna is endemic (IUCN, 2008). The complexity of the Mediterranean forest composition and structure is the result of millennia of human activities and impacts (Blondel, 2006; Lefevre and Fady, 2016), such as water consumption, land opening for agriculture, exploitation of forest resources, selection of forestry species and pollution (Masson-Delmotte, 2021).

Although the forest area in the region has increased by 2 million ha in the last 20 years, 80 million ha of land are degraded, including forests (FAO and UNEP, 2020). In addition, climate change is adding and intensifying pressures on the environment. The Mediterranean region is one of the environments most affected by climate change (Cramer *et al.*, 2018, 2019). An increase in the average and maximum temperatures, a decrease in precipitation and more extensive summer periods have augmented drought events (in duration, severity and frequency), fire occurrence and severity, and the risk of plagues (Masson-Delmotte, 2021).

Forests provide vital (wood and non-wood) resources and ecosystem services, and they play a key role in climate regulation and mitigation (Bonan, 2008; Noce and Santini, 2018; Forest Europe, 2020; Science for Environment Policy, 2021; Lefevre and Fady, 2016). More detailed knowledge of the state of Mediterranean forests is needed to protect them and continue to benefit from the ecological and economic goods and services that they have provided for centuries as a part of a sustainable and green economy. There must be a shift from traditional (wood-oriented) forestry to sustainable forest management as a way of protecting, restoring and maintaining healthy, diverse, resilient and productive forests (Science for Environment Policy, 2021). Likewise, there is a need to restore degraded forest areas.

More than ever, it is essential to have updated and integrative spatial information at multiple geographical levels about the distribution, status and evolution of forests and their multidimensional context to understand the drivers of degradation and potential variables for recovery, support policies and prioritize actions for restoration and conservation.

Forest inventories and cartography as a tool for forest management

Forest inventories and forest maps are essential tools to guide action plans on forest management, strategies and policies. Forest inventories collect key variables to monitor the status of forests and their resources and to guide their management (e.g. height, density, trunk diameter, biomass, species composition, understory species, dead trees, litter and combustible species). Forest maps offer an integrated spatial overview of the status of forests, which allows for a better understanding of spatial connections, drivers and dynamics in the landscape that might affect and impact forests and could, therefore, help implement restoration strategies. Temporal series of forest maps can be used to monitor forest development and help evaluate the effectiveness of forest management plans. Stehman (2009) highlights this issue in estimating the area of land cover and land-cover change.

However, the development of forest inventories and mapping requires significant effort in terms of time, human power and economic resources. Forest inventories are generally developed and organized at the national level. For the Mediterranean area, this creates a mosaic of data and information. For instance, the number and frequency of forest inventories vary from one country to another. Therefore, support to forest management should be framed according to a multifaceted approach that integrates mapping and inventory to provide comprehensive knowledge of the state and trends of forest resources and the interactions and interdependencies with other land uses (Corona, 2010).

It takes several years to generate and publish forest inventories and maps. On average, there is a forest inventory every 10 years in the Mediterranean context at the national scale. In other cases, some countries do not have systematic or frequent forest inventories or maps. From country to country, there are substantial differences in the methodologies adopted for the field inventories (e.g. plot sample size and plot nesting), the variables measured, the definitions of forest types, the selection of areas and the frequency of inventories. The methodologies and design of the field campaigns can also vary within the same country, from one inventory to another.

Forest cartography is traditionally generated based on high-resolution images (generally aerial photographs) by photo interpretation with the support of field inventories for class labelling. The entire process of map production can last several years (6–10 years) and, usually, there is a significant disparity in dates between the aerial photographs – depending on the size of the country and the resources invested, a flight campaign can last 2–5 year – and the field data used to label the classes.

An internal European Environment Agency (EEA) report about several reference forest maps available for the Mediterranean region revealed several limitations (ETC/ULS, 2021) (Table 1). Whereas some of these maps are produced traditionally (e.g. CORINE Land Cover Map), other maps use satellite data and automated classification methods (e.g. Copernicus Global Land Cover Map, Buchhorn *et al.*, 2020). In fact, the classification system of forests varies among map sources; in all cases, the list is not very detailed, differentiating generic forest classes such as “broadleaved forests”, “mixed forests”, “coniferous forests” or “open forests”. More worrisome, the accuracy of the maps evaluated (by comparing the map forest area against FAO’s *Global Forest Resources Assessment 2015* report) was shown to be very low, especially for non-European Union (EU) countries, with up to 78 percent error in some cases (Table 1). The most frequent inaccuracies were tree crops classified as forests and shrubs classified as open forests and vice versa. Several of the key maps are funded by the European Commission and do not cover non-European countries.

Table 1. Evaluation of maps including the “forest” class for the Mediterranean region (ETC/ULS for EEA)

Data source	Data type	Data resolution	Mediterranean coverage
Corine Land Cover	Dominant LULC Broad-leaved forest Coniferous forest Mixed forest Transitional woodland shrub	100 m	EEA - countries
Copernicus High Resolution Layers - Forest -	Three products: - Tree cover density (0-100%) - Dominant leaf type (DLT) - Forest type product (FTY) <i>3 forest classes: broadleaved, coniferous and mixed</i>	20 m	EEA - countries
Copernicus Global land cover (GLC)	Dominant LULC and cover fractions Open/closed and evergreen/deciduous classes	100 m	Total
Global Watch Forest	Tree Cover Density Percentage of tree cover	30 m	Total

Dataset	Cyprus	Lebanon	Spain	Tunisia
FRA (2015) (*1000 ha)	173	137	18.418	1041
CLC (2018)	+9.8%	-	-27.4%	-
Copernicus GLC (2015)	+56.6%	+78.1%	+29.4%	-9.7%
Forest Global Watch (2010)	-16.2%	-44.5%	-31.1%	-78.7%

Sources: Copernicus Global Land Cover Map 2019 (<https://land.copernicus.eu/global/products/lc>); CORINE Land Cover Map 2018 (<https://land.copernicus.eu/pan-european/corine-land-cover/clc2018>); Copernicus High-Resolution Layer 2018 (<https://land.copernicus.eu/pan-european/high-resolution-layers/forests>); and Global Watch Forest map 2010, from: Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, and J. R. G. Townshend, 2013. High-Resolution Global Maps of 21st-Century Forest Cover Change. *Science*, 342 (6160): 850–53. <https://glad.umd.edu/dataset/global-2010-tree-cover-30-m..> FRA: FAO. 2020. *Global Forest Resources Assessment 2020: main report*. Rome. <https://doi.org/10.4060/ca9825en>. Forest area disparity between maps and FRA are reported in percent (difference between map and FRA, divided by total area reported in FRA).

The disparities in field inventories and forest mapping practices at different times and in different places make it impossible to compare data across years and regions and, therefore, cannot provide a good enough description of the status of forests on a yearly basis. Moreover, the low frequency of forest inventories and maps and poor definition of forest classes fail to adequately support forest management and policies. This is a cause for concern, particularly in the face of climate change, which requires quick decision-making and action.

Against this background, the development of alternative methodologies and strategies is necessary to produce more frequent and homogeneous information on the extent and status of forests in Mediterranean countries.

New technologies and open data for forest cartography

We face a historical moment where we have the tools to move forward with the automatic generation of maps with excellent accuracy and quality. The use of new technologies and big and open data can better support the restoration and sustainable management of forests while creating job opportunities for young generations.

Many countries in the Mediterranean region have begun a transition from traditional mapping and forest inventories to semi-automatic forest mapping (FAO, 2010). We are experiencing a change in paradigm about how automatic maps can support the planning of forest inventories and fill the temporal gaps between forest inventory campaigns. Notably, one of the strategic objectives recommended by the EEA

and its European Information and Observation Network (Eionet) in the EEA-Eionet Strategy 2021–2030, is the “full use of data, technology and digitalization” (EEA, 2021).

In the last few decades, several space agencies have dedicated satellite missions to Earth observation and monitoring. During this time, the data collected by these satellites have been analysed for forest and other environmental applications and have been cross-checked with environmental managers and stakeholders to improve the coming generations of satellites. The current satellite missions have the technology required to characterize key ecological variables to support forest conservation and restoration. Some of those features are the scale (pixel resolution varies from 1 kilometre (km) to 5 metres (m), depending on applications), the spectral configuration (visible and infrared bands to describe plant productivity and biomass), temporal resolution (every 1–5 days) and digital elevation models.

Two space agencies manage the leading programmes for Earth observation worldwide: the U.S. National Administration Space Agency (NASA, www.nasa.gov) and the European Space Agency (ESA, www.esa.int). Within their programmes, the Copernicus mission (ESA, www.copernicus.eu) and the Landsat mission (NASA, www.usgs.gov/landsat-missions) are dedicated to environmental monitoring and, particularly, forest monitoring. Sentinels-1 and -2 focus on vegetation structure and imaging, respectively (<https://sentinel.esa.int/web/sentinel/missions>). Both NASA and ESA have an open-committee policy, which has revolutionized environmental conservation rules.

The current challenge is to manage the download, processing and analysis of large amounts of data into operative products for users, such as forest managers and policymakers, using big data technologies and artificial intelligence. In parallel with data production development (to produce satellite images), data analysis technology is evolving continuously to retrieve as much information as possible from the satellite data. Artificial intelligence can categorize and identify similar patterns and classes in a relatively small sample dataset throughout an area. This makes it possible to extrapolate data (e.g. forest inventories) from some regions to other regions with little information or infer data from a particular point in time to previous or later years.

A Mediterranean-wide database and map of forest types

As part of the Enbic2Lab¹ project (www.etc.uma.es/enbic2-lab/), funded by a LifeWatch ERIC programme (www.lifewatch.eu), the European Topic Centre on Spatial Analysis and Synthesis (ETC-UMA, www.etc.uma.es), the Department of Supercomputation and Bioinformatics at the University of Malaga (Khaos, <https://khaos.uma.es/>), the Medforval network (www.medforval.org), EEA and FAO's *Silva Mediterranea* (www.fao.org/forestry/silva-mediterranea) are developing a map of Mediterranean forest types to overcome the limitations mentioned above about forest inventories and existing maps. The aim is to obtain a homogeneous and equally accurate map for all the countries within the region, spatially and temporally, to allow a comparative evaluation of forests. This is made possible by using the same type of data (satellite data) for the entire region and a common methodology (machine learning) to analyse the data.

The study covers the forests of the whole Mediterranean ecoregion as identified by the World Wide Fund for Nature (WWF, 2020) using the globally recognized and harmonized definition of forests by FAO (2018), and which grow in the Mediterranean Basin as defined in Figure 1.

¹ The development of the forest types map is part of the activities included in the e-infrastructure LifeWach ERIC Project "EnBiC2-Lab", co-funded by the ERDF (Spain's Pluri-regional Operative Programme 2014–2020) through the Spanish Ministry for Research and Innovation.



Figure 1. Current extent of the major forest types in the Mediterranean region

Source: WWF (World Wide Fund for Nature). 2020. *The Mediterranean forests – A new conservation strategy*. https://wwf-eu.awsassets.panda.org/downloads/brochure_english.pdf

The map of Mediterranean forest types to be generated in this project will be useful to forest managers and other stakeholders because it provides a better scale (10 m resolution) and a detailed forest classification. The classification deals with on-site management needs, allowing the identification of forest systems, forest types and habitats, and linking them with associated understory species and ecosystem services. The map legend will distinguish forest types based on dominant species. The map will thus identify oak, pine, chestnut, beech, spruce, fir, juniper and cypress forests, as well as riparian forests and other emblematic forest types in the Mediterranean, such as cedar, hornbeam, argan and thuja forests.

Furthermore, the ultimate purpose is to create a methodology and infrastructure to allow the generation of annual maps to monitor changes in Mediterranean forests over time.

The process of cocreation of a Mediterranean forest map

For the development of the forest database, ETC-UMA enlisted the support and collaboration of more than 20 researchers and institutions who shared their data on forests to feed the artificial intelligence models (Figure 2). Data were harmonized and updated to 2021 using Google Earth imagery (www.google.com/intl/es/earth/). The harmonized database is a by-product of the project, which will be of value for further projects and research. The collaborators also participated in the definition of the list of forest types in the Mediterranean and will work together to validate the map soon.

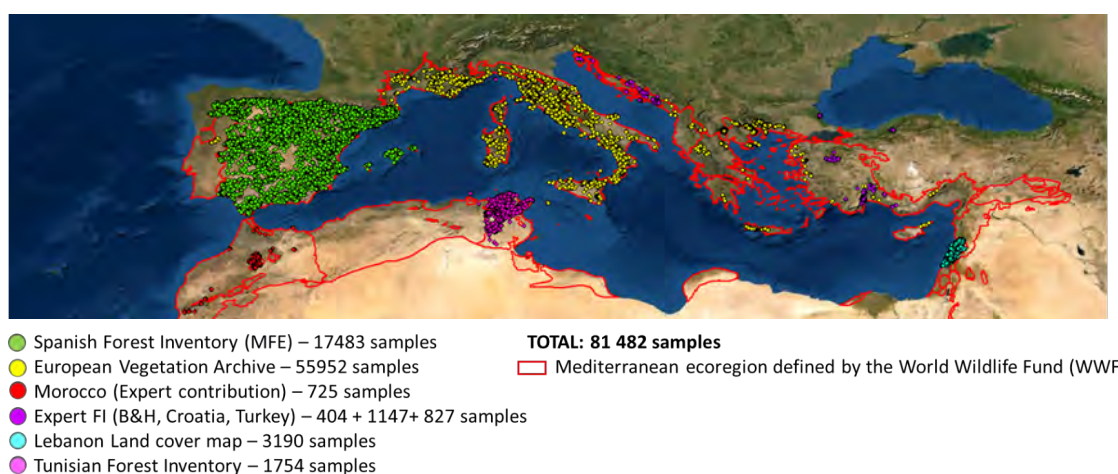


Figure 2. Forest databases used in the classification of Mediterranean forest types

As a first step, a land-cover map for the Mediterranean region was created using data exclusively from the Spanish national land-cover cartography with the purpose of evaluating the reliability of artificial

intelligence in classifying different areas within the Mediterranean Basin using data from a restricted area. Spain was selected because the data are open access.

In a second stage, the layers of “forest” and “open forest” were extracted and used in a second classification to distinguish forest types based on dominant species. The map accuracy could only be measured for Spain, as samples for the rest of the region were required (Figure 3). However, a preliminary visual inspection of the map in 20 locations in the basin revealed good results (Figure 4). The map results for Spain provided a total land-cover accuracy of 96.5 percent, an accuracy of 99.9 percent for dense forests, and 97.4 percent for open forests (Figure 3). The next phases of the project involve the validation of the land-cover map and the mapping of forest types for the entire region, assisted by experts from all Mediterranean countries.

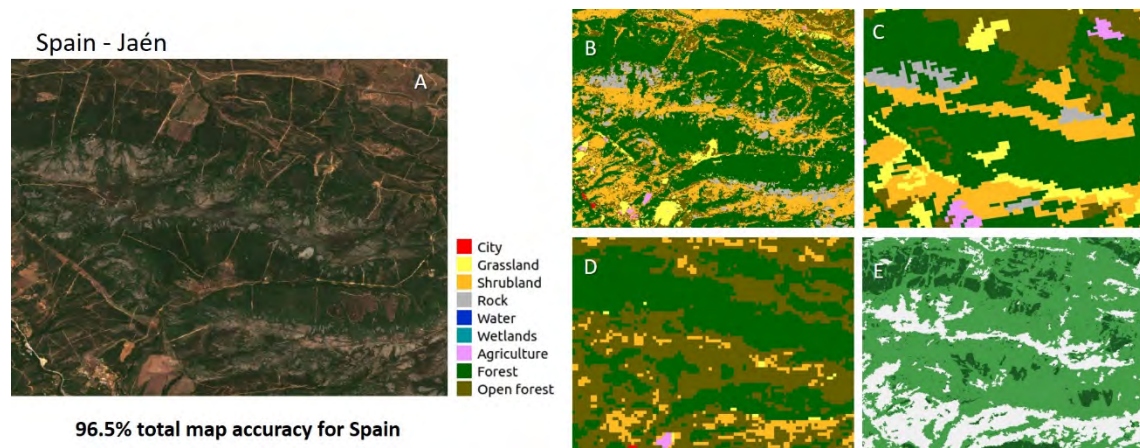


Figure 3. Example of land-cover map created by ETC-UMA and Khaos (B) in Spain and comparison with existing reference cartography (C: CORINE Land Cover; D: Copernicus Global Land Cover [GLC]; E: Copernicus High Resolution Layer [HRL]). For reference, a natural image composition for Sentinel-2 in 2021 is also shown (A).

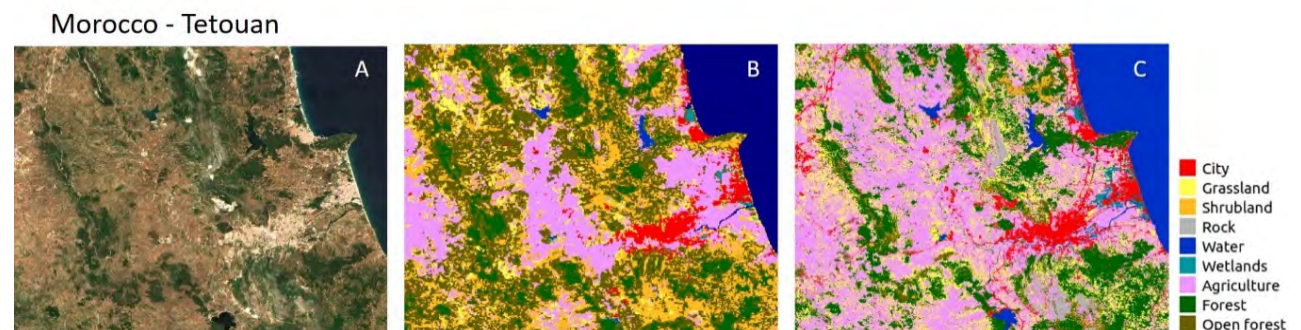


Figure 4. Example of land-cover map created by ETC-UMA and Khaos (C) in Morocco and comparison with existing reference cartography (B: Copernicus Global Land Cover [GLC])

Note: For reference, a natural image composition for Sentinel-2 in 2021 is also shown (A).

Synergies among Mediterranean initiatives and international policies

Human activities can alter ecosystem functioning by increasing forest fragmentation, boosting negative edge effects and reducing overall connectivity (Marcantonio *et al.*, 2013; De Montis *et al.*, 2017), which eventually leads to degradation, loss of habitat and species extinction (IPBES, 2021). On the other hand, land retirement can affect the mosaic figuration of Mediterranean landscapes, which is associated with high ecosystem service provision and biodiversity conservation (Otero *et al.*, 2015). Urgent action should be taken to address biodiversity threats and challenges, including from climate change. Synergies among existing policies and measures for biodiversity conservation need to be developed, as well as management and implementation tools, while ensuring necessary alignment with the identified biodiversity related priorities where possible.

The protection of forests from climate change and other human impacts in the Mediterranean region requires collaboration among all countries in the basin. Several multistakeholder and transnational initiatives, such as the *Silva Mediterranea* committee hosted by FAO, Forest Europe, the EEA and its Eionet network, and the Medforval network, monitor and report on forests globally, across Europe and within the EEA regions to assess the state and trends shown by forest resources, as well as their sustainable management and biodiversity. The leading international environmental conventions, strategies and policies explicitly address forest protection including the Sustainable Development Goals (SDGs), the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC), the EU Green Deal and Ecological Transition, and FAO's *State of Mediterranean Forests 2018* report (FAO and Plan Bleu, 2018). In addition, the Mediterranean Forest Weeks provide a stage for discussion and collaboration.

In line with the Euro-Mediterranean policy context (EU Agenda for the Mediterranean, February 2021 and the Union for the Mediterranean 2030 GreenerMED Agenda), the new EEA-Eionet Strategy 2021–2030 and the new EEA-UNEP/MAP Barcelona Convention strategic partnership 2022–2030, the Mediterranean is a strategic imperative for the European Union and the EEA, with the need to ensure that strong Mediterranean regional partnerships on forests can rely on the Eionet. The Eionet is a unique network connecting institutions across Europe and delivering benchmarking, capacity building, streamlining and exchange of best practices. The partnership network consists of the EEA itself, eight European topic centres (ETCs), a network of around 1 500 experts from 38 countries in circa 500 national environment agencies and other bodies dealing with environmental information. A new Eionet structure is in place since January 2022, structured around 13 Eionet groups, operating in an integrated and cross-cutting way across environmental domains. Together with the EU national focal points (NFPs), the Eionet groups are the backbone of the network, ensuring knowledge creation and sharing. In the area of forests, a dedicated Eionet thematic group bringing together forest experts, represents together with the EEA, a leading network for policy-relevant environmental and climate knowledge at the EU, regional and state levels.

In addition, transboundary initiatives, such as the Medforval network, support the protection of forests and their ecosystem services in the Mediterranean region. Medforval is a network of High Ecological Value (HEV) forest sites which currently includes 19 sites in 12 countries, covering 13 Mediterranean ecoregions in the three elevation life zones. Medforval promotes transboundary collaboration and positive exchanges through joint projects on knowledge improvement, awareness-raising and restoration activities. Three attributes define the concept of HEV forests, namely biological diversity (in terms of rarity and richness, from genetics to ecosystems), ecosystem functioning (forest size and forest ecological process) and old growth (forest age and maturity). The developing forest database can support the conservation of the HEVs featured by Medforval member sites. As for biological diversity, the database could provide evidence of potential reduction of the dominant tree species, a serious issue in cases of endemism, such as with the Spanish and Moroccan firs, *Abies pinsapo* and *A. moroccana*, and the Atlas and Lebanon cedars, *Cedrus atlantica* and *C. libani*, living in some Medforval sites. It can also highlight changes in forest type richness, an important feature in the context of climate change, since the presence of different tree species and functional types can promote forest adaptation (Thompson *et al.*, 2009).

Yet, forest protection and management must be designed collaboratively according to local needs identified by forest managers and users. Institutions like the Shouf Biosphere Reserve in Lebanon have worked for years in the design and development of management plans and actions to preserve, restore and increase the value of the forests of Lebanon, engaging a wide range of stakeholders and taking into account all factors involved (cultural, economic and environmental). To them and many other locally based organizations, a map of Mediterranean forest types can be a valuable tool to design their general master and detailed urban plans and prioritize and optimize their actions.

Conclusion and way forward

The Seventh Mediterranean Forest Week held in Antalya in March 2022 offered an opportunity for collaboration and discussion among the speakers and the audience. The meeting organized by ETC-UMA and the EEA to present this new knowledge during the Seventh Mediterranean Forest Week, entitled “The Use of New Technologies and Open Data to Better Support Restoration and Sustainable Management of Forests”, fostered collaboration among several session participants within the project of the Mediterranean forest type map and future projects.

The session organizers identified three main areas of collaboration, for which participation was called for during the session presentation: contribution to data, discussions about the list of Mediterranean forest types and participation in the validation of the maps. This motivated some new institutions to participate in the process, such as the Moroccan Ministry for Forest and Water, the French Provence-Côte-d'Azur region and the General Bureau of Forests in Algeria. Furthermore, new collaborations with researchers from Tunisia (The National Research Institute of Rural Engineering, Water and Forests – INRGREF), Türkiye (Forestry Faculty of Karabük University) and Lebanon (Shouf Biosphere Reserve and Lebanese University Faculty of Sciences, Fanar) were established. In addition, these collaborators will participate in the validation of the land-cover and forest maps as local experts.

Moreover, several discussions with distinguished experts in the field helped to guide future applications for the Mediterranean forest types map. Several recommendations were collected from different types of stakeholders and potential users of the Mediterranean forest map, including:

- ◆ Use of the Mediterranean forest type map for sustainable management, conservation and restoration to:
 - create a map of forest fragmentation;
 - locate priority areas for conservation and restoration;
 - identify the potential distribution of forest tree species in several climate change scenarios, considering the current location of species, paths of dispersion and vulnerable areas; and
 - evaluate the effectiveness of measures implemented (e.g. protected area designation or restoration plan).
- ◆ Potential future projects:
 - establish the annual production of forest type maps and rebuild maps from previous years, starting in 2017, which is when the Sentinel-2 imagery database was created and the Agadir commitment on forest restoration was signed;
 - use the machine for the mapping of other ecosystems (wetlands and shrubs);
 - engage transboundary initiatives (such as Medforval) for future collaboration; and
 - focus on a bottom-up approach for designing maps, by engaging local initiatives such as Shouf Biosphere Reserve.

During a meeting with *Silva Mediterranea*, the possibility of publishing the Mediterranean forest type map in the forthcoming *State of the Mediterranean Forests 2023* report was considered, with the presentation of some statistics extracted from the map on forest areas per country as an additional source of data to report in the assessment of forest resources.

For further information about the EnBic2Lab project and the Mediterranean forest type map, please visit: www.etc.uma.es/enbic2-lab/.

References

- AFWC/EFC/NEFC Committee on Mediterranean Forestry Questions – *Silva Mediterranea. The Agadir Commitment towards a Mediterranean Regional Initiative on Forest and Landscape Restoration*. Agadir, Morocco, March 2017. www.fao.org/forestry/45656-0ed7af343bc2e08d467c000593c2cd9ae.pdf
- Bonan, B. 2008. Forests and Climate Change: Forcings, Feedbacks, and the Climate Benefits of Forests. *Nature* 320:1444-1449. <https://doi.org/10.1126/science.1155121>
- Blondel, J. 2006. The 'design' of Mediterranean landscapes: a millennial story of humans and ecological systems during the historic period. *Human ecology*, 34(5), 713–729.
- Buchhorn, M.; Smets, B.; Bertels, L.; De Roo, B.; Lesiv, M.; Tsendbazar, N. - E.; Herold, M.; Fritz, S. 2020. Copernicus Global Land Service: Land Cover 100m: collection 3: epoch 2019: Globe 2020. <https://doi.org/10.5281/zenodo.3939050>
- CORINE land cover product user manual. 2021. Copernicus Land Monitoring Service (CLMS). European Environment Agency (EEA). <https://land.copernicus.eu/user-corner/technical-library/clc-product-user-manual>
- Corona, P. 2010. Integration of forest mapping and inventory to support forest management. *iForest- Biogeosciences and Forestry*, 3(3), p.59. DOI: 10.3832/ifer0531-003
- Cramer, W.; J. Guiot; M. Fader; J. Garrabou; J.-P. Gattuso; A. Iglesias; M. A. Lange; P. Lionello; M. C. Llasat; S. Paz; J. Peñuelas; M. Snoussi; A. Toreti; M. N. Tsimplis and E. Xoplaki. 2018. *Climate change and interconnected risks to sustainable development in the Mediterranean*. *Nature Climate Change*, 8 (11), 972-980, 2018. <https://doi.org/10.1038/s41558-018-0299-2>
- Cramer, W.; J. Guiot and K. Marini. 2019. *Risks associated to climate and environmental changes in the Mediterranean region – A preliminary assessment by the MedECC Network Science-policy interface*. MedECC, Marseille, France, 36 pp., 2019.
- De Montis, A., Martín, B., Ortega, E., Ledda, A., & Serra, V. 2017. Landscape fragmentation in Mediterranean Europe: A comparative approach. *Land Use Policy*, 64, 83–94. <https://doi.org/10.1016/j.landusepol.2017.02.028>
- European Environment Agency. 2021. *Delivering data and knowledge to achieve Europe's environment and climate ambitions*. EEA-Eionet Strategy 2021-2030. ISBN 978-92-9480-360-3. <https://doi.org/10.2800/92395>
- European Topic Centre on Urban, Land and Soil Systems. 2021. *Forest cooperation with regional conventions: Support Mediterranean forest extent factsheet in FISE: Forest map for the Mediterranean Basin*. Technical Report. https://forum.eionet.europa.eu/etc-urban-land-and-soil-systems/library/c3_ap-2021/1.2.4.1-forest-cooperation-regional-conventions/m3.-final-mediterranean-forest-extent-resport/final-mediterranean-forest-extent-report
- European Union External Action. 2021. *Renewed partnership with the Southern Neighbourhood: a new agenda for the Mediterranean*. In: *European Union External Action*. Cited 28 March 2023. www.eeas.europa.eu/eeas/renewed-partnership-southern-neighbourhood-new-agenda-mediterranean_en
- UfM (Union for the Mediterranean). 2022. UfM Environment Agenda. In: *Union for the Mediterranean - UfM*. Cited 28 March 2023. <https://ufmsecretariat.org/ufm-environment-agenda/> FAO (Food and Agriculture Organization of the United Nations). 2020. *Global Forest Resources Assessment 2020: main report*. Rome. <https://doi.org/10.4060/ca9825en>
- FAO. 2010. *Global forest resources assessment 2010: main report*. FAO Forestry Report 163. ISSN 0258-6150, 340 pp.

- FAO & Plan Bleu. 2018. *State of Mediterranean Forests 2018*. Marseille, France.
- FAO. 2018. Terms and definitions (FRA 2020)
- FAO and United Nations Environment Programme (UNEP). 2020. *The State of the World's Forests 2020. Forests, biodiversity, and people*. Rome. <https://doi.org/10.4060/ca8642en>
- Forest Europe. 2020. *Adaptation to Climate Change in Sustainable Forest Management in Europe*. Liaison Unit Bratislava, Zvolen, 2020.
- IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services). 2021. *Report of the IPBES task force on scenarios and models on its workshop on modelling Nature Futures scenarios under the 2030*. IPBES rolling work programme. <https://ipbes.net/resource-file/102751>
- Lefèvre, F. & Fady, B. 2016. Introduction to Mediterranean forest systems: Mediterranean basin. *Insects and Diseases of Mediterranean Forest Systems*, 7–28. Springer, Cham. https://doi.org/10.1007/978-3-319-24744-1_2
- Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C., Berger, S., Caud, N. et al., eds. 2021. *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, USA, Cambridge University Press. <https://doi.org/10.1017/9781009157896>
- Mittermeier, R., Gil, P., Hoffman, M., Pilgrim, J., Brooks, T., Mittermeier, C., Lamoreux, J. and Fonseca, G. 2004. *Hotspots Revisited: Earth's Biologically Richest and Most Endangered Ecoregions, Hotspots Revisited: Earth's Biologically Richest and Most Endangered Ecoregions*. Cemex. Sierra Madre.
- Marcantonio, M., Rocchini, D., Geri, F., Bacaro, G., & Amici, V. 2013. Biodiversity, roads, & landscape fragmentation: Two Mediterranean cases. *Applied Geography*, 42, 63–72. <https://doi.org/10.1016/j.apgeog.2013.05.001>
- Noce, S., Santini-CMCC, M. & Noce-CMCC, S. 2018. *Mediterranean Forest Ecosystem Services and their Vulnerability*. Foundation Euro-Mediterranean Center on Climate Change (CMCC), vol. 10.
- Otero, I., Marull, J., Tello, E., Diana, G., Pons, M., Coll, F., & Boada, M. 2015. Land abandonment, landscape, and biodiversity: Questioning the restorative character of the forest transition in the Mediterranean. *Ecology and Society*, 20(2). <https://doi.org/10.5751/ES-07378-200207>
- Science for Environment Policy. 2021. *European Forests for biodiversity, climate change mitigation and adaptation*. Future Brief 25. Brief produced for the European Commission DG Environment by the Science Communication Unit, UWE Bristol.
- Stehman, S.V. 2009. Model-assisted estimation as a unifying framework for estimating the area of land cover and land-cover change from remote sensing. *Remote Sensing of Environment*, 113(11), 2455–2462. <https://doi.org/10.1016/j.rse.2009.07.006>
- Thompson, I., Mackey, B., McNulty, S., Mosseler, A. 2009. *Forest Resilience, Biodiversity, and Climate Change. A synthesis of the biodiversity/resilience/stability relationship in forest ecosystems*. Secretariat of the Convention on Biological Diversity, Montreal, Canada. Technical Series no. 43, 67 pp.
- UNEP/Mediterranean Action Plan (MAP) 2012. *State of the Mediterranean Marine and Coastal Environment*. UNEP/MAP – Barcelona Convention, Athens, 2012. https://wedocs.unep.org/bitstream/handle/20.500.11822/375/unepmap_soehighlights_2012_eng.pdf?sequence=3&isAllowed=y

THEMATIC SESSION 3

**Non-wood forest products for people,
nature and the green economy:
recommendations for policy priorities
in the Mediterranean**

Non-wood forest products for people, nature and the green economy: recommendations for policy priorities in the Mediterranean

Eduard Mauri¹ | Giulia Muir²

¹Junior Researcher,
Mediterranean Facility, European
Forest Institute, c. Sant Antoni
Maria Claret 167, 08025
Barcelona, Spain

²Forestry Consultant, Forestry
Policy and Resources Division,
Food and Agriculture Organization
of the United Nations, Viale delle
Terme di Caracalla, 00153 Rome,
Italy

Abstract:

Businesses based on non-wood forest products (NWFPs) need appropriate policies to thrive. These policies must secure the conservation and sustainable supply of NWFPs; build competitive, equitable and sustainable value chains; improve transparency, data and information flow on NWFPs; and establish suitable conditions in political, financial and innovative terms. Four successful studies were presented illustrating these policies, as follows: (i) the linkage of forest management in Slovenia with beekeepers' needs; (ii) the expected increase of cork production through cork oak plantations in Spain and Portugal; (iii) the sophisticated data-gathering system that the Turkish General Directorate of Forestry developed to collect and report data on NWFP resources, in addition to data on their prices and sales; and (iv) the impact of Italy's fiscal reform for mushroom and truffle pickers, which gave them a legal and professional status, provided traceability in the food system and increased the revenue for the state. In the debate, panellists agreed that public administration should minimize bureaucracy for the certification process, protect price stability, strengthen the sector by promoting the organization of producers, and foster integrated forest management.

Introduction

The forest-based sector can play an important role in progressing towards an innovative, resource efficient and biobased economy, particularly in view of the range of forest products derived from forests beyond timber. Non-wood forest products (NWFPs), including fruits, mushrooms, cork, pine kernels, chestnuts, aromatic and medicinal plants, defined as “products of biological origin other than wood derived from forests, other wooded land and trees outside forests” (FAO, 1999), can add significant economic value in the bioeconomy, especially in regions such as the Mediterranean Basin where wood is not the most profitable product (Wolfslehner *et al.*, 2019).

Non-wood forest products play an important role in forestry marketing and rural development, contributing to the achievement of the United Nations Sustainable Development Goals (SDGs), particularly to the social, cultural, environmental and economic dimensions (Martinez de Arano *et al.*, 2021). However, the full potential of NWFPs has yet to be realized. This is especially important to increase the socioeconomic opportunities and competitiveness of rural economies. Moreover, there are no policies or legislation specifically targeting NWFPs at the EU level. Most forests are not managed for NWFPs, and the market is underdeveloped (Wolfslehner *et al.*, 2019). Therefore, there is an urgent need for action and policy options based on the specific regional, national or subnational circumstances for the following reasons: (i) to secure the conservation and sustainable supply of NWFPs; (ii) to build competitive, equitable and sustainable value chains; (iii) to improve transparency, data and information flow on NWFPs; and (iv) to establish enabling conditions in political, financial and innovative terms (Martinez de Arano *et al.*, 2021). The session Non-Wood Forest Products for People, Nature and the Green Economy: Recommendations for Policy Priorities in the Mediterranean presented during the Seventh Mediterranean Forest Week focused on these four groups of policy options, illustrated with success stories, and aimed to foster debate between experts and participants.

Structure of the session

The session was divided into three blocks. The first block introduced the linkage between entrepreneurship in NWFPs and appropriate policies that allow these businesses to thrive with a special emphasis on the Turkish context. It included a short presentation of the report entitled *Non-wood forest products for people, nature and the green economy: recommendations for policy priorities in Europe* (Martinez de Arano *et al.*, 2021). The second block presented five success stories on how appropriate policies can: (i) maintain the sustainability of NWFP value chains; (ii) secure competitive and equitable value chains; (iii) allow market transparency, data and information flow; and (iv) enable conditions for NWFP businesses to flourish. It concluded with an example of women empowerment by harvesting NWFPs in Tunisia. Finally, the last block was a joint debate of the first two sessions called Improving the Value-Chain of Mediterranean Wild Food Products: Special Insight into How Certification, Branding and Labelling can upgrade the economic value of edible NWFPs, with panellists from both.

Linkage between entrepreneurship in non-wood forest products and appropriate policies

The first block focused on the linkage between entrepreneurship in the NWFP sector and appropriate policies that allow NWFP-based businesses to thrive. Sara Maltoni, from FoReSTAS (the main public agency involved in forest and natural resource management in Sardinia, Italy), opened the floor briefly by introducing the EU-funded project Innovation Networks of Cork, Resins and Edibles in the Mediterranean Basin known as INCREDIBLE (Innovation Networks of Cork, Resins and Edibles in the Mediterranean Basin Consortium, 2021), the document *Non-wood forest products for people, nature and the green economy: recommendations for policy priorities in Europe* (Martinez de Arano *et al.*, 2021), and the Policy Forum: Untapping the Potential of Non-wood Forest Products for Europe's Green Economy held in 2021, in which stakeholders expressed the need to support NWFP producers that contribute to the green economy and build forest resilience to climate change, among other recommendations. **Maltoni stressed that NWFPs play a vital role for food security, economies and biodiversity, yet their value is largely underestimated and not reported in official statistics, hence the poor reflection in policies. The goal of the white paper**

presented was to better link the needs of NWFP producers and harvesters to useful policy actions. Several video testimonials of NWFP producers were presented. Alvaro Picardo, from the General Directorate of Natural Heritage and Forest Policy of the regional government of Castilla y León, Spain, continued the presentation, stressing that many NWFPs provide a livelihood for many people. **Picardo said that nature-based solutions were a new concept but that in the NWFP sector, they were in fact ancient traditions.** Picardo used examples from Italian and Portuguese experiences to underline some key messages in the *white paper* as real solutions to real problems, such as a fair price-setting system for resin. **The final message was that there are not only opportunities, but also key challenges, and a need to work together.**

Ismail Belen, from the Turkish Ministry of Agriculture and Forestry, presented the National Turkish Programme on NWFPs. He opened his presentation by highlighting key figures: there are 23 million hectares (ha) of forest in Türkiye, all of which belong to the state, and 7 million people in Türkiye living in forest villages. He noted several policy and legislative tools as well as institutional structures in Türkiye that support NWFPs, including a **sophisticated inventory system under the forest management regulation.** Non-wood forest products fall mainly under the organic agriculture law. The Turkish national development plans and the Ministry of Trade also support NWFPs. Türkiye has a forest management regulation that provides for inventories on NWFPs and other communities on honey or beekeeping and mushroom and truffle harvesting, all of which serve as a basis for legislation. Türkiye also has on-site utilization plans for specific products and guidelines for the private sector. Together, NWFPs contribute USD 880 million to the economy, more than timber. Twenty-five thousand people are employed directly in NWFP harvesting, and some 500 000 benefit financially from this. One of the main issues in Türkiye is also shared in many Mediterranean countries: prices on the field and in the markets are very different. Moreover, considerable amounts of NWFPs are exported unprocessed, and the communities do not capture the added value from this step. For example, more than 25 percent of chestnut production is exported, mainly to Italy. Belen's key messages were that NWFPs are the "face of forests", the life of forests, and that forests without flowers, water, animals, colours, insects and fragrances would only be mechanical deserts.

Sara Maltoni took the floor again to share the process in developing the *white paper* with key partners such as the Food and Agriculture Organization of the United Nations (FAO), the International Union of Forest Research Organizations (IUFRO) non-timber forest products taskforce and European universities, with key recommendations to leverage the potential of NWFPs. **Maltoni described the main policy actions in the white paper, grouped under four blocks:**

- supply – secure the conservation and sustainable supply of NWFPs;
- value – build competitive and equitable value chains;
- inform – provide transparency, data and information flow on NWFPs; and
- enable – create enabling conditions.

Maltoni described **supply issues** and the need for active forest management, which must be multifunctional and diverse, specifically for NWFPs, and not just timber-centric management. For example, through proper management, mushroom picking and pine resin tapping can generate more income than timber harvesting. It is important to think with an agroforestry mindset, domesticating species where possible to alleviate pressure on wild populations. She also stressed the need for adequate monitoring and inventory, household surveys, trade data and more. Concerning **equitable value chains**, it is important to grant the co-management of often untapped resources and territorial marketing strategies. Maltoni stated that governments have an important role to play, allowing the emergence of markets for different types of pickers, and appropriate policies and legislation. **Picardo described the need to provide transparency, data and information. Decision-makers are missing the very basic data on NWFPs.** There is a need for better accounting on NWFPs and more homogeneity across countries. We need to ensure **traceability and innovative marketing**, he stressed. What is also necessary is the **enabling of conditions such as policy coherence, improved financial support and fostering of innovation.** All of these actions are embedded in the *Manifesto of Alghero* and were adopted at the Policy Forum (Alvaro Picardo Nieto, 2021). There has already been a follow-up in the *EU Forest Strategy 2030* (European Commission, 2021), where the

importance of NWFPs is recognized. The strategy encourages the national and local authorities and other stakeholders to further promote and support NWFPs, and to “to seize benefits from non-wood forest products to rural communities in forested landscapes and supporting producers’ organizations, the Commission will promote the elaboration of coordinated and integrated regional, national and subnational programmes on the sustainable production of non-wood forest products.”

Success stories on appropriate policies

The **second block** presented five success stories on how appropriate policies could maintain the sustainability of NWFP value chains, secure competitive and equitable value chains, thus allowing market transparency, data and information flow, thereby enabling the conditions required for NWFP businesses to flourish and empowering rural women. The case studies drew on experiences and examples across Europe. They included the following:

- ◆ **Associations of honey producers in Slovenia, by Andreja Kandolf (food safety advisor, Slovenian Beekeepers’ Association), for which Kandolf underlined the necessity of linking forest management with beekeepers due to their essential pollination services and the value of honey and honey products, which exceeds that of timber in the country. Kandolf also noted important links to conservation (e.g. bee forage), the innovative nectar flow and bee forage monitoring stations in the country.**
 - Beekeeping is very well established in Slovenia, with more than 11 200 beekeepers and around 2 000 tonnes of honey produced annually, typically from forests (as forests cover 60 percent of the country).
 - The beekeeping industry is a part of the agricultural food chain, and bees, as important pollinators, provide the priceless value of pollination.
 - Crop yields on average increase 30–50 percent when hives are located nearby.
 - Honey, honeydew (particularly in forests) or nectar are the main products.
 - Bees find forage opportunities in forests without pesticides.
 - **Monitoring services track nectar flow** so that beekeepers know where to transport their bees to increase productivity. This data is collected daily.
 - The yield of honey can exceed the value of wood, yet it is still not entirely tapped.
 - In the Slovenian Forest Act, forest owners must allow access for the recreational gathering of NWFPs, including bee forage.
 - The Slovenian Forest Service keeps a cadastre of bee forage spots to support beekeepers.
 - Most of the Slovenian honey comes from forests, especially honeydew honey, but also pollen and propolis products.
 - To sustain the beekeepers–forest relationship, forest managers can plant indigenous honey plants in forests and cofinance the arrangement of stands for beehives in forests (especially at higher altitudes).
- ◆ **Cork oak plantations in Portugal and Spain, by Ramón Santiago Beltrán (expert in cork production), have led to the increase of cork oak distribution and will substantially increase cork production with the support of conducive policies. Beltrán underlined successful reforestation efforts, including through innovative methods and technologies.**
 - Cork oaks (*Quercus suber* L.) are distributed in the western side of the Mediterranean region (mainly in Portugal and Spain, but also in Morocco, Algeria and Italy), and some are more adapted to forest fires.
 - Due to the increasing demand on cork motivated by innovative uses of this material, the cork oak area increased in 2000–2020 through reforestation programmes in Portugal and Spain, and conducive policies, especially agricultural policies in Spain, Portugal, Algeria and Morocco.

- Globally, current annual cork production is around 175 000 tonnes, of which one-half come from Portugal and one-third from Spain.
 - Current practices of shelterwood or replanting involve traditional methods, but the main driver of the increase in cork oak area is afforestation on agricultural land.
 - Innovative planting methods include fertirrigation, which, compared to traditional planting, allows for replanting despite climatic conditions and bringing forward cork harvesting; fertirrigated stands allow for the first cork harvesting after 8 years instead of 37, the second harvesting after 15 years instead of 46, and the third harvesting after 24 years instead of 55.
 - New portable cork harvesting machinery can cut cork oak bark while protecting the tree and the harvester, thus supporting the extraction of different cork layers and increasing the efficiency and yield.
- ◆ **Transparency, data and information on NWFPs in Türkiye, by Ozgur Balci (Head of Non-Wood Forest Products Department at the General Directorate of Forestry, Türkiye), for which Balci brought participants through the sophisticated data-gathering system that the Turkish General Directorate of Forestry has developed to collect and report data on NWFP resources, in addition to data on prices and sales of NWFPs.**
- There are three steps for gathering NWFP data:
 1. Taking inventory and planning (310 species on 1.9 million hectares (ha) of land).
 2. Data entries in Orbis, the forestry information system, along with data collected from the site and uploaded to the system.
 3. The NWFP citizen portal, where users can see what species there are, if or where they can be collected, and training videos to encourage sustainable use, for example.
 - The NWFP Sales Procedures System informs on public sales and prices of NWFPs.
 - All the data obtained will be harmonized into action plans for NWFPs and feasibility reports.
- ◆ **The importance of adapting legal regulations and taxation for mushroom and truffle harvesters, by Davide Pettenella (professor at the University of Padova, Italy), for which Pettenella introduced the topic of NWFP fiscal regimes and the impact of Italy's fiscal reform for mushroom and truffle pickers in the country. This gave a legal and professional status to pickers and increased traceability in the food system and revenue for the state.**
- Previously, the rate of value added tax (VAT) was 22 percent for NWFP pickers. This had a cascade of negative impacts including a black economy, no registration of collectors or sellers, no traceability of products and variable tax revenues for the state.
 - Italy needed to have a traceability system if wild food products were to be placed on the market, which led to a huge increase of imports in NWFPs. Italian producers were not able to sell their products regularly.
 - In 2019, the Budget Law reformed the fiscal regime for mushroom and truffle harvesters to include an annual flat income tax of EUR 100 for collectors that receive less than EUR 7 000 per year from selling mushrooms and truffles collected in the wild. In addition, when a middleman buys NWFPs, a receipt with the name of the collector and their code, the fiscal code, and the quantity and quality of the products is produced (there is no VAT to be paid in this phase).
 - The impacts of the reform include that fact that regular collectors gained a legal and professional status, their mushrooms and truffles could be traced in the food value chain and accounted for, and the state increased its revenues. The state tax agency was supporting the reform; the revenues from the annual flat fee were higher than the previous revenues from the VAT payments.

- In 2015, truffle pickers declared EUR 1 535, but companies reported EUR 38 million of raw material costs for purchasing wild truffles. In 2019 (after the reform), nearly 4 500 truffle pickers reported transactions worth EUR 25 million.
- ◆ **Empowering women through harvesting of NWFPs in Tunisia, by Ibtissem Taghouti (researcher, Polytechnic University of Catalunya, Spain), in which Taghouti described the different approaches adopted to empower women NWFP collectors, from training and capacity-building programmes to the decentralized, co-management of resources.**
 - Aleppo pine seeds, stone pine, rosemary, myrtle and mastic are the main NWFPs in Tunisia.
 - The resource use rights are subject to a public tender organized by the forestry authority.
 - Collectors receive the smallest portion of revenues from the overall NWFP value chain.
 - It is mainly women who are involved in the transformation and processing of aromatic and medicinal plants.
 - There are three main approaches to empowering women who harvest NWFPs in Tunisia:
 1. Technical cooperation programmes, which include training, strengthening local knowledge, funding facilitation to create jobs (e.g. for certified distillation units), improving living conditions and contributing to the national economy – all without depleting or degrading the resource base.
 2. The co-management of forest resources, in which decentralized community forest management systems grant community members closely monitored land-use rights over an area of forest that allows them to sustainably extract wood and NWFPs in exchange for protecting the land from overexploitation. Along with conservation goals, many of these decentralized management plans are created with development objectives. The General Directorate of Forestry is promoting a new form of sustainable management for forest resources to conclude contracts between the organized local community and the administration to improve their livelihoods and protect forest areas.
 3. The clustering of forest management communities, targeting craftswomen producing essential oils and other aromatic and medicinal plant extracts. As a start, 150 craftswomen were trained in distillation techniques.

Debate and conclusions

During the **last session block**, a rich dialogue took place between panellists from the sessions Improving the Value-Chain of Mediterranean Wild Food Products: Special Insight into How Certification, Branding and Labelling Can Upgrade the Economic Value of Edible Non-wood Forest Products (organized by the WildFood project, reference number: 2019-SECTION2-29) and *Non-wood forest products for people, nature and the green economy: recommendations for policy priorities in the Mediterranean*.

The following includes the key questions raised and their answers:

- ◆ **What should be the role of public administration (PA) towards NWFP certification?**
 - “One of the main roles for PA would be **minimizing bureaucracy** for the certification process. It is one of the biggest obstacles for people applying for it. Another role would be providing **financial support for those who actively do forest management**, which would avoid land retirement. Another issue is having a regulated market with fair prices; PA could help with this. Public administration should follow up during and also after the process of certification, as it is important for the sustainability of businesses,” stated **Susete Marques**.
 - “**National authorities should implement/adapt standards to national contexts**; certification is important throughout the Mediterranean, but national contexts are very different. Training is also necessary to better understand how to certify NWFPs and the particularities of the forest sector,” replied **Ibtissem Taghouti**.

- “The first area of public intervention should be **information**. Proper use of certification is third-party certification (independent and accredited). Information should also enable the consumer **to understanding the meaning** of certification labelling; current messages are not always consistent (e.g. palm oil free, no-GMOs, etc.). There should be a trend whereby PA takes the place of standards developed by other stakeholders (civil society, private sector, etc.), which are not always useful or can be misleading (e.g. 0 km food),” said **Davide Pettenella**.
 - “**NWFPs should be under the authority of the PA for their identification, because this is the basis of sustainability, and local communities should be main users of these products**. Public administration should be regulating bodies determining prices and should protect price stability. In facilities where NWFPs are processed, PA also has a role to play in minimizing the loss of value of these products,” replied **Ozgur Balci**.
 - “Stakeholders should, in general circumstances, join efforts with PA. It depends on the angle. For example, tax reform in Italy was a success, where the PA was instrumental. **Public administration should provide an overall framework. We are missing this. There are different production systems, but NWFP producers need an overall framework, like a 'produced in the wild' label,**” stated **Alvaro Picardo**.
 - “**The regulatory role of government is very important**, with appropriate policies, legislative tools and government structures,” replied **Ismail Belen**.
- ♦ **What should be the role of PA towards other issues related to NWFPs and the involvement of private stakeholders?**
- “**We need specialized bodies to give certificates and identify products, the process should be facilitated by PA (with less bureaucracy)**. In Türkiye, a certificate of origin can prove that a product has been sourced from a forest,” said **Ozgur Balci**.
 - “**An important step is to organize producers to share and understand their main problems and needs**; we are far from interbranch organizations like in agriculture, but this is where we should be. If a group of producers get together and share common needs to PA, this would really help and strengthen in the sector. The role of PA in understanding the sector is also important, and that comes through dialogue,” replied **Alvaro Picardo**.
 - “The private sector will do the actual work when it comes to certification. **If the private sector is not regulated in a favourable way, those laws will not be enforced in the field**. The private sector needs incentives. From a food security point of view, NWFPs are important. **We need to inform the public of the value of NWFPs**. Truffles, pine honey, these are all very important products for Türkiye. We need to improve knowledge and information on them,” stated **Ismail Belen**.
 - “Private owners and PA must work together for the integrated management of forests and landscapes,” answered **Susete Marques**.
 - “In Tunisia, we have a very good product: pine nuts; people collect the nuts in June knowing that the collection period starts in October. In these circumstances, the **economic and social situation is critical; dialogue was very important to enable us to understand these conditions**. We tried to set up a cooperative, and now these people have representation and a channel to communicate with the PA, the private actors and society. We need to protect this social capital,” said **Ibtissem Taghouti**.
 - “**We must create groups of producers but also a link with consumers through, for example, groups of consumers** who interact directly with harvesters and these niche markets,” replied **Davide Pettenella**.
- ♦ **One final key message from each panellist:**
- “We have not discussed NWFPs that we cannot see: carbon stocks, biodiversity, ecosystem services, etc. How can we value these invisible NWFPs?” asked **Susete Marques**.

- “Let us describe these products with a positive term, such as ‘wild forest products’, not using a negative term ‘non-wood forest products’”, shared **Davide Pettenella**.
- “In response to Pettenella, the name of the department responsible for NWFPs has been changed to ‘ecosystem services’,” said **Ozgur Balci**.
- “By treating the forest well (sustainable management, supporting local populations, etc.), we can ensure the development of these products,” shared **Ibtissem Taghouti**.
- “Let us be optimistic. We have seen a lot of successful examples, and in the coming years, we are likely to see flourishing markets,” replied **Alvaro Picardo**.
- “Forests are family. NWFPs make them a family. What makes trees a forest are the NWFPs, the ecosystem services, and we need to protect them and develop them further,” said **Ismail Belen**.

Bibliography

- European Commission. 2021. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: New EU Forest Strategy for 2030*. https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12674-Forests-new-EU-strategy_en
- FAO. 1999. Towards a harmonized definition for non-wood forest products. *Unasylva*, 50:63–63.
- Innovation Networks of Cork, Resins and Edibles in the Mediterranean Basin Consortium. 2021. *Innovation Networks of Cork, Resins and Edibles in the Mediterranean Basin*. <https://incredibleforest.net>
- Alvaro Picardo Nieto. 2021. *Manifesto of Alghero: A commitment to promote the contribution of non-wood forest products to inclusive and green growth and eco-social progress in Europe and worldwide*. www.incredibleforest.net/sites/default/files/u191/draft_manifesto_9.04.2021.pdf
- Martinez de Arano, Inazio, Maltoni, Sara, Picardo, Álvaro, Mutke, Sven *et al.* 2021. *Non-wood forest products for people, nature and the green economy. Recommendations for policy priorities in Europe. A white paper based on lessons learned from around the Mediterranean*, Knowledge to Action 5. European Forest Institute, 85 pp. <https://doi.org/10.36333/k2a05>.
- Wolfslehner, Bernhard, Prokofieva, Irina, and Mavsar, Robert (eds). 2019. *Non-wood forest products in Europe: Seeing the forest around the trees*. What Science Can Tell Us 10, European Forest Institute, 116 pp. <https://doi.org/10.36333/wsctu>

Cork oak reforestation in Portugal and Spain to ensure future cork supply

Ramón Santiago Beltrán¹

¹Subericulture technician at the Instituto del Corcho, la Madera y el Carbón Vegetal - CICYTEX

Abstract:

This article gives a brief description of cork oak and cork: it discusses their biodiversity, origin and provides some figures on surface areas and cork production in the world. Its main problems and strengths are listed. Some numbers are given on global reforestation of *Quercus suber* in recent decades. The key issues for maintaining these ecosystems are described. The article concludes with the benefits of using cork and continuing to manage cork oak forests sustainably.

Keywords: *Quercus suber*, cork oak, cork, forest management, sustainability, responsible consumption

Cork oak forests, biodiversity, cork production and the cork industry

The cork oak (*Quercus suber*) is a species exclusive to southwest Europe and northwest Africa that make up the very special cork oak forests. These mixed forests are highly biodiverse, with several species in the tree canopy, numerous species in the shrub and subshrub strata, many herbaceous species and numerous lianas intertwining these strata. Moreover, there is a very rich fauna with emblematic species for the conservation of nature: the Iberian lynx, the Iberian imperial eagle, the Barbary deer, the black vulture, the black stork and many other species of mammals, birds, reptiles and invertebrates, some of which are exclusive to these ecosystems. It is no coincidence that cork oak forests originated in the Neogene more than 11.6 million years ago when southern Europe and North Africa had a much warmer and more humid climate than in the present day, and the tertiary flora that accompanied them was very rich in subtropical and tropical elements. The cork oak forests survived climatic vicissitudes (droughts that reduced the Mediterranean to a series of unconnected salt lakes and quaternary glaciations, for example) and even spread to become dominant in large parts of their present area.

Cork oak forests cover more than 2.6 million hectares (ha) of land according to data from official bodies and experts from the seven countries where it is naturally present. Table 1 shows the breakdown and data source by country.

Table 1. World distribution of cork oak forest area

Global cork oak forest area		
Country	Area (ha)	Source
Portugal	719 900	IFN6 Portugal, 2015
Spain	818 448	MFE25, 2020 data compiled by ICMC
Algeria	357 000	Third National Forest Inventory of Algeria, 2008
Morocco	384 280	Water and Forestry Department, 2021
France	102 000	IML, 2021
Tunisia	70 113	DGF Tunisia, 2010
Italy	186 344	INFC, 2005
Total	2 638 085	

The global cork oak forest area was estimated at 2.17 million ha 70 years ago. This growth in surface area is partly due to the improvement in forestry statistical systems and partly to the reforestation effort that has been made especially in the last three decades. Table 2 shows reforestation carried out in five of the countries of the cork oak's natural area.

Table 2. Areas afforested with cork oak in five countries

Area afforested with <i>Quercus suber</i> (ha)		
Country	1990–2000	2000–2020
Algeria	200	18 500
Spain	83 435	16 637
Italy	5 434	1 566
Morocco	4 926	8 400
Portugal	80 606	14 578
	174 601	59 681
Total	234 282	

At least 234 282 ha of cork oak groves have been repopulated in the last 30 years.

These 2.64 million ha of cork oak forests are of enormous environmental, economic and social interest. On average, around 175 000 tonnes of cork are produced worldwide each year, with the following breakdown by country:

Table 3. Average annual cork production in the world, broken down by country

World cork production		
Country	Average annual production (tonnes)	Source
Portugal	83 236	UNAC
Spain	61 345	Instituto CMC - CICYTEX
Morocco	10 085	Water and Forestry Department
Tunisia	7 000	National Observatory for Agriculture
Italy	6 730	Regional Forestry Agency Development, Sardinia
Algeria	6 000	DGF
France	1 500	IML
TOTAL	175 896	

In Spain, this production has a value in the forest of around EUR 80 million per year and a final product value of around EUR 200 million per year (INE, 2022). To obtain each tonne of cork, about 9 days of labour are needed in the field (debarking and other works). The preparation industry (primary processing) requires 3.6 days of labour to prepare a tonne of cork. The cork-tapping industry (secondary processing) requires 17.21–20.65 days of labour to manufacture cork stoppers. Each tonne of cork therefore needs 29.81–33.25 direct labour days from the field to the final product (ICMC-CICYTEX). The cork sector as a whole requires 5.3 million day labourers. In terms of indirect employment in the cork sector, it is estimated that for every direct job, 2.36 indirect jobs are created. Around 100 000 people directly or indirectly depend on the cork sector around the world (CELIEGE, 2008).

This production will be reinforced by cork oak reforestation completed in recent years. For example, in the region of Extremadura, Spain, cork oak reforestation was carried out on over 53 000 ha in the last 30 years. It is expected that in 2026–2069, the average production of virgin cork will be 1 630 tonnes/year. In 2035–2069, average production of cork from primary processing is predicted to be 2 190 tonnes/year. In 2044–2069, average production of cork from secondary processing (suitable for natural cork stoppers) is predicted to be 8 793 tonnes/year (Santiago Beltrán *et al.*, 2022).

The management of cork oak forests is environmentally friendly, as evidenced by the high level of biodiversity they harbour. In Spain, for example, around 80 percent of the cork oak forest area is protected

under European or Spanish legislation. Cork harvesting is respectful of the trees and keeps them alive in the forest. It is done every 9 years (in many cases, 10 or more), which allows these ecosystems to remain untouched for long periods.

The cork industry is kind to nature. It uses a natural, renewable and recyclable raw material without generating harmful waste, apart from water and cork's natural elements. In addition, the cork industry is often located near cork oak forests, which reduces its carbon footprint and provides an economic boost for rural areas in southern Europe and the Maghreb. The alternatives to cork stoppers are aluminium screwcaps and plastic stoppers. The industries that produce them consume a great deal of energy, use perishable resources and are quite polluting.

Weaknesses and strengths of cork oak forests

The main challenges facing cork oak forests today are as follows:

- Aging populations: in many areas, there is a lack of younger people working in cork oak forestry while the cork oak age classes present are close to the end of the rotation.
- Phytosanitary problems: the main one is the drought stress caused by *Phytophthora*, an exotic pathogen that is threatening many cork oak groves and other tree species in other parts of the world. There are also other problems such as attacks by cerambycids, defoliators, borers and cork shingles, which, without endangering the life of the tree, depreciate the cork considerably.
- Human pressure: degradation of cork oak forests is often caused by poor forestry practices that are applied more out of ignorance than bad faith. Examples of these poor practices are tillage with heavy machinery and pruning of adult trees. Excessive human pressure also leads to degradation, as caused by overgrazing.
- Climate change: this affects the natural regeneration capacity of cork oak forests. It is becoming increasingly rare for a good year of good weather to coincide with a good acorn harvest and for the young cork oak trees from these acorns not to be eaten by livestock or destroyed in other ways.



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Figure 1. Cork oak forest in the Oued Zen National Park (near Aïn Draham, Jendouba province) in Tunisia, a barrier to desertification

- Shortage of workers specialized in subericulture and specifically in debarking: there are fewer and fewer debarkers, and only in Andalusia, Spain, have there been training initiatives in this area, yet the number of new trained debarkers is very low.
- Forest fires: large fires are occurring with increasing frequency, sometimes affecting areas of cork oak forest. A recent example is the Sierra Bermeja fire in the summer of 2021 in Spain. Although cork oak forests are naturally adapted to fires, effective prevention is necessary.

The main strengths of the cork oak forests are as follows:

- Biological vigour and resilience of cork oak: capacity for regeneration and survival in the face of climatic adversities (they have already faced four glaciations and corresponding interglacial periods), pests, fires and poor practices.
- High biodiversity: the biodiversity of these ecosystems can help them be more stable in the face of degradation and recover more quickly when degradation occurs.
- Multifunctionality: in addition to cork, which is an exceptional product with a huge range of potential applications, cork oak forests provide a wide variety of very useful goods and services to society. Some of them, such as carbon sinks, can contribute to combating climate change. Others are natural products, which are obtained from an ecosystem with little intervention and are healthy, as evidenced by traditional use (for over 2 000 years) and recent studies. These products include salted Iberian pork, beef and lamb, sheep and goat cheeses, and honey.
- Exceptional cultural richness: the people who inhabit the cork oak forests have a wealth of knowledge, tools, vocabulary and ways of life specific to these forests and this region that have allowed them to live in harmony with these forests for millennia.
- New debarking technologies: new debarking technologies have made significant advances in recent years. In 2019, a new machine, the COVELESS 3C18, was launched on the market with very good characteristics. In 2021, the CICYTEX debarking pincer, a tool that complements the previous COVELESS machine, was put on the market (see Figure 2). Another tool, the CICYTEX technological lever makes it possible to complete the debarking with new technologies in most of the cork harvesting process. These new technologies will allow more careful and efficient cork removal, better working conditions for the cork workers, easier learning and access for women to a profession in which they have been practically absent until now.



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Figure 2. Wing operation carried out with CICYTEX's corking pincer (near Aliseda, Cáceres, Spain)

- Reforestation with cork oak: even in very unfavourable conditions, artificial regeneration techniques can be used to ensure the future existence of cork oak trees. These techniques are evolving and include new developments such as “fertirrigation” (irrigation and fertilization at the same time), which can significantly improve the survival of young cork oaks. Regeneration is the weakest point of the cork oak forest, which is threatened by climate change, and it can be solved with artificial regeneration techniques to ensure the survival of these forests.

Conclusion

To ensure the sustainability of cork oak forests, it is necessary to address the following challenges:

- Establish formal training for specialized workers in all the tasks carried out in cork oak groves, such as cork debarking, pruning, grazing and mycological use.
- Plan and ensure the regeneration of cork oak groves by ensuring that everyone contributes to this work, as it is very expensive and brings benefits to all from the resources it generates.
- Boost research and development on key issues such as plant and animal health, modernization of exploitation, cork harvesting (in particular), “fertirrigation” in afforestation, genetics applied to subericulture, and more.

The sustainable use of cork oak forests ensures their survival and that of those who depend on it. It maintains the balance between human intervention and natural ecosystem processes, and the tree cover that protects the soil, withstands forest fires, sequesters carbon, modifies the local microclimate and provides many goods and services in addition to cork, a unique product whose new valuable properties and uses are coming to light.

We must continue to use cork, make sustainable use of cork oak forests, restore degraded cork oak forests and repopulate suitable land with cork oak forests, knowing that it is good for the planet, for people and for the very rich fauna and flora of these ecosystems.

Bibliography

INE. 2022. *INE*. Cited 29 March 2023. www.ine.es/en/

Molina, L. 2012. Sector forestal: propuestas de cambio para la creación de 50.000 empleos. CCOO.

Pais, J. 1972. Fósseis de *Quercus suber* L. provenientes de formações cenozóicas continentais do Alentejo. *Boletim do Museu e Laboratorio Mineralógico e Geológico da Faculdade de Ciencias* 13(1), 35-48.

Santiago Beltrán, R., Lanzo Palacios, R., Berdón Berdón, J., Cardillo Amo, E., Murillo Vilanova, M., Montero Calvo, A.J., Fernández Santos, A.M., y Maya Blanco, V. 2022. Estudio de las repoblaciones de alcornoque en Extremadura y estimación de su producción futura de corcho. 8 Congreso Forestal Español. Lérida.

Several authors. 2008. The European cork industry responds to the Commission’s Communication on innovative and sustainable forest-based industries. CELIEGE.

Several authors. 2006. Cork screwed? Environmental and economic impacts of the cork stoppers market. WWF - Mediterranean Programme Office.

THEMATIC SESSION 4

Forest restoration strategies in the Mediterranean region: exploring cost-effective interventions through assisted natural regeneration and appropriate use of forest genetic resources

Restoration strategies in the Mediterranean region: exploring cost-effective interventions through assisted natural regeneration and appropriate use of forest genetic resources

Alain Chaudron¹

¹ AIFM Vice President, www.aifm.org

Based on a bioclimatic definition, the Mediterranean region comprises more than 25 million hectares (ha) of forests and about 50 million ha of other wooded land, which represents 1.8 percent of the global forest area.

Despite an 1.8 million ha increase in forest cover between 2010 and 2015, there are 80 million ha of degraded land – including forests – in the Mediterranean. More than 400 000 ha of forest burn down each year, and at least 16 percent of plant and animal species in Mediterranean forests are at risk of extinction due to global threats such as climate change.

It is important to identify and properly implement low-cost, long-term strategies for forest and landscape restoration (FLR). Most restoration strategies involving tree planting are often expensive.

Natural regeneration is a biological process that can be assisted and managed to increase forest cover and achieve recovery of the native ecosystem or some of its functions. Assisted natural regeneration (ANR) is one of the components of FLR, among other types of interventions such as agroforestry and reforestation.

Where ANR is not possible because of ecological, social or regulatory factors, afforestation or reforestation interventions may be the chosen options. In this case, the choice of species and provenances is fundamental: this is a key issue for forest genetic resources (FGR).

The main objective of this session was therefore to share knowledge related to the restoration of degraded Mediterranean forest landscapes, focusing on ANR and FGR.

Four presentations were given.

Firstly, **Valentina Garavaglia**, from the Forest and Landscape Restoration Mechanism (FLRM) of the Food and Agriculture Organization of the United Nations (FAO) spoke on the role of restoration in the Mediterranean region, placing it in the local, national, regional and global context. She stressed the importance of sharing knowledge through the different networks.

Magda Bou Dagher, from the Mediterranean Facility of the European Forest Institute (EFIMED) then welcomed the fact that the strategic role of genetic resources for the restoration of degraded forests and landscapes in the Mediterranean region was being addressed in the plenary session and gave a high-level scientific presentation. She stressed the importance of diversity within forest species (genetic diversity) but also between species as well as landscape diversity.

Barbara Vinceti, from the Alliance of Bioversity and CIAT, presented a decision-support tool for the selection of tree species and provenances. This tool has so far been developed for countries outside the Mediterranean region, but it could easily be extended to include restoration initiatives targeting Mediterranean forest ecosystems.

Finally, **Kaoutar Aouane**, Director of the Talassemtane National Park in Morocco, presented a concrete example of participatory restoration of degraded land where the endemic Moroccan fir tree is threatened. She underlined the contribution of students from the University of Tetouan and the importance of involving local populations and schools.

In short, this comprehensive and diverse session enabled participants to gain a better understanding of the context of the restoration of Mediterranean forests and landscapes through the sharing of experiences and knowledge.

Restoration strategies in the Mediterranean region: exploring cost-effective interventions through assisted natural regeneration and appropriate use of forest genetic resources

Giovanbattista de Dato¹

Valentina Garavaglia² | Magda Bou Dagher Kharrat³ | Barbara Vinceti⁴ | Tobias Fremout⁴

¹ *Silva Mediterranea* Secretariat
FAO Forestry Division

² Forest and Landscape
Restoration Mechanism, Forestry
Division, FAO

³ EFIMED, St. Antoni M. Claret,
167, 08025, Barcelona, Spain

⁴ Bioversity International, Via di S.
Domenico, 1, 00153 Rome, Italy

Abstract:

The main objective of the session was to share knowledge related to the restoration of degraded Mediterranean forest landscapes using assisted natural regeneration (ANR) and forest genetic resource (FGR) techniques. The presentations aimed to explain the concepts and rationale for ANR, when the application of ANR is appropriate, and the factors to consider in implementing ANR, including the basic procedures to be put in place, fire recovery strategies, FGR management, practices to recover and improve biodiversity, interactions between species and movements within landscapes, and the financial resources available for ANR and restoration.

Moreover, the session illustrated an online decision-making tool called Diversity for Restoration (D4R, www.diversityforrestoration.org/) that provides support in selecting tree species and tree seed sources in circumstances where ANR is insufficient to support restoration.

Setting the scene: the role of restoration in the Mediterranean region, the regional and global context

Based on a bioclimatic definition of Mediterranean forests, the Mediterranean region includes more than 25 million hectares (ha) of forest and about 50 million ha of other wooded lands, representing 1.8 percent of the global forest area. Mediterranean forests are part of multifaceted landscapes, strongly marked by centuries of human intervention. Despite an 1.8 million ha increase in forest cover between 2010 and 2015, there are 80 million ha of degraded land – including forests – in the Mediterranean. More than 400 000 ha of forests are burnt each year, and at least 16 percent of animal and plant species in Mediterranean forests are threatened with extinction due to global threats such as climate change (FAO and Plan Bleu, 2018).

Restoration is the primary means to reverse land degradation and restore ecosystem composition, functioning and sustainability, thus improving the livelihoods and well-being of local populations (Lohbeck *et al.*, 2021; Santini & Miquelajauregui, 2022). Many restoration projects have relied on monospecific tree stands with low genetic diversity (monospecific afforestation). This was because the Mediterranean site conditions often do not allow for restoring degraded lands by using multiple species but need to improve soil fertility by using preparatory species, such as plastic species and species suited to long-term drought conditions like the Mediterranean pines.

This restoration practice has been progressively replaced by a landscape and ecosystem-based approach, with the diversification of land uses and plant species, one of the main goals of forest and landscape restoration (FLR).

The FLR approach includes many national, regional and global goals. The challenge is to conserve the main cultural landscapes and restore the most degraded or threatened ecosystems. Given these global and regional goals and ambitious new national commitments, it is important to identify and properly implement low-cost, long-term strategies for landscape restoration.

Most restoration strategies are usually based on tree planting while natural regeneration is generally neglected as a restoration intervention. Natural regeneration is a biological process that can be assisted and managed to increase forest cover and achieve recovery of the native ecosystem or some of its functions.

Natural regeneration can contribute to restoration targets like climate change mitigation, biodiversity conservation, soil fertility, agricultural production and livelihood benefits.

Natural regeneration, or secondary succession, is the gradual buildup of vegetation through biomass accumulation and species turnover over time (Chazdon, 2017). The potential for natural regeneration and the success rate depends on various factors, including the landscape, previous land-use history and management practices (Jakovac *et al.*, 2021). This potential may be hindered by the level of disturbances (e.g. wildfire frequency), soil degradation, plant species composition and functional traits. A basic understanding of successional processes is helpful to identify possible barriers to restoration and how to address them.

The method aims to accelerate, rather than replace, natural successional processes by removing or reducing barriers to natural forest regeneration, such as soil degradation, competition with weedy species and recurring disturbances (e.g. fire, grazing and wood harvesting). Compared to conventional reforestation methods involving the planting of tree seedlings, ANR offers significant cost advantages because it reduces or eliminates the costs associated with propagating, and growing and planting seedlings. However, it is likely that the implementation and benefits of tree planting are easier to assess and communicate than those of natural regeneration.

The applicability of ANR covers a broad range of forest types and geographical areas. The techniques can be adapted to meet various objectives, such as income generation from non-timber forest products (NTFPs), the production of fuelwood and timber, and biodiversity conservation.

Also, ANR represents a low-cost opportunity to conserve biodiversity and improve ecosystem services, including carbon sequestration and watershed protection. It emphasizes the protection of natural shoots and seedlings from fire, invasive species and uncontrolled grazing by livestock. Assisted natural regeneration can be a component of FLR, among other interventions such as agroforestry and reforestation practices, which support national, regional and global ecosystem and forest restoration goals. Despite its economic and environmental benefits, the potential of ANR as a low-cost forest restoration method is not well recognized, and the technique is underutilized and often overlooked for various reasons when restoration policies and programmes are designed. These reasons include the failure to recognize natural regeneration as a restoration option, disincentives that favour the clearing of young secondary shoots for the development of plantations or other land uses, a lack of institutional support from government agencies and other organizations, unclear land and property rights, a lack of incentives for local communities, and uncertainty about the processes and results of restoration.

Besides the aforementioned advantages, ANR has some limitations since it can be less effective than restoration planting approaches in enhancing floristic diversity at the initial stages, but it is much cheaper to implement and can be applied over larger areas. Forest restoration through ANR will create forests with little commercial value in terms of woody products. Still, it can support greater biodiversity and often more effectively meet the subsistence needs of local people compared to commercial plantations. Certainly, ANR is best implemented in areas where the main objective is to enhance the protective role of forests. Other drawbacks that can be ascribed to ANR are as follows:

- The development processes can be slower.
- It is labour intensive in its early stages due to competition from weeds and grasses.
- Assisted natural regeneration displaces grazing and fuelwood collection, so these needs must be satisfied elsewhere.
- Active tree-planting approaches to the restoration of degraded sites are better known and preferred by policymakers.

The strategic role of genetic resources for forest and landscape restoration

Genetic considerations are often neglected because the most severe bottlenecks are outside the usual time frame of restoration projects. Nevertheless, seed sources must be selected with precision. Long-term restoration success requires choosing species and seed sources suited to local site conditions and sufficiently genetically diverse to regenerate naturally, while adapting to future climate conditions and resisting future pests and diseases. Within species diversity, choosing the appropriate provenance and/or ecotype, is especially important for improving the capacity of restored forest landscapes to mitigate climate change, adapt to future climate conditions and cope with other abiotic and biotic threats. These are a consequence of a changing climate in the Mediterranean, with warmer and drier weather, and more frequent extreme events (heat waves and longer dry spells), which will expand its climatic influence to higher latitudes.

Given the prospects of rapid, unpredictable and unprecedented changes, the conservation of current genetic and phenotypic composition and integrity of Mediterranean species is at risk. However, as demonstrated by past species extinction during previous major extinction events, while the vast majority of the dominant lineages of terrestrial vertebrates (e.g. the dinosaurs) were lost at the last major extinction, no major lineage of plants became extinct. In fact, extinction rates in flowering plants did not significantly change at the Cretaceous–Paleogene boundary, and speciation may have accelerated (Silvestro *et al.*, 2015). Thus, although trees are particularly vulnerable to shifts in climate due to their slow macroevolutionary dynamics and protracted life history strategies (Petit and Hampe, 2006), creating, maintaining and preserving large tree populations and reproductive capacity would counterbalance this risk, allowing for adaptation and plasticity.

Conservation policy and actions must also recognize populations of wild organisms that hybridize naturally, creating genetic variation for future evolution (Stronen and Paquet 2013). It is, therefore, wise to refer to

groups of taxa that frequently engage in natural hybridization and lack strong reproductive barriers that prevent interbreeding. This is the so-called syngameon, representing more than the sum of the pairwise interactions between species, but instead a dynamic network of species acting over significant periods and at continental scales. Focusing on the syngameon and developing an understanding of how networks of species interact genetically, rather than focusing independently on each species, is a way to strike a balance between assisting species in accelerating their diversification with the threats of outbreeding depression and genetic erosion. However, further research is needed to utilize the syngameon for conservation and management purposes.

Diversity For Restoration: a tool to guide selection of tree species and seed sources for climate-resilient forest landscape restoration

Diversity For Restoration (D4R) was developed to improve the effectiveness of forest restoration actions when natural or assisted regeneration would not be sufficient (Fremout *et al.*, 2021a). The tool assists in decision-making about optimal tree species to be planted based on the conditions of the planting site and the different objectives of restoration initiatives. It also assists in the identification of appropriate tree seed sources, considering how future climate changes are expected to affect the planting site.

The user is invited to identify the area to be restored on a map as a first step.

Next, the user is asked to fill in an online form with information about the conditions of the site targeted for restoration action, the restoration objectives and additional options, such how many and what type of species they wish to plant.

The tool selects species from a list of all possible species suited to the habitat of the planting site under current and future climate conditions.

To select appropriate species combinations, the tool identifies those tree species that, according to the suitability models, are predicted to be able to persist at the chosen site, and ranks them according to a set of functional traits scored in relation to different site conditions and restoration objectives. The traits used to characterize the tree species are based on literature and on traditional knowledge (Fremout *et al.*, 2021b).

Finally, the tool generates information on combinations of tree species that are expected to be adapted to the environmental conditions under current and future climatic conditions. The tool generates different options of species combinations, ranging from a higher focus on diversity to a higher focus on species suitability for the selected restoration objectives and resistance to local stress conditions.

Seed zone maps are generated to indicate from which areas planting material should be sourced (Fremout *et al.*, 2021c). The idea is that for each species, planting material is obtained from a combination of sources, including from local populations or populations growing under environmental conditions that are similar to those at the planting site, as well as from populations growing in areas with environmental conditions most similar to those that are expected to occur at the planting site in the future.

References

- Chazdon, R.L. 2017. Landscape Restoration, Natural Regeneration, and the Forests of the Future. *Annals of the Missouri Botanical Garden*, 102: 251–257. <https://doi.org/10.3417/2016035>.
- FAO and Plan Bleu. 2018. *State of Mediterranean Forests 2018*. Rome and Plan Bleu, Marseille, France.
- Fremout, T., Thomas, E., Taedoumg, H., Briers, S., Gutiérrez-Miranda, C.E., Alcázar-Caicedo, C., Lindau, A., Mounmemi Kpoumie, H., Vinceti, B., Kettle, C., Ekué, M., Atkinson, R., Jalonen, R., Gaisberger, H., Elliott, S., Brechbühler, E., Ceccarelli, V., Krishnan, S., Vacik, H., Muys, B. 2021a. Diversity for Restoration (D4R): guiding the selection of tree species and seed sources for climate-resilient restoration of tropical forest landscapes. *Journal of Applied Ecology*. <https://doi.org/10.1111/1365-2664.14079>
- Lohbeck M, Rother D.C., Jakovac C.C. 2021. Editorial: Enhancing Natural Regeneration to Restore Landscapes. *Frontiers in Forests and Global Change*, 4. <https://doi.org/10.3389/ffgc.2021.735457>.

- Petit, R.J., Hampe A. 2006. Some Evolutionary Consequences of Being a Tree. *Annual Review of Ecology, Evolution, and Systematics*, 37: 187–214. <https://doi.org/10.1146/annurev.ecolsys.37.091305.110215>
- Fremout, T., Gutiérrez-Miranda, C.E., Briers, S., Marcelo-Peña, J. L., Cueva-Ortiz, E., Linares-Palomino, R., la Torre-Cuadros, M. de los Á., Chang-Ruiz, J.C., Villegas-Gómez, T.L., Acosta-Flota, A.H., Plouvier, D., Atkinson, R., Charcape-Ravelo, M., Aguirre-Mendoza, Z., Muys, B. & Thomas, E. 2021b. The value of local ecological knowledge to guide tree species selection in tropical dry forest restoration. *Restoration Ecology*. <https://doi.org/10.1111/rec.13347>
- Fremout, T., Thomas, E., Bocanegra-gonz, K.T., Aguirre-morales, C.A., Morillo-paz, A.T., Atkinson, R., Alc, C., Kettle, C., Gonz, R., Adriana, M., Guti, J.P., Gil-Tob, C., Moscoso-Higueta, L.G., Augusto, L., Becerra, L., Carvalho, D. & Muys, B. 2021c. *Dynamic seed zones to guide climate-smart seed sourcing for tropical dry forest restoration in Colombia*. 490(March). <https://doi.org/10.1016/j.foreco.2021.119127>
- Jakovac, C.C., Lohbeck, M., Rother, D.C., eds. 2022. *Enhancing Natural Regeneration to Restore Landscapes*. Frontiers Media SA, Lausanne, Switzerland. <https://doi.org/10.3389/978-2-88971-445-2>
- Santini N.S. & Miquelajauregui, Y. 2022. The Restoration of Degraded Lands by Local Communities and Indigenous Peoples. *Frontiers in Conservation Science*, 3. <https://doi.org/10.3389/fcosc.2022.873659>
- Silvestro D., Cascales-Miñana B., Bacon, C.D., Antonelli, A. 2015. Revisiting the origin and diversification of vascular plants through a comprehensive Bayesian analysis of the fossil record. *New Phytologist*, 207: 425–436. <https://doi.org/10.1111/nph.13247>.
- Stronen, A.V. & Paquet, P.C. 2013. Perspectives on the conservation of wild hybrids. *Biological Conservation*, 167: 390–395. <https://doi.org/10.1016/j.biocon.2013.09.004>

An example of a restoration project in Morocco: the Moroccan RESTOR'MED FORESTS project

Kaoutar Aouane¹

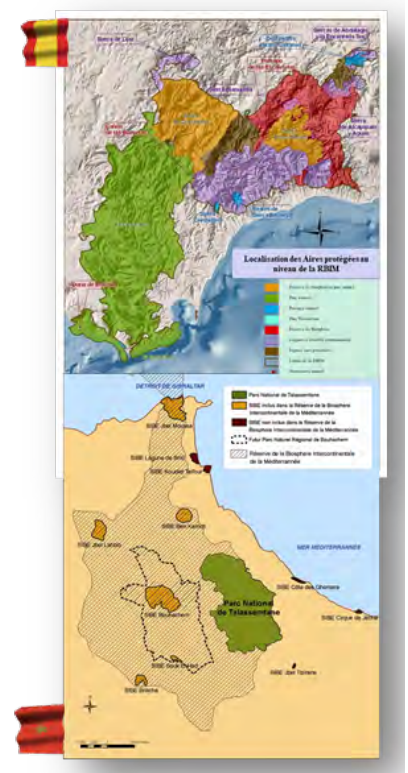
¹Director of the Talassemtane National Park
Regional Directorate of Water and Forests and the Fight against Desertification of the Rif
National Agency for Water and Forests

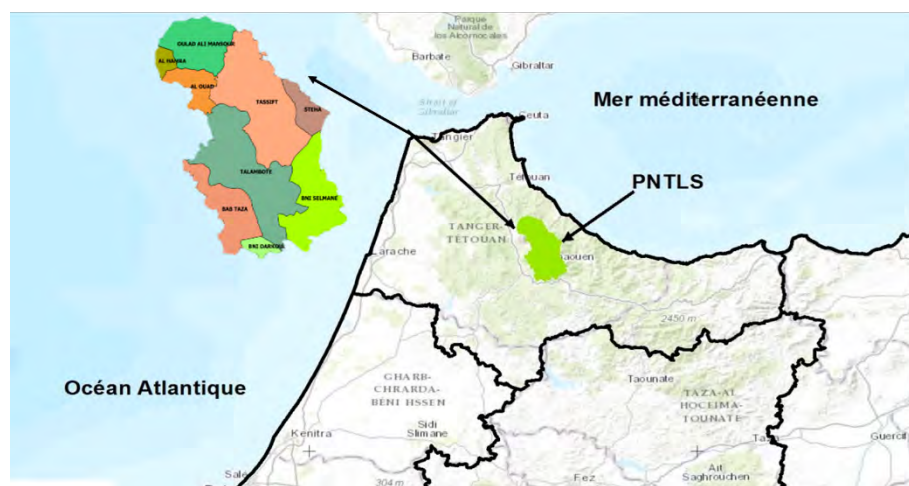
Context

The **Talassemtane National Park (PNTLS)** covers an area of 58 950 hectares (ha) and is located in the western Rif region, one of the most distinctive regions from a geographical, climatic and ecological point of view and among the most valuable regions on a biological and biogeographical level. It covers two territories, the provinces of Chefchaouen and Tetouan, and nine communes.

The PNTLS is part of the **Intercontinental Biosphere Reserve of the Mediterranean (RBIM)**, which was officially founded in 2006 by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Its ecological, historical and cultural wealth is shared between northern Morocco and Andalusia (about 1 million ha). The objective of creating the RBIM is to promote a sustainable development model that promotes the conservation of its specific and shared natural and cultural resources and the consolidation of the network of protected natural areas of northern Morocco and southern Andalusia.

The PNTLS contains the only Moroccan fir forests, remnants of a unique ecosystem, now threatened by extinction. These fir forests form the central part of the park, covering an area of 3 000 ha.





I. The Talassemtane National Park's potential

The PNTLS covers a distinct area renowned for its biodiversity, remarkable landscapes and cultural wealth, including:

- multiple landscapes, deep valleys, impressively steep gorges, caves and remarkable geological formations;
- a unique biodiversity in the Mediterranean, whose habitats are invaluable refuges for the local wildlife;
- specific natural, cultural and historical heritage sites, such as the fir forest of Talassemtane, the Akchour site, Oued Kenar, sacred sites and historical monuments; and
- a cultural richness expressed through culinary traditions and oral expressions, local products and traditional craftsmanship, and the people who have shaped the history of these landscapes.

Creation objectives

- preservation of the ecosystems' biodiversity;
- sustainable development of natural resources;
- development of ecotourism; and
- awareness-raising and education on the environment.

II. Presentation of the Moroccan RESTOR'MED FORESTS project

The RESTOR'MED FORESTS project aims to implement actions for the sustainable management of forest ecosystems around the Mediterranean Basin to make forests more resilient and functional while training technical staff and raising awareness among the local communities. It also aims to involve residents at every stage in order to foster engagement in land development.

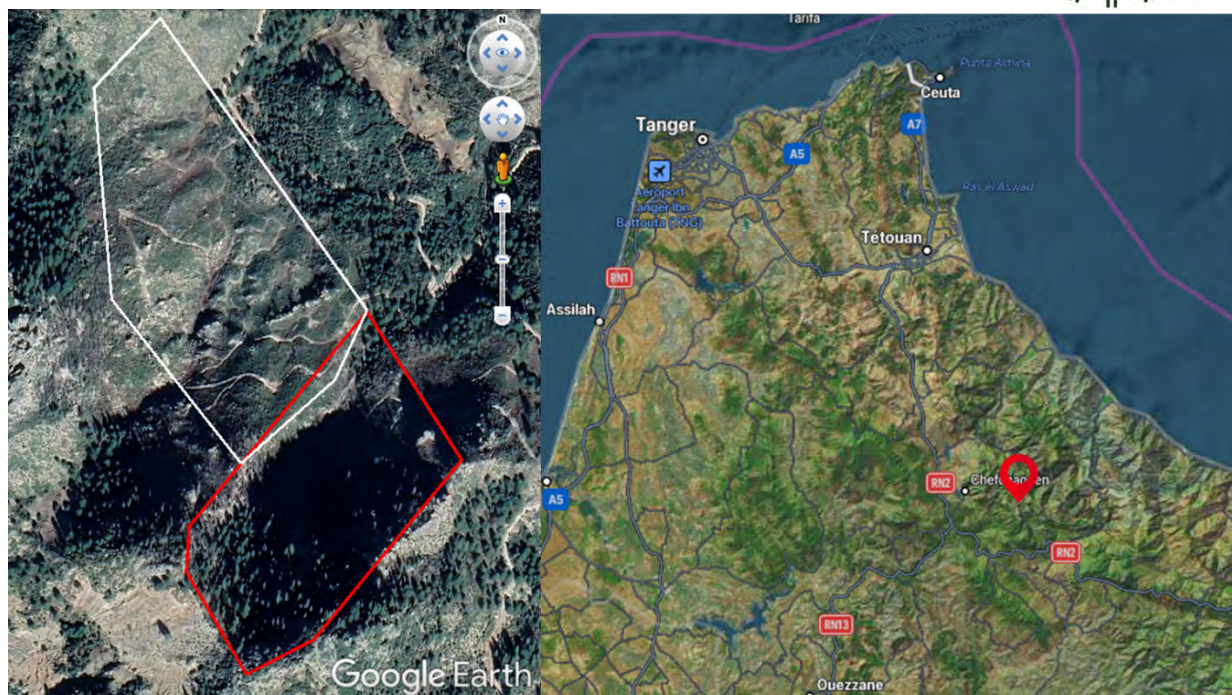


Figure 1. Map of the Madissouka site being restored in the Talassemrane National Park

A. Objectives and actions of the Moroccan RESTOR'MED FORESTS project

The objectives of the project are to:

- **contribute to mitigating the effects of climate change;**
- **contribute to the conservation of biodiversity,** particularly endemic and emblematic Mediterranean forest species; and
- **actively involve local people.**

The project in Morocco started in January 2021 and ended on 31 December 2022. It was implemented jointly with the Talassemrane Association for the Environment and Development (ATED), the Moroccan Association of Regional Sciences (AMSR) and the Department of Water and Forests of Morocco.

The actions to be carried out in the PNTLS are as follows:

- designing an ecosystem restoration plan;
- sustainable restoration of the pilot site with participatory reforestation of 15 hectares;
- scientific monitoring of the plantation by students from the University of Tétouan;
- awareness- and capacity-building workshops;
- creation of a tree nursery near the site village; and
- active and participatory involvement of local communities in all actions.



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A. Management of *Abies marocana*

The Moroccan fir forests of the PNTLS represent the only stand of this species. It used to be considered a subspecies of *Abies pinsapo*. However, it separated from *Abies pinsapo* under the influence of several geographical and historical factors. The Moroccan species is endemic to Morocco and is only found in the Rif, exclusively in Talassemtane in the mountains of Chefchaouen. These forests cover the mountain slopes at 1 600 metres (m) to 2 200 m high. The reference plant association is the Peonio-abietetum, which has three variants that differ from each other in terms of altitudes: the lowest one is mixed with *Cedrus atlantica*, *Quercus faginea*, *Acer granatensis* and *Quercus ilex*; the middle one has a greater presence of Moroccan fir, sometimes in pure stands; and the highest one has a greater prevalence of Atlas cedar. These stands were last extensively logged more than a century ago and are now protected by a silvicultural management focused on stand conservation.

B. Restoration of the Madissouka site

The Amazzar zone, which covers an area of about 15 ha, was chosen as a pilot zone to implement the RESTOR'MED FORESTS restoration project. The pilot area was restored by removing residual woody material, preparing the soil by digging holes and subsequently planting maritime pines. The Moroccan fir was not reintroduced because of the lack of adequate forest reproductive material. Indeed, the tree nurseries are not currently equipped with the appropriate material for the production of this species. The maritime pines between 3 and 4 years of age tend to regenerate naturally throughout the entire area. The reforestation areas were selected among the plots which presented the least natural regeneration. For Moroccan fir, natural regeneration seedlings are currently only found in a specific part of the plot in the vicinity of surviving fir trees that escaped the fire. Monitoring is underway to identify the most favourable ecological pattern for fir regeneration. Monitoring activities correlate soil and site conditions in areas where

natural regeneration of the species was observed. Direct seeding of Moroccan fir took place on the most suitable sites in the autumn of 2022.

References

- Aafi, A. 1995. Contribution à l'étude phytoécologique et à la cartographie des groupements végétaux du parc national de Talassemtane (provinces de Tétouan et Chefchaouen). Post-graduate thesis of the ENFI, 192.
- Benabid, A. 1994. Connaissance sur la végétation du Maroc : Phytogéographie, phytosociologie et séries de végétation. *Lazaroa*, 14, 21–97.
- Benabid A., 2000. *Flore et écosystèmes du Maroc : Evaluation et préservation de la biodiversité*. Ibis Presse, Paris.
- EL Melhaoui, Y.1990. Etude phytoécologique, productivité et classes de croissance du sapin du Maroc (*Abies Maroccana* TRAB.) : problématique de la régénération naturelle des peuplements de la sapinière marocaine. Post-graduate thesis. Université Aix Marseille, France.
- Naji, M. 2021. *Contribution à l'évaluation des efforts de restauration des écosystèmes forestiers du Rif occidental : Potential of the Talassemtane National Parc*. Post-graduate thesis of a forest engineer, ENFI, 139 pp.

THEMATIC SESSION 5

Income generating restoration activities in Türkiye: sharing best practices on restoration of forests and ecosystems in Türkiye

Ecosystem rehabilitation and restoration in the landscapes of Türkiye: from past to present

İbrahim Ergüven¹

¹General Directorate of Forestry,
Ankara, Türkiye

Abstract:

In the past 150–200 years in Türkiye, the pressure on natural resources has increased considerably from the Ottoman Empire to the present day due to excessive use of natural resources, conflict and economic difficulties. Increased pressure has accelerated the process of destruction of pastures and forests. Destruction increased the erosion of these areas, lack of productivity of agricultural lands and the destruction of other ecosystems. As a result of this, natural disasters have increased. Floods have threatened settlements and caused high losses of life and property. The search for a solution to these problems has begun.

Since 1950, erosion control, flood control and watershed rehabilitation studies initiated by the General Directorate of Forestry in various provinces have yielded successful results. Successful results in flood control in watersheds have increased the importance given to watershed studies throughout the country and have led to more studies in many subwatersheds where there is a risk of flooding.

With these studies, different working units were created by providing a significant capacity increase in the General Directorate of Forestry (OGM). The forest engineers working on these projects evaluated the achievements and negative aspects, and thus the watershed projects were further developed. To ensure the sustainability of these studies, the aim is to improve the economic and social status of the villagers in the watersheds and, therefore, reduce the pressure on the forests. In this context, studies on improving the socioeconomic status of rural villages living in watersheds have been added to the watershed studies.

In the 1990s, the Eastern Anatolian Watershed Rehabilitation Project and in the 2000s, the Anatolian Watershed Rehabilitation Project were initiated. Then, the Murat River Watershed Rehabilitation Project, which includes Elazığ, Bingöl and Muş provinces in the Eastern Anatolia Region, started in 2013.

In addition, Coruh River Watershed Rehabilitation Project, which includes Erzurum, Bayburt and Artvin Provinces, and in which the General Directorate of Forestry, General Directorate of Agricultural Reform, Special Provincial Administrations and General Directorate of State Hydraulic Works are stakeholders, has been initiated.

With the successful results and gains obtained from these projects, the aim is to carry out projects that are more participatory, sustainable and climate resilient while involving different institutions and general directorates in wider watersheds.

The effects of climate change, especially in recent years, have become visible. In the geography of Türkiye, some regions have received even less rainfall, while others have started to receive maximum rainfall. With delays in usual air movements and very different rainfall patterns, the regions where the annual rainfall of 50 percent have started to rain within a few days.

This process has begun to guide future studies. Ensuring the sustainability of the studies and projects will be possible with structures resistant to climate change. It is important to make the livelihoods of the people living in the watersheds more resilient to change. It is also necessary to create livelihood alternatives with different projects.

Considering the various contracts to which Türkiye is party to in its work on watershed rehabilitation projects, the aim is to integrate the projects with the landscape and ecosystem rehabilitation or restoration activities and to reflect them in the project studies.

For this reason, taking into account the United Nations Decade on Ecosystem Restoration 2021–2030, studies will be planned to restore and rehabilitate natural resources and ecosystems in the watersheds.

After the Coruh River Watershed Rehabilitation Project was completed in 2021 and the Murat River Watershed Rehabilitation Project to be completed in 2022, the Bolaman Watershed Rehabilitation Project was initiated in the Ordu province in the Eastern Black Sea Basin, which struggles with floods.

With this watershed project, the Cekerek River Watershed Rehabilitation Project in Yozgat, is seriously affected by climate change, has been initiated. These two watershed projects were combined under a single umbrella named the Resilient Landscape Integration Project (TULIP) during the negotiations between the Ministry of Treasury and Finance and the World Bank.

With TULIP, the aim is to rehabilitate the natural resources in the watersheds, to make them climate resistant and to make the livelihoods of the villagers living in these watersheds more resilient and diversified.

Similarly, there is the aim to put forward a strategy and make capacity development and monitoring evaluations that will guide future studies.

For this purpose, the draft of the National Watershed Rehabilitation Strategy Document was prepared, and, after the necessary approvals of this draft are obtained, action plans will be prepared to direct the restoration and rehabilitation works in the watersheds.

Introduction

Many events have occurred since the existence of humanity that cause excessive damage to forests and ecosystems, which are natural resources, such as conflict, migrations, fires and border changes between countries.

As a result of this, infertile lands, poverty, degraded ecosystems, excessive flood events have caused loss of life and property.

Solutions were sought by existing institutions in many countries, including Türkiye.

This article describes the stages of creation of the Türkiye Resilient Landscape Integration Project (TULIP) from the initial studies carried out to rehabilitate degraded natural resources in Türkiye.

Rehabilitation from past to present in Türkiye

Anatolian geography was greatly affected by wars in the 1800s and during the First World War and up to 1923.

During this time, nature and people suffered fires, epidemics, overuse of natural resources to meet people's needs.

Due to excessive use, old photographs show that around many settlements, there is no forest and vegetation in the mountains and surrounding landscapes.

Photos taken in the 1800s show that there is no forest around Uludağ in the Bursa Province and that nature is destroyed. However, today's photos clearly show the positive results of the long years of productive work by the General Directorate of Forestry (OGM). There is a view of Uludağ covered with forests and beech trees.

These landscapes are the same for Manisa, Hatay and many Anatolian Provinces.

Watershed rehabilitation works in Türkiye started in 1955 in a technical sense:

- The General Directorate of Forestry sent a team of forest engineers to complete two years of training in France on watershed rehabilitation in 1953 after the flood events.
- In line with the report made by the forest engineer who was trained in France in 1953, the "improvement of the upper watershed of the Tokat Behzat stream", which caused continuous

floods and overflows, was initiated in 1955. Subsequently, a provincial organization called Flood Watershed Engineering was established in 1955.

With this organization, many flood control and watershed rehabilitation works were initiated and completed. A few examples of these works are:

1. Behzat Stream Watershed Rehabilitation (Tokat) 1955.
2. Kargi Watershed Rehabilitation (Kargi, Çorum) 1959–1961.
3. Serabat Stream Watershed Rehabilitation (Kuyucak, Aydın) 1962–1968.
4. Uluborlu Dam Watershed Rehabilitation (Uluborlu, Isparta) 1975–1990.
5. Çakıt Stream Watershed Rehabilitation (Adana, Ulukışla, Niğde) 1982–1990.

With increasing works, the need for additional institutions emerged. The General Directorate of Afforestation was established in 1960 for this purpose.

With the watershed works, the need to improve the living conditions of forest villagers living in the upper watershed became evident. The General Directorate Ork y (Forest and Village Relations Department) was established in 1970 with the General Directorate. Forest villagers were provided with:

- livestock support;
- support to improve livelihoods from beekeeping, carpeting, dairy farming and greenhouses; and
- support to improve living conditions.

In the light of these studies and in line with the need for additional institutions, different projects were throughout the country:

1. Eastern Anatolian Watershed Rehabilitation Project (1991–2001).
2. Anatolian Watershed Rehabilitation Project (2005–2012).
3. Coruh River Watershed Rehabilitation Project (2013–2019–2021).
4. Murat River Watershed Rehabilitation Project (2013–2019–2021).



Figure 1. Map of provinces where watershed rehabilitation works were executed

T rkiye Resilient Landscape Integration Project with the United Nations ecosystem restoration approach

Starting from World Environment Day 2021, the years 2021–2030 were declared the United Nations Decade in Ecosystem Restoration.

Ecosystem restoration means assisting in the recovery of ecosystems that have been degraded or destroyed, as well as conserving the ecosystems that are still intact. Restoration can happen in many ways – for example, through actively planting or by removing pressures so that nature can recover on its own.

The economic benefits of ecosystem restoration exceed nine times the cost of investment, whereas inaction is at least three times more costly than ecosystem restoration.

With the United Nations Ecosystem Restoration Decade 2021–2030 (hereafter, the "UN Decade"), the purpose is to restore 350 million hectares (ha) of degraded terrestrial and aquatic ecosystems. Countries, organizations and non-governmental organizations (NGOs) are expected to contribute to this study (United Nations, 2021a).

This strategy includes:

- preventing, stopping and reversing ecosystem degradation; and
- **joining forces in a global movement to secure a sustainable future for everyone.**

With this strategy, ecosystems are divided into seven groups:

- forests and trees;
- rivers and lakes;
- towns and cities;
- oceans and beaches;
- farms and pastures;
- mountains; and
- peatlands.



APPROACH TO WATERSHED REHABILITATION IN TÜRKİYE

With the previous studies – flood control studies in the watersheds, afforestation, erosion control and rehabilitation in degraded forest areas – pasture improvement works were carried out in many parts of the country. Along with these studies, support was given to improve the social conditions in the forest villages in the watershed.

By collecting the restoration works carried out within the UN Decade itself in a strategy document, the “UN Decade in Ecosystem Restoration” document was published and the importance of cooperation between countries in restoring the degraded ecosystems in the world was emphasized; it was also emphasized that countries should provide the necessary support for the restoration of degraded ecosystems.

It is important to continue the rehabilitation and restoration works in the watersheds based on basin boundaries in Türkiye, in line with the contracts OGM is party to, and in the light of the experiences it has gained from the watershed rehabilitation projects implemented before. Within this framework, the decision to carry out watershed rehabilitation project studies has been taken and project studies have been initiated.

OBJECTIVE

In recent years, when the effects of climate change, the watersheds have deteriorated as a result of excessive use. The objectives are therefore to:

- rehabilitate and restore natural resources;
- carry out rehabilitation and restoration in rural villages in the watershed; and
- initiate new project studies to improve the socio-economic situation in a climate-resistant and sustainable manner.

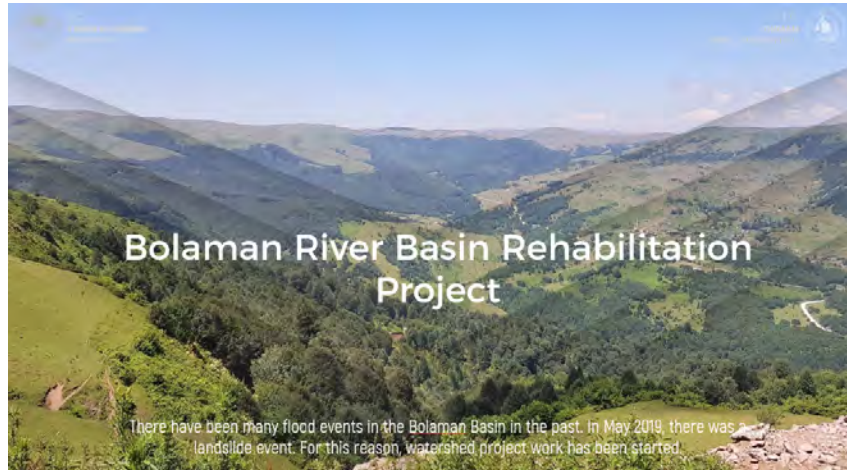
For this purpose, rehabilitation projects have been initiated in two separate watersheds.



TÜRKİYE RESILIENT LANDSCAPE INTEGRATION PROJECT

The Türkiye Resilient Landscape Integration Project (TULIP) consists of two subprojects.

1. Bolaman River Watershed Rehabilitation Project

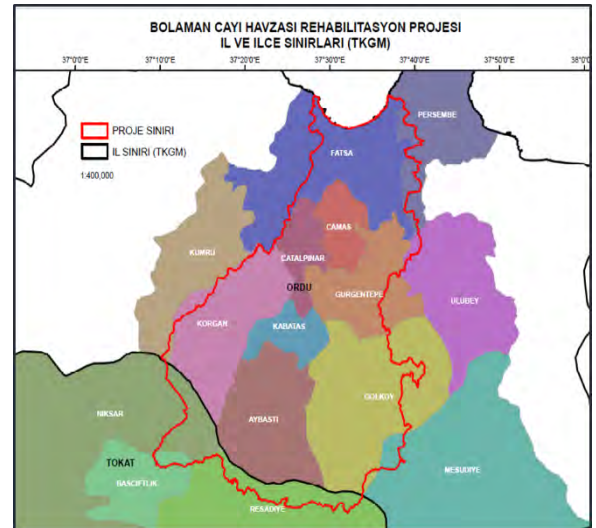


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Photo 1. A view from the upper reaches of the Bolaman Watershed.

Project information:

- Project area – from 25 national basins
- Located in the Eastern Black Sea Basin
- Watershed area – 158 886 ha
- Population – 257 500 people
- In Ordu and Tokat Provinces
- Number of villages – 266 villages and neighbourhoods
- 15 total districts
 - Ordu: 12 districts
 - Tokat: 3 districts
- Project period – 7 years (2021–2027)
- Implementing institution – General Directorate of Forestry
- Project stakeholder institutions
 - General Directorate of Agricultural Reform
 - General Directorate of State Hydraulic Works
 - General Directorate of Highways
 - General Directorate of Combating Desertification and Erosion



2. Çekerek River Watershed Rehabilitation Project



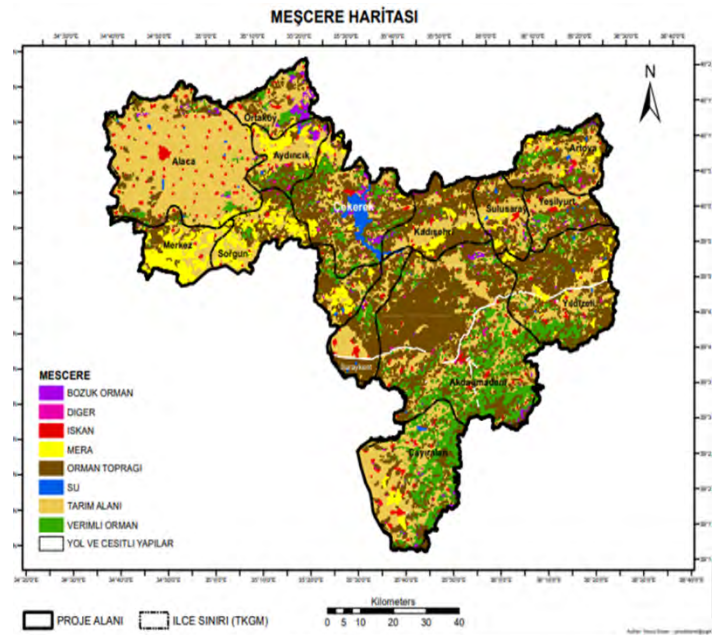
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Photo 2. A view from the Çekerek Dam and erosion control study areas of the Çekerek Watershed.

Yesilirmak Basin and some of it stays in the Kızılırmak Basin.

Project Information:

- 14 districts:
 - Yozgat Province: 8 districts
 - Tokat Province: 3 districts
 - Corum Province: 2 districts
 - Sivas Province: 1 district
- 14 watershed areas – 876 551 ha
- Population – 225 618 people
- Number of villages – 480
- A project period – 7 years (2021–2027)
- implementing institution – General Directorate of Forestry
- Project stakeholder institutions:
 - General Directorate of Agricultural Reform
 - General Directorate of State Hydraulic Works
 - Special Provincial Administrations of Governorate
 - General Directorate to Combat Desertification and Erosion



These two project studies were included in the 2022 investment programme. During the negotiations with the World Bank while searching for resources for these projects by the Ministry of Treasury and Finance, two projects were gathered under the name of the Türkiye Resilient Landscape Integration Project (TULIP) and a contract worth USD 135 million was signed.

The implementers and stakeholders of this project are the General Directorate of Forestry, General Directorate of Agricultural Reform, General Directorate of State Hydraulic Works and General Directorate of Highways. The budget distribution of the institutions belonging to this project and the components of the project are given below.

Component 1. Türkiye Resilient Landscape Integration Project

Table 1. Budget distribution and components of the stakeholder institutions

Component 1: Investments in Resilient Landscape Integration in Targeted Areas	127.505.000
1.1. Green infrastructure and sustainable livelihoods (OGM+TRGM)	
1.1.A. Upper Basin rehabilitation and livelihoods OGM [35.849.000]	58.839.000
1.1.B. Sustainable and climate-smart agriculture value chains TRGM (22.990.000)	
1.2. Resilient gray infrastructure (DSİ+KGM)	
1.2.A. Resilient infrastructure for water security DSİ (55.511.000)	68.913.000
1.2.B. Resilient mobility KGM (13.402.000)	
Component 2: Institutional Framework, Project Management and Sustainability (OGM)	7.495.000
2.1: Framework of Practice for Integrated Landscape Management	3.113.000
2.2: Project management and sustainability	4.382.000
TOTAL AMOUNT	135.000.000

Source: Ergüven, I. 2022. *Türkiye Resilient Landscape Integration Project (TULIP) - Procurement Plan (English)*. World Bank Group, Washington, DC.

<http://documents.worldbank.org/curated/en/099050001242224095/Turkey000EUROP00000Procurement0Plan>

The planned activities in TULIP are divided into two components. Activities to be carried out by stakeholder institutions in the first component are listed below:

GENERAL DIRECTORATE OF FORESTRY

- Afforestation, soil conservation, erosion and flood control projects, degraded forest rehabilitation, pasture rehabilitation projects and seedling production projects.
- Support for livestock, beekeeping, greenhouses and improvement of living conditions with Orküy investments.
- Ecotourism, recreation area projects and non-wood products diversification projects.



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Photo 3, 4, 5 & 6. GDF sample erosion control, recreation area, rangeland improvement activities and solar heating project applications.

GENERAL DIRECTORATE OF AGRICULTURAL REFORM

- Development and support projects for livestock breeding.
- Good agricultural practices, development and support projects for agricultural activities.
- Pasture management and application projects.
- Machine and equipment support projects.
- Farmer education projects.



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Photo 7 & 8. GDAR sample, rangeland improvement activities and greenhouse project application photos.

GENERAL DIRECTORATE OF STATE HYDRAULIC WORKS

- Lake and pond irrigation constructions.
- Flood, overflow and sediment control projects.





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Photo 9, 10, 11 & 12. General Directorate of State Hydraulic Works pond, dam, stream improvement and irrigation project application sample photos. GDF Archive

GENERAL DIRECTORATE OF HIGHWAYS

- Climate-resistant road rehabilitation in the countryside (Kabataş, Aybastı Road) over 8 kilometres (km).
- Climate-resistant road rehabilitation in the countryside (Aybastı, Gökçöy Road), 37 km.

SPECIAL PROVINCIAL ADMINISTRATIONS

- Construction of ponds and irrigation pools.
- Construction of small and medium-sized agricultural irrigation plants.
- Construction of recreation areas.



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Photo 13 & 14. Special Provincial Administration sample photos of small and medium-scaled irrigation project applications. GDF Archive

The planned activities in the second component are given below.

Component 2. Institutional framework, project management and sustainability

2.1.A. A framework of practice for integrated landscape management

1. Preparation of national strategy document for integrated watershed projects.
2. Preparation of TULIP integrated watershed rehabilitation projects.
 - i. Preparation of the Bolaman Integrated Watershed Rehabilitation Project.
 - ii. Preparation of the Çekerek Integrated Watershed Rehabilitation Project.

3. Microcatchment implementation plans (MCP).
 - i. Bolaman microcatchment rehabilitation plans.
 - ii. Çekerek microcatchment rehabilitation plans.

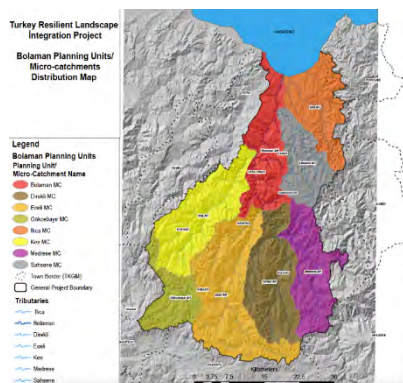


Figure 4. Bolaman Watershed subwatershed boundaries map

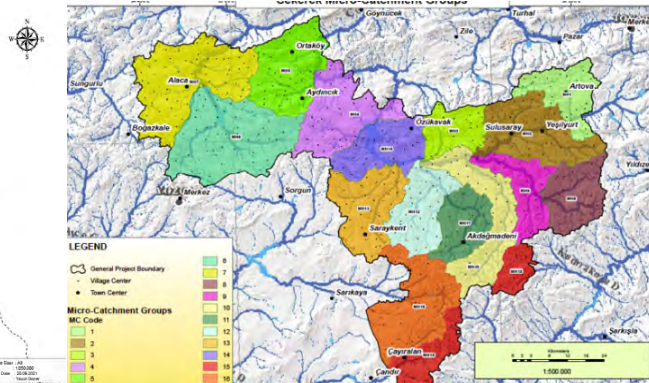


Figure 5. Çekerek Watershed subwatershed boundaries map

2.1.B. Preparation of integrated landscape management and implementation tools

1. Preparation of the technical guidance document for the Integrated Basin Rehabilitation (IBRP).
2. Feasibility studies and environmental and social tools for near future investments.
3. Determination of flood control structures in climate-resistant integrated land management plans (ILMP).

2.1.C. Institutional capacity building for integrated landscape management

1. International technical capacity development training.
2. Domestic technical capacity development trainings.
3. Technical Capacity Development Programme for beneficiaries.

2.2. Project management and sustainability

1. Project management.
2. Environmental and social risk management.
3. Monitoring and evaluation.
 - a. Management information system (MIS) development.
 - b. Reports and evaluation
 - i. Baseline survey.
 - ii. Medium term survey.
 - iii. Impact assessment survey.
4. Complaints, resolutions and citizen participation.

Project components and activities have been put forward in this direction.

Within the framework of the first component of TULIP, the activities of stakeholder institutions in the watershed will be carried out in an integrated manner. For this purpose, the upper scale Integrated Watershed Rehabilitation Project specified in the second component will be carried out, the general structure and status of the watershed will be defined, proposals will be put forward and targets will be determined. In line with the main objectives, microcatchment planning will ensure that all activities in the watershed are planned in an integrated way and that there are projects that produce solutions to the identified problems. The effects of the projects of a stakeholder institution will be supported by the

subprojects of the other stakeholder institution and, thus, the project integration between the institutions will also be realized.

Under the second component of TULIP, an institutional strategy document will be created that will guide works in the following years. In addition, it is planned to carry out project management, monitoring and evaluation studies within the second component.

NATIONAL BASIN REHABILITATION STRATEGY

The National Basin Rehabilitation Strategy is a document that will guide the rehabilitation works to be carried out in the watersheds after TULIP.

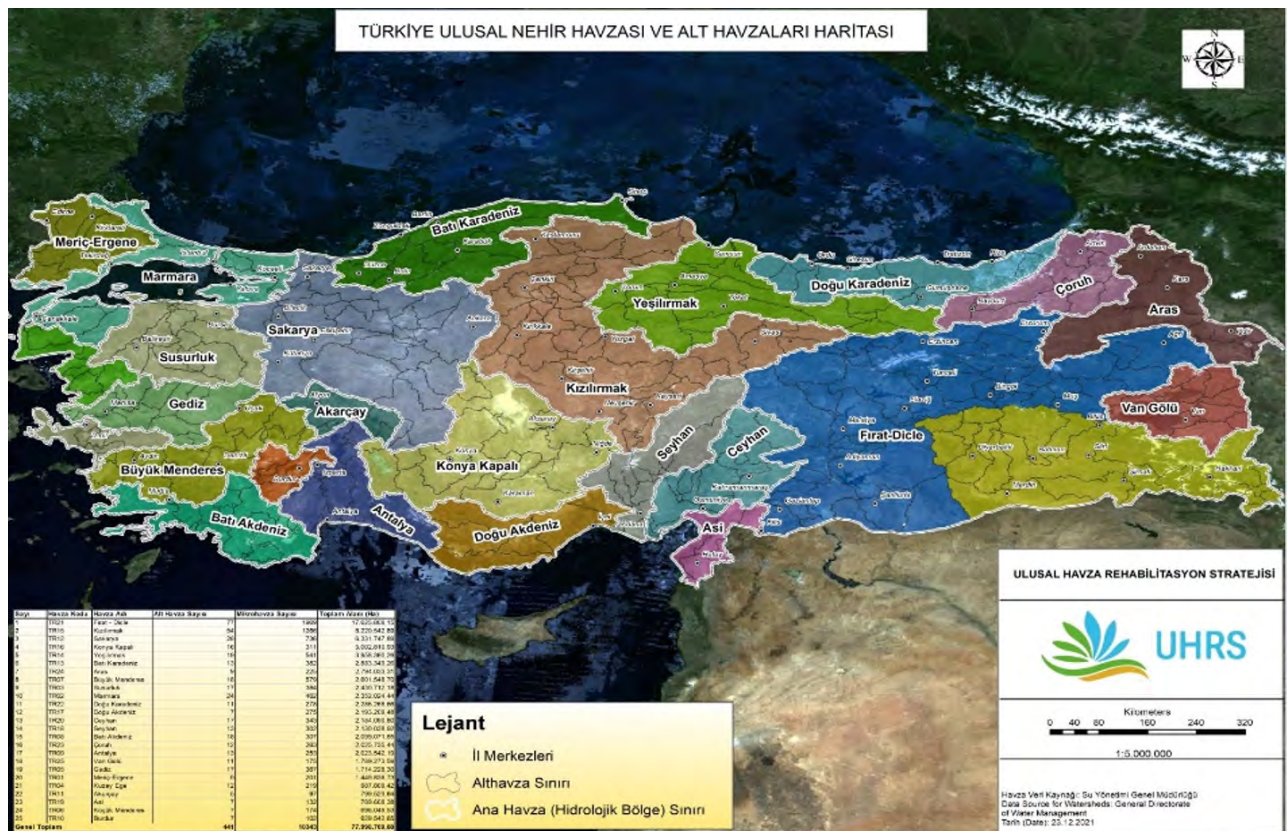


Figure 6. Türkiye map of basin borders

It is a document that reveals the way in which the destroyed ecosystems in the watersheds are rehabilitated and restored together with the authorized institutions and organizations.

This document sets out the principles of prioritizing subwatersheds in line with the criteria and rehabilitating or restoring the landscape in the basins with the ILMP and MCP to be prepared in line with the basic approaches.

When the strategy document is completed and published, in line with this strategy, necessary legislative studies and action plans will be created and the watersheds rehabilitation and restoration studies in Türkiye will be directed accordingly.

What is the National Basin Rehabilitation Strategy Document (NBRIS)?

It determines the subwatershed working priorities by evaluating the watersheds and subwatersheds in Türkiye according to a number of criteria and reveals the priority watersheds to be invested in. After this determination, rehabilitation works will be started in the most essential and prioritized watersheds.

The prioritization of subwatersheds in the National Basin Rehabilitation Strategy (NBRS) is based on three main and six subindicators, which are:

- **socioeconomic** (demographic, disasters and various risk factors, environment and natural resource management);
- **ecological** (land-use status, natural resource management and climate); and
- **morphological** (geophysical and morphometry).

According to the 56 criteria determined, the subwatersheds are:

- prioritization;
- legislation preparation;
- preparation of action plan; and
- preparation and implementation of watershed; and
- rehabilitation projects.



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Photo 15. Coruh Watershed and Olur District erosion control area.

It is planned that the next watershed rehabilitation works will continue in line with the strategy document.

Conclusion

Successful results were obtained as the studies conducted continued to address the problems that have increased. The importance of integration among the projects of the institutions operating legally in that watershed emerges in the studies such as flood control carried out on a watershed basis.

For this reason, TULIP is considered a successful project in terms of interinstitutional integration in the rehabilitation projects to be carried out by the institutions in the watershed. This will ensure sustainability and efficiency of the projects and increase the watersheds resilience to climate change.

References

- LEGKL. 2021. *Official Documents- Loan Agreement for Loan 9272-TR (English)*. World Bank Group, Washington, DC. <http://documents.worldbank.org/curated/en/133211631310544040/Official-Documents-Loan-Agreement-for-Loan-9272-TR>
- Mustafa, DAL. 2011. Organizational Structure in Yandere Breeding Studies in Türkiye. Orm. Eng. <http://nek.istanbul.edu.tr:4444/ekos/TEZ/47390.pdf>
- United Nations. 2021a. What is Ecosystem Restoration? In: *United Nations Decade on Restoration*. www.decadeonrestoration.org/what-ecosystem-restoration
- United Nations. 2021b. Strategy. In: *United Nations Decade on Restoration*. www.decadeonrestoration.org/strategy

Forest and landscape restoration activities in Türkiye under the Bonn Challenge

Ümit Turhan¹

¹General Directorate of Forestry,
Ankara, Türkiye;

Abstract:

Currently, Türkiye has 22.9 million hectares (ha) of forests managed by the government. This area represents one-third of the country.

Türkiye joined the Bonn Challenge for the first time in 2019. Türkiye has committed to bringing 2.3 million ha into restoration by 2030 under ECCA30 as a contribution to the challenge. This includes post-fire restoration, artificial rehabilitation and silvicultural rehabilitation. Achieving this pledge will contribute to multiple domestic and international targets, which are to increase productive forest value, increase forest area to 30 percent of the country by the end of 2023, enhance internal coordination mechanisms and establish collaboration with other countries and international and national organizations, including the Bonn Challenge.

Türkiye stated the endorsement of ECCA30 as a platform for exchanging knowledge and experiences with other countries in the region.

In 2019–2021, 2 million ha were completed, with the remaining 300 000 ha to be completed by 2030.

Introduction

Forests cover around 31 percent of the Earth's surface. The annual loss of natural forests, however, is around 10 million hectares (ha) according to the Food and Agriculture Organization of the United Nations. Deforestation and land degradation are major causes of biodiversity loss and significantly reduce the productivity of natural assets.

Degradation of the Earth's land surface impacts the well-being of 3.2 billion people. Costs of biodiversity and ecosystem losses are estimated at 10 percent of annual global gross product (IPBES, 2018).

The Intergovernmental Panel on Climate Change (IPCC) warns of increased risks to ecosystems, food security, livelihoods, water supply and economic growth over 1.5 degrees Celsius (°C) of global warming (IPCC, 2018).

Forest-based methods include afforestation, reforestation and forest management. Building on previous work that emphasized the global potential of various options, more recent advances have focused on the limits of those global potentials in light of ecological and climate risks that can threaten the long-term permanence of carbon stocks (Anderegg *et al.*, 2020; Boysen *et al.*, 2017). Some of those risks arise from droughts, fires, insect outbreaks, diseases, erosion and other disturbances (IPCC, 2022, p. 221; Thompson *et al.*, 2009).

As an opportunity, restoration of 350 million ha of degraded land by 2030 could generate USD 9 trillion in ecosystem services and remove 13–26 gigatonnes of greenhouse gases (GHGs) from the atmosphere (Bonn Challenge, 2020).

The United Nations Decade on Ecosystem Restoration 2021–2030, led by the United Nations Environment Programme (UNEP) and the Food and Agriculture Organization of the United Nations (FAO), underlines the necessity to scale up restoration of degraded and deforested ecosystems as a proven measure to conserve biodiversity, fight climate change and enhance food security from 2021 to 2030.

The Bonn Challenge, a comprehensive initiative, is a global goal to bring 150 million ha of degraded and deforested landscapes into restoration by 2020 and 350 million ha by 2030.

Launched in 2019 by Europe, the Caucasus and Central Asia, ECCA30 is a regional forest landscape restoration initiative that contributes to the Bonn Challenge and aims to bring 30 million ha of degraded and deforested landscapes in Europe, the Caucasus and Central Asia into restoration by 2030.

The status of Türkiye on the Bonn Challenge

In the Mediterranean Basin, Türkiye is much more affected by climate change than predicted estimations and projections, with an additional impact on existing problems including the loss of biodiversity, desertification, land degradation and water scarcity.

Currently, Türkiye has 22.9 million ha of forests managed by the government. This area corresponds to one-third of the country.

Türkiye joined the Bonn Challenge for the first time in 2019. Türkiye is committed to bringing 2.3 million ha into restoration by 2030 under ECCA30 as a contribution to the Bonn Challenge. This pledge includes post-fire restoration, artificial rehabilitation and silvicultural rehabilitation. Achieving this pledge will contribute to multiple domestic and international targets, increase productive forest value, increase the forest area to 30 percent of the country by the end of 2023, enhance internal coordination mechanisms and establish collaborations with other countries, international organizations and national organizations, including the Bonn Challenge.

Türkiye began endorsing ECCA30 as a platform for exchanging knowledge and experiences with other countries in the region.

Between 2019 and 2021, 2 million ha were completed, and the remaining 300 000 ha will be completed before 2030.

Forest practices for the Bonn Challenge

Türkiye is one of the rare countries that can increase its forest assets. Multipurpose afforestation and soil conservation works were carried out in suitable areas, thus increasing the forest area while preventing erosion and sediment transport, creating new recreation and ecotourism areas, and forming new carbon sinks and oxygen sources. Forestland is increasing in Türkiye day by day.

Türkiye has developed several strategies and plans with the intention of improving its forest assets. Regarding forest activities, some plans and strategies are as follows:

- National Forestry Programme of Türkiye (2004–2023):
 - development of existing forests; and
 - expansion of forestlands with forest facilities in suitable areas other than the forest.
- Climate Change Strategy of Türkiye (2010–2023):
 - developing and disseminating efforts to combat desertification and erosion.
- General Directorate of Forestry Strategic Plan (2019–2023).
- Strategic Goal (G2) to develop forests, increase efficiency and expand lands.
- National Combating Desertification Strategy and Action Plan (2015–2023):
 - rehabilitation of mining sites; and
 - to protect and develop natural resources within the framework of sustainable land management principles with a holistic and participatory approach, implementation of studies, especially integrated watershed rehabilitation and management plans.
- National Watershed Management Strategy (2014–2023):
 - preparation and implementation of basin rehabilitation, flood, avalanche and landslide projects against natural disasters in upper basin areas;
 - preparation and implementation of large-scale integrated and participatory watershed rehabilitation projects in appropriate basins for the implementation of watershed protection and rehabilitation activities, along with activities to improve the living and income conditions of low-income people who put pressure on natural resources; and
 - with the rehabilitation and afforestation works to be carried out in degraded forest areas, increasing the normal or productive forest areas, which still constitute 50 percent of the forests in the basins, to 75 percent in 2023.

Türkiye has ranked sixth among the top ten countries that have gained in forest areas in the last decade, according to the FAO's latest *Global Forest Resources Assessment* (FAO, 2020b).

Table 1. Top ten countries for average annual net gain in forest area, 2010–2020 (FAO, 2020a).

Ranking	Country	Annual net change	
		1 000 ha/yr	%
1	China	1 937	0.93
2	Australia	446	0.34
3	India	266	0.38
4	Chile	149	0.85
5	Viet Nam	126	0.90
6	Türkiye	114	0.53
7	United States of America	108	0.03
8	France	83	0.50
9	Italy	54	0.58
10	Romania	41	0.62

Source: FAO. 2020a. *Global Forest Resources Assessment 2020: main report*, pp. 36. www.fao.org/3/ca9825en/ca9825en.pdf

Note: The rate of change (%) is calculated as the compound annual change rate.

Table 2. Annual forest expansion, deforestation and net change

FRA categories	Area (1000 ha/year)			
	1990–2000	2000–2010	2010–2015	2015–2020
Forest expansion (a)	38.71	94.85	110.47	119.18
...of which afforestation	22.65	62.91	75.36	80.20
...of which natural expansion	16.06	31.94	35.11	38.98
Deforestation (b)	2.22	1.38	1.03	1.17
Forest area net change (a-b)	36.49	93.47	109.44	118.01

Source: FAO. 2020b. *Global Forest Resources Assessment 2020: report Türkiye*, pp. 24–26.

Table 3. Annual reforestation

FRA categories	Area (1000 ha/year)			
	1990–2000	2000–2010	2010–2015	2015–2020
Reforestation	60.08	76.71	104.76	118.82

Source: FAO. 2020b. *Global Forest Resources Assessment 2020: report Türkiye*, pp. 24–26.

Türkiye has carried out considerable afforestation practices for erosion control, adding a total of 2.14 million ha of forestland since 1973. Within the scope of the works aimed at developing and expanding forests through afforestation, combating erosion and rehabilitation of degraded forest areas, work has been carried out on an area of 9.2 million ha since 1946. New afforestation work has been carried out on 2 415 569 ha of land, 598 000 ha of which has been in the last 18 years. To date, efforts to improve degraded forest areas have been carried out in an area of 3 254 000 ha.

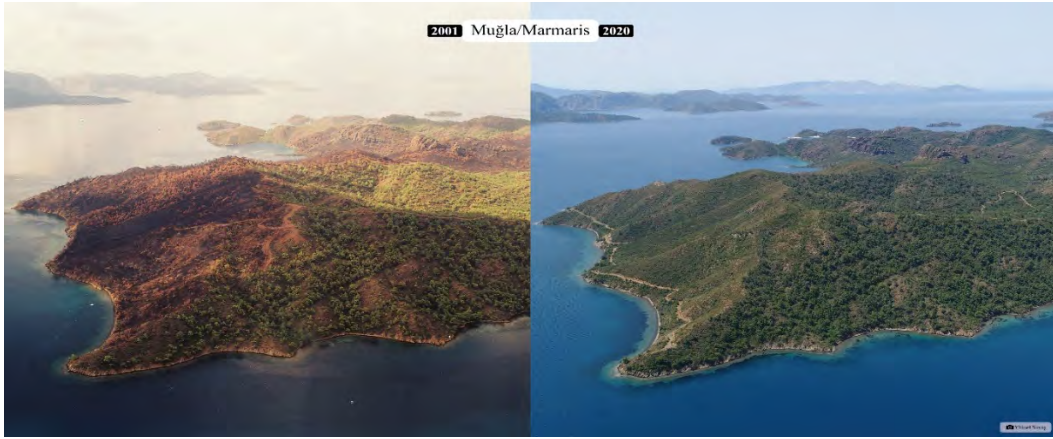


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Photo 1. Antalya/Adrasan (2014–2021)

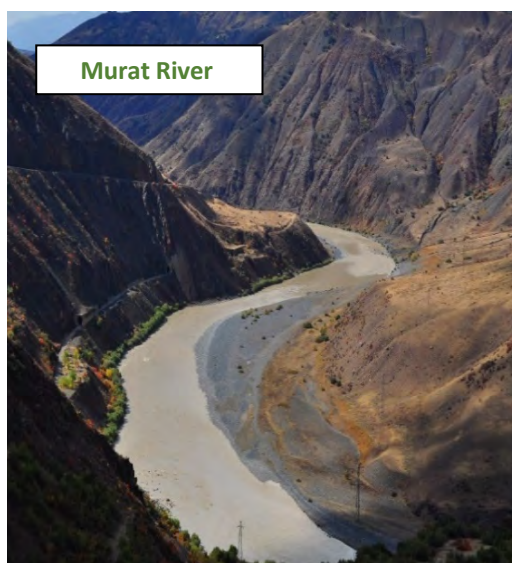


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Photo 2. Antalya/Olimpos (2016–2020)

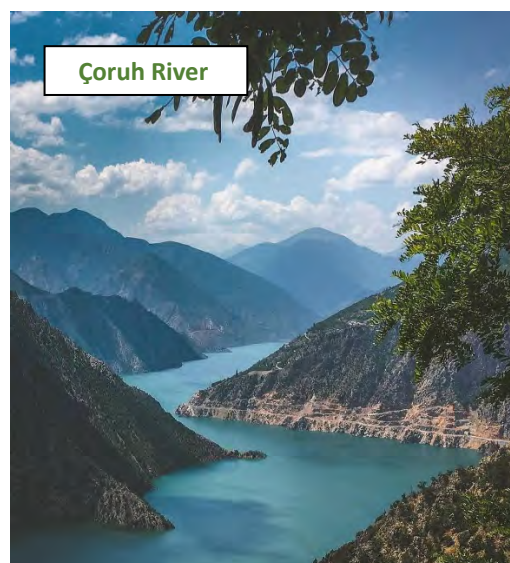


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Photo 3. Muğla/Marmaris (2016–2020)

Erosion control and soil conservation projects have been given priority in all basins. In addition, the implementation of basin rehabilitation, flood, avalanche and landslide projects prepared against natural disasters. Considering the rehabilitation studies of natural resources within the basin integrity, especially erosion control, the Çoruh Basin Rehabilitation Project and the Murat River Basin Rehabilitation Project were prepared by making use of the experiences obtained from the Eastern Anatolian Watershed Rehabilitation Project and the Anatolian Watershed Rehabilitation Project. Another one of the biggest projects, the Türkiye Resilient Landscape Integration Project (TULIP), funded by the World Bank, aims to strengthen integrated landscape management and increase access to improved livelihood opportunities and resilient infrastructure services for rural communities in targeted areas of Türkiye.



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Photo 4. Murat River Basin



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Photo 5. Çoruh River Basin

The Rehabilitation of Burnt Areas and Fire-Resistant Forest Plant Project (YARDOP), put into practice in 2010, reinforces forest areas under fire and reduces the impact of possible forest fires.

In this context, the Youth Stands Mobilization Action Plan (2012–2016) and the Pruning Action Plan in Forest Trees (2015–2019) have been put into practice.

To rehabilitate some forest areas and make them productive, rehabilitation work was completed in a total of 1 558 583 ha during 2010–2017. The implementation processes of the prepared Cedar Forests Rehabilitation Action Plan (2015–2019), Chestnut Action Plan (2013–2019) and Mining Sites Rehabilitation Action Plan (2014–2018) are ongoing.

Table 4. Achievements in rehabilitation activities, 2017–2021

	2017	2018	2019	2020	2021	
					Programme	Practice
					(ha)	(ha)
Rehabilitation	112 100	112 273	73 248	56 576	46 420	85 098
Rehabilitation tending	42 736	58 152	39 768	34 589	47 635	44 292

Source: OGM. 2022. 2021 Activities Report, p. 26. www.ogm.gov.tr/tr/e-kutuphane-sitesi/FaaliyetRaporu/Orman%20Genel%20M%C3%BCd%C3%BCrl%C3%BC%C4%9F%C3%BC%202021%20Y%C4%B1%C4%B1%20Faaliyet%20Raporu.pdf

"By planting millions of young trees, the nation is working to foster a new, lush green Türkiye," the Türkiye President stated to initiate the mass tree-planting project in Ankara. He declared 11 November the National Forestation Day and expressed hope that such planting ceremonies will become an annual event for the Turkish public and that they will set an example for the world. On 12 November 2019, Guinness World Records announced that Türkiye had established a world record of planting most saplings in an hour at 303 150 trees (UNCCD, 2019).



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Photo 6. National Afforestation Day, Ankara 2019

Under the FAO and Türkiye Partnership, the Government of Türkiye has committed USD 10 million to the FAO–Türkiye Forestry Partnership Programme (FTFP). Established in 2014, the FTFP aims to strengthen the capacities of countries in the subregion and beyond by sharing Türkiye and FAO’s technical expertise in forestry, natural resources, desertification prevention and sustainable development for practical application in the field. Areas covered by the agreement include sustainable forest management, plantations and rehabilitation, forest products and ecosystem services, forests and the environment, people and forests, governance, assessments and monitoring, combating desertification and interdisciplinary issues (FAO, 2014).

The amount of soil carried by rivers in Türkiye has reduced to 154 million tonnes this year from about 500 million tonnes per year back in the 1970s, thanks to afforestation activities, changes of irrigation techniques in agricultural areas, improvement of rangeland and erosion control studies. The target is to reduce the number to 130 million tonnes in the next five years (UNCCD, 2018).

Conclusion

Forest rehabilitation and restoration practices create a crucial window of opportunity to protect, conserve and restore forest in consideration with sustainable forest management.

They are also closely associated with the Turkish Government’s commitments through the nationally determined contributions (NDCs) under the United Nations Framework Convention on Climate Change (UNFCCC), Aichi Targets and the Convention on Biological Diversity (CBD), land degradation neutrality (LDN) under the United Nations Convention on Combating Desertification (UNCCD), the Sustainable Development Goals (SDGs) – particularly SDGs 1, 2, 6, 8 and 15 – and the United Nations Strategic Plan for Forests (UNSPF). Along with these commitments, Türkiye strengthens not only forest and landscape restoration activities at all levels and supports the mobilization of favourable resources, but also fosters intersectoral cooperation amongst various land management agencies responsible for agriculture, forestry and livestock management. In this regard, Türkiye also seeks further cooperation with international and regional partners to encourage the restoration and rehabilitation activities on degraded and deforested lands, in particular regional initiatives like the Bonn Challenge.

There is a growing awareness of the importance of forest and landscape restoration in Türkiye. Across the country, forest ecosystems have been degraded and deforested for various reasons over time. It should be ensured that degraded and deforested forest ecosystems are rehabilitated and brought back to their original state or as close as possible to it since restoration work is very costly.

With its strong organizational structure and the unique feature of having a well-established forestry organization, Türkiye fulfills its assigned mission with success today, as it has done consistently in the past.

References

- Anderegg, W., Trugman, A. T., Badgley, G., Anderson, C. M., Bartuska, A., Ciais, P., Cullenward, D., Field, C. B., Freeman, J., Goetz, S. J., Hicke, J. A., Huntzinger, D., Jackson, R. B., Nickerson, J., Pacala, S. & Randerson, J. T. 2020. Climate-driven risks to the climate mitigation potential of forests. *Science* 368, eaaz7005. <https://doi.org/10.1126/science.aaz7005>
- Boysen, L., Lucht, W., Gerten, D., Heck, V., Lenton, T.M. & Schellnhuber, H.J. 2017. The limits to global-warming mitigation by terrestrial carbon removal. *Earth's Future*. 5(5): 463–474. <https://doi.org/10.1002/2016EF000469>
- FAO. 2014. *FAO-Turkey Forestry Partnership Programme*. www.fao.org/in-action/fao-turkey-partnership/about/en/
- FAO. 2020b. *Global Forest Resources Assessment 2020: report Turkey*, pp. 24–26. www.fao.org/3/cb0081en/cb0081en.pdf
- OGM (General Directorate of Forestry of Türkiye). 2018. *General Directorate of Forestry Strategic Plan 2019–2023*, pp. 11, 21–22. [www.ogm.gov.tr/tr/e-kutuphane-sitesi/StratejikPlan/General%20Directorate%20Of%20Forestry%20Strategic%20Plan%20\(2019-2023\).pdf](http://www.ogm.gov.tr/tr/e-kutuphane-sitesi/StratejikPlan/General%20Directorate%20Of%20Forestry%20Strategic%20Plan%20(2019-2023).pdf)
- IPPC (The Intergovernmental Panel on Climate Change). 2018. *Special Report: Global Warming of 1.5 °C*. <https://www.ipcc.ch/sr15/>
- IPCC. 2022. *Sixth Assessment Report*, p. 221. www.ipcc.ch/assessment-report/ar6/
- IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services). 2018. *Assessment Report on Land Degradation and Restoration*. <https://ipbes.net/assessment-reports/ldr>
- International Union for the Conservation of Nature (IUCN). 2020. *The Bonn Challenge*. www.bonnchallenge.org/
- Thompson, I., Mackey, B., McNulty, S. & Mosseler, A. 2009. Forest Resilience, Biodiversity, and Climate Change: A Synthesis of the Biodiversity/Resilience/Stability Relationship in Forest Ecosystems. *CBD Technical series* No. 43. www.researchgate.net/publication/232129022_Forest_Resilience_Biodiversity_and_Climate_Change_A_Synthesis_of_the_BiodiversityResilienceStability_Relationship_in_Forest_Ecosystems
- UNCCD (United Nations Convention to Combat Desertification). 2018. *Turkey gets results in combating soil erosion*. www.unccd.int/news-stories/stories/turkey-gets-results-combating-soil-erosion
- UNCCD. 2019. *Turkey plants millions of trees to set the world record*. www.unccd.int/news-stories/stories/turkey-plants-millions-trees-set-world-record
- United Nations Decade on Ecosystem Restoration. 2019. About the UN Decade. In: *United Nations Decade on Ecosystem Restoration*. www.decadeonrestoration.org/about-un-decade
- UNEP (United Nations Environment Programme). 2019. New UN Decade on Ecosystem Restoration offers unparalleled opportunity for job creation, food security and addressing climate change. In: *UNEP*. www.unep.org/news-and-stories/press-release/new-un-decade-ecosystem-restoration-offers-unparalleled-opportunity

Pasture restoration activities and their effects on rural development in Türkiye

Abdülssamet Aydın¹ | Eray Özdemir²

¹General Directorate of Agricultural Reform, Ministry of Agriculture and Forestry, Ankara, Türkiye

²General Directorate of Forestry, Ministry of Agriculture and Forestry, Ankara, Türkiye

Abstract:

The livestock sector, which is included in agricultural production, has been Türkiye's leading economic sector for a long time and is vital for rural development and food security. The roughage that livestock need is provided by three main sources: meadow and pasture areas, forage crops and plant production residues. However, due to climate change, poor practices and conflicts in rural areas, pasture areas lose productivity, the agricultural sector weakens, and young people migrate to urban areas. Rangelands, important natural resources in terms of biodiversity, erosion prevention, rural development and tradition, are also important carbon sinks. This study highlights the importance of rangelands for rural development in Türkiye and explains how rangeland improvement activities should be done, focusing on degraded rangelands and showcasing good practices on the sustainability of rangelands.

Keywords: Pasture areas, rural development, pasture improvement works, livestock and rangelands

1. Introduction

Pastures are lands with a sloping and rugged topography representing very large areas, covered with short, sparse and ball-shaped plants, with shallow and deep groundwater. They are also food sources for grazing (Altın *et al.*, 2005).

Meadows and pastures are natural places of vegetation and serve different functions as sources of roughage for farm animals. Meadows and pastures produce quality feed, especially when they are green. Thanks to the abundance of species diversity, they help animals to have a balanced diet. The fact that they are the cheapest source of roughage in countries where animal product costs are high, as in Türkiye, gives a special importance to pastures (Gökkuş, 2018). Concurrently, they have many ecological functions, such as protecting and sustaining natural resources, being indispensable for wildlife, increasing biodiversity, preventing soil erosion, storing carbon, providing fuel and contributing to rural landscapes (Gökkuş, 2001).

Meadows and pastures form a continuous green cover, absorb the Sun's rays and use them in the food chain. The reflection values are lower than in areas not covered with plants, thereby reducing the effects of global warming to some extent (TAGEM, 2016). For appropriate management and improvement of pastures, their current status should be identified correctly. In the light of the latest developments in the world, a new form of evaluation is needed to accurately present the current state of pastures in Türkiye.

In addition to being important terrestrial carbon sinks, pastures are also crucial for the continuity of rural tradition, food sovereignty and local sustainable development for rural producers who make a living from animal husbandry. Today, the demands for sustainable food production systems require that they meet the needs of modern consumers seeking both quality and safety, aim to increase the income of rural producers and protect the environment, contribute to reducing the effects of climate change, and protect biodiversity (TÜBİTAK, 2021). The diversity of major farming systems associated with semi-natural habitats and rural landscapes is also valuable for mutually supporting economic sectors such as agriculture, agrotourism and ecotourism (Hazar, 2018).

In recent years in Türkiye, the interaction of agricultural production systems with ecosystems has come to the fore in national and local policy agendas in line with strategies to combat climate change and promote rural development while reducing pressure on biodiversity and greenhouse gases and creating carbon sinks. In addition, industrial agrifood systems, which have many economic, ecological and social negative effects, have been globalized by neoliberal agricultural policies since the 1980s (Karakaya and Ayalp, 2017; İZKA, 2021). The agricultural sector is among those most affected by this situation, with in particular the migration of people from rural to urban areas, the increase in residential areas, and the fact that producers are living in rural areas with gradually decreasing income levels.

In the 2000s, because of increasing consumer concerns about production cycle quality and sustainability of animal food products, "alternative agricultural food systems" (ATGS) emerged to establish direct producer–consumer relations and enable rural producers to make a living and access healthier food (Karakaya Ayalp, 2020). It is thought that ATGS can provide powerful benefits when integrated into the livestock sector. Ovine husbandry practices, which are still mostly carried out with extensive traditional methods (commonly in pastures) in Türkiye, have great potential in this sense (TÜBİTAK, 2021).

2. The importance of pastures

The green grass of the pastures has 12–18.5 percent crude protein, depending on the species composition and environmental conditions (Koç and Gökkuş, 1996; Bakoğlu *et al.*, 1999). On the other hand, wheat straw contains 3.6 percent crude protein (Özen and Çakır, 1993). In addition, pasture grasses are especially rich in vitamins A, E and B, as well as minerals (McDowell, 1989; Özen and Çakır, 1993). Animals grazing in the pasture are healthier and more peaceful (Altın *et al.*, 2011). Moreover, the products of the animals in the pasture are of better quality. For example, conjugated linoleic acid found in milk and meat, which is extremely important for human health, increases in animals grazing on pasture (Kurban and Mehmetoğlu, 2006).

Meadows and pastures cover 18.8 percent of the Turkish total land area with 14.6 million hectares (ha) (TUIK, 2021), and all these areas are used for grazing. However, approximately 80 percent of the land is utilized by grazing animals in other areas (agriculture, forest, etc.), especially during periods when pastures are insufficient (Gökkuş, 2018).

Although they are highly important, the common use of pastures in Türkiye involves excessive grazing pressure with no care for improvement. This situation is the biggest problem caused by the Turkish extensive animal husbandry. Producers accessing pastures generally use these areas in an unlimited and uncontrolled manner without incurring any costs other than the shepherd's expense. Even the "grazing fee", which must be paid by law, cannot be obtained from the producers. The exploitation of pastures, the lack of necessary maintenance or improvements in return, and the inadequacy of regulations on their use cause these areas to lose their productive power and ecological functions to a great extent. Therefore, production costs in pasture livestock did not decrease as desired, and as a result, prices of animal products increased above the purchasing power of the Turkish people. As a temporary solution to the increase in meat prices, meat and livestock were imported. However, it should not be overlooked that this may prepare the way for bigger problems in the coming years (Gökkuş, 2018).



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Picture 1. Pasture grazing

Meadows, pastures and forage crops are highly important for agriculture, animal husbandry, humans and the environment for the following reasons (Gülcan and Anlarsal, 2001; Serin and Tan, 2001; Avcioğlu *et al.*, 2009):

- They are a cheap source of roughage for animals.
- They are rich in vitamins and minerals.
- They increase the yield of animals and the quality of animal products.
- They increase the reproductive power of animals.
- They contain essential nutrients for the stomach microflora of animals.
- Animals grazing on pastures are healthier than animals fed in barns, and the animal products obtained are more delicious.
- They increase soil fertility.
- They protect the soils against erosion.

- They rehabilitate salty and alkaline soils.
- They enrich the underground water resources.
- They clean the air and increase the oxygen rate of the air.
- They provide shelter and nutrition for wild animals (fauna).
- They ensure the protection and continuity of plant gene resources (flora).
- Some legume forage crops such as clover and sainfoin are sources of nectar (honeycomb) and pollen for bees.
- Some legume seeds and fruits (beans, lupines, etc.) can also be used as food by humans for various purposes.
- They are green and picnic areas for people to enjoy.

3. Pasture restoration activities

Meadow and pasture breeding represents all processes carried out to increase the yield of low-quality unproductive pastures to maximize efficiency and increase feed quality. The first purpose of breeding studies is to increase the amount and quality of grass produced in meadow pastures, and the second is to ensure that animals benefit from this grass in the best way (Altıntaş *et al.*, 2018). Rangeland improvement activities also increase the carbon storage and sink capacity held in the rangelands.

The improvement of pastures and appropriate grazing management are essential to make the best use of them. Due to the economic, social and cultural reasons, widespread grazing of pastures at the wrong time and poor practices causes these areas to deteriorate in Türkiye, as in other parts of the world. Therefore, mistakes in rangeland management can lead to reclamation (Bingöl Üniversitesi, 2017).

In Türkiye, the deterioration of meadows and pastures is more advanced because it has been inhabited since ancient times. In the last 50 years, there has been a dramatic 70 percent decrease in Turkish rangelands. Meadows and pastures that have lost their original vegetation must be rehabilitated to regain their previous productive capacity and high-quality forage production. It is therefore important to clearly define meadows and pastures to understand the differences in the structure and uses of vegetation.

Meadow improvement can be defined as "all kinds of applications made on the meadow to increase the yield and quality of the feed produced in the meadow areas". Pasture improvement can be defined as "the facilities established on the pasture and the arrangements and practices to increase the yield and quality of the pastures and enable the grazing animals to benefit more and more easily from the grass (feed) produced".

Rangeland improvement consists of two separate parts:

- Increasing the yield and quality of the grass produced by the pasture.
- Ensuring that animals benefit from the grass produced to the maximum extent.

Methods such as fertilization, seeding, and disease and pest control are used to increase grass yield and create better vegetation in the pasture. Grass quality can also be increased by practices such as foreign plant control and burning. In addition, fences, shelters, feeding areas, water bowls, saltshakers, pasture roads and more are created to allow the animals to better benefit from the grass produced.

In breeding projects, one or more of the above-mentioned methods are applied together. In a pasture with decreasing yields and which has lost most of the original plant species composition, seeding with fertile and qualified grass-producing plants is mainly considered. Fertilization must be considered for the planted species to attain their maximum yield. In addition, if weeds compete with the planted species, these should also be kept in check for successful breeding. Also, when it comes to improving a bush pasture, the bushes should be burnt first, the plant composition should then be enriched through seeding, and fertilization should be used to increase plant yield. If a pasture is not too far from its original condition and has not been excessively degraded or converted to another land use, control of grazing or fertilization alone may be

sufficient. All pastures in the world need improvement according to their degree of effectiveness due to reasons such as deterioration, overgrazing and land conversion.

Pasture restoration and improvement projects are needed for low-yielding pasturelands located in neighbourhoods or villages by systematization of irregular grazing, removal of excessive pressure on pastures, increasing the area and yield of forage crops in field agriculture, reduction of roughage deficit and increasing livestock production and yield. For this purpose, the Pasture Rehabilitation and Amenity Project is being prepared by the Agriculture and Forestry Provincial Directorates in the pasture areas where needed.

During the preparation phase of the Pasture Rehabilitation and Amenity Project, several factors, including the class of pastures, vegetation structure and status, slope, groundwater level, soil structure, climatic conditions, current usage habits of pastures, type and number of animals benefiting from pastures and roughage needs, should be considered over the total animal count in the planned area.

The owners of the animals located in the settlements where the Pasture Rehabilitation and Amenity Project is implemented should be actively involved by contributing towards labour, tools, equipment and fuel.

To combat weeds and invasive poisonous plants, prompt intervention should occur as soon as they appear, allowing for the most effective control with minimal costs. Conversely, the breeding of foreign plants, especially shrubs, at later stages in terms of growth and reproduction will be both more expensive and less effective.

In the selection and application of breeding methods in Pasture Rehabilitation and Amenity Projects, areas with the greatest potential to increase the productivity of the pasture should be preferred. Areas with shallow and unproductive soils, low land power, little rainfall or steep topography often require expensive breeding practices and produce very little forage. Attention should be paid to the cost–benefit ratio in these areas. When deciding on the breeding methods, the class of pastures, the method of use and climatic features should be considered.



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Picture 2. Atriplex applied pasture area change

Table 1. Type of restoration method applicable according to the state and structure of meadows and pastures

The State and Structure of Meadow-Pastures	Rehabilitation Methods That Can Be Applied
Excellent (climax)	Proper management (Grazing Plan)
Good-quality pasture	Proper management + fertilization + combating with foreign plants when necessary
Medium-quality pasture	Proper management + fertilization + foreign plant struggle + artificial insemination (scattering seeding or interplanting)
Poor-qualified pasture	Proper management + fertilization + foreign plant struggle + artificial insemination (interplanting or re-meadow-pasture construction)
Bushy pasture (grass cover good)	Proper management + firing/combating with foreign plants + fertilization
Bushy pasture (grass cover weak)	Proper management + firing/combating with foreign plants+ fertilization+ artificial insemination
Base land (insufficient water)	Proper management + fertilization + maintaining water order + combating foreign plants if necessary
Base land (excess water)	Proper management + fertilization + maintaining water order (especially drainage)++ combating foreign plants if necessary

4. The importance of pasture improvement and its effects on rural development

Since pasture improvement is a long-term process, the benefits will be visible after a long time. Irrigation, drainage and various soil and water storage facilities for the provision of drinking water are very costly practices. Therefore, rangeland improvement requires very long-term and expensive investments. To protect and develop meadows and pastures, which are one of the main forage resources for animals, and to ensure more profitable use of these natural resources, efforts should be made to develop them. It is difficult to predict the net profit that will be provided by meadow pasture improvement. The period depends on the vegetation's response to the improvement.

Pasture improvement has many benefits. These benefits are the following:

- Feed production increases: high feed production forms the basis of meadow and pasture improvement. For successful meadow and pasture management and pasture livestock production, high-quality and sufficient feed production and continuity are required. However, it is not enough for any breeding method applied to increase feed production alone. At the same time, it is necessary for this to be economical in terms of a profitable pasture.
- Feed quality increases: in addition to high feed production in meadows and pastures, in order for this feed to be converted into more animal production, its nutritional value and palatability must be high and the green growth period must be long. Farm animals fed with meadow and pasture forage, which has less foreign plant ratio and sufficient nutrients for animals, have a higher yield power.
- The amount of animal products increases: animal products such as meat, milk and wool is the final product from meadows and pastures, and these have many benefits for people. In improved pastures, the number of grazing animals increases, together with the fertility of the animals, the birth weights and weaning weights of the offspring, and the mortality rates decrease.

- Animal handling and management become easier, animals become more docile and the number of male breeders needed is reduced: this can be achieved by controlling bushes, providing pasture fences, shelters and drinking water facilities and building pasture roads. By controlling bushes, the loss of lambs from the herd and from predators can be reduced.
- Poisonings are reduced: in all meadows and pastures in the world, poisonous plants are frequently encountered. If these plants are eaten by animals, various diseases can lead to death, resulting in serious yield and offspring losses. It is possible to prevent these losses in animals by removing poisonous plants in meadows.
- The fire hazard is reduced: the fire hazard can be reduced by opening fire lanes in the forest pastures or forest areas utilized by grazing the lower vegetation and by destroying the easily flammable material in the season when the fire hazard is low. In addition, the risk of fire and loss can be reduced by controlling bush species that burn quickly and have no feed value.
- The water efficiency of the basins increases: better vegetation helps accumulate more water in the soil where the roots spread (rhizosphere), for a longer time by preventing the runoff or seepage of precipitation away from the soil. By removing bush or herbaceous species with alien plant characteristics from the vegetation as part of breeding, the remaining edible species use the available water more effectively.
- Erosion is prevented: in weakened pastures with a high risk of erosion, the plant roots of the cover improved by reclamation reduce the risk of erosion by holding the soil. Keeping the soils in place (prevention of erosion) through improvement works in sloping and poor pastures where erosion is severe is a greater priority than increasing the animal production from the pasture. In this regard, many-headed geven (*Astragalus eriocephalus*) and snow thorn species (*Acantholimon* spp.), which are common exotic plants in the rangelands of Central and Eastern Anatolia, should be protected as they are good erosion control plants, although animals cannot graze them.
- Conflicts are reduced between the multiple uses of rangeland resources: opening up pastures can help improve hunting activities by leading to a better distribution of farm animals in the pasture, and an increase in game animals. Again, with the seeding of bare pastures, the feed needed by animals is provided, and erosion is prevented, thus increasing the number of fish in streams and lakes with cleaner water.
- Migration pressure on rural communities is reduced: the rural young have been migrating to the cities due to a sharp decrease in income in rural areas in the last four decades in Türkiye. One of the reasons for this reduction is the loss or degradation of pastures. This migration pressure on people in rural areas can be reduced by pasture improvement.

5. Conclusion

In recent years, human beings have been consuming natural resources faster and in larger quantities than ever before in human history, resulting in overuse of natural resources, including meadows and pastures.

Migration of rural communities, especially young people, to cities, is among the main problems associated with the loss of pastures. To change this situation, the geographical, biological, climatic and physical characteristics of pasture areas should be taken into consideration in land-use planning in ecologically sensitive rural contexts.

Ensuring the sustainability of meadow and pasture areas will allow for both the development of animal husbandry and improved incomes for rural communities engaged in animal husbandry. Higher incomes directly impact local development. Meadows and pastures could play a central role for social, economic and environmental development due to their contribution to agriculture and animal husbandry, and their positive impact on biodiversity and carbon sequestration.

References

- Allen, J. & McDowell, L. 1989. *Landlords and property: social relations in the private rented sector*.
- Altın, M., Gökkuş, A. & Koç, A. 2005. *Çayır Mera Islahı. T.C. Tarım ve Köyişleri Bakanlığı*. ISBN:975-407-188-8.
- Altın, M., Gökkuş, A., Koç, A. 2011. Çayır ve Mera Yönetimi 2. Cilt (Genel İlkeler). Tarım ve Köyişleri Bakanlığı TÜGEM yayınları. 84-88s, Ankara.
- Altıntaş, G., Altıntaş, A., Çakmak, E., Demir, O., TEAD. 2018. 4(2);1–16, Araştırma Makalesi.
- Bingöl Üniversitesi. 2017. Çayır Mera Islahı. Cited 10 January 2022. www.bingol.edu.tr/documents/ÇAYIR%20MERASLAHI.pdf
- Koç, A., Gökkuş, A. 1996. Palandöken dağlarında kayak pisti olarak kullanılan ve nispeten korunan mera ile otlatılan meranın bitki örtülerinin karşılaştırılması. Türkiye 3. Çayır-Mera ve Yem Bitkileri Kongresi, 162-170, Erzurum.
- Avcıoğlu, R., Hatipoğlu, R. ve Karadağ, Y. 2009. Yem bitkileri (genel bölüm). Tarım ve Köyişleri Bakanlığı, Tarımsal Üretim ve Geliştirme Genel Müdürlüğü Cilt I, İzmir.
- Bakoğlu, A., Koç, A., Erkovan, H.İ., Özaslan, A. 1999. Erzurum Yöresi Mera Vegetasyonlarında Bulunan Korunga (*Onobrychis viciifolia* Scop.)'nın Bazı Özellikleri. Türkiye 3. Tarla Bitkileri Kongresi 15-18 Kasım 1999 Adana. Cilt III. 251-255 s.
- Özen, N., Çakır, A., Haşimoğlu, S., Aksoy, A., 1993. Yemler ve Yem Teknolojisi. Atatürk Üniversitesi Ziraat Fakültesi Ders Notları No 50, Atatürk Üniversitesi Ziraat Fakültesi Ofset Tesisi, Erzurum.
- Gülcan, H. ve Anlarsal, A.E. 2001. Yem bitkileri II. Ç.Ü. Ziraat Fakültesi Genel Yayın No: 5, Ders Kitapları Yayın No: A-3, Adana.
- Hazar Kalonya, D. 2021. Müştereklerin Çitlenmesi Ekseninde Kadınlar: Ekofeminist Perspektiften Türkiye'de Çevre Hareketleri, PLANLAMA, 31(3), 448–465.
- Hazar Kalonya, D., Ayalp, E., Karakaya Ayalp, E., Candan Demirkol, E., Özden, F., Yıldız, M. Y., Kocagöz, U., & Çelik, Z. 2020. Korona Günlerinde Tarım ve Gıda Politikalarını Yeniden Düşünmek, Spektrum 02: Pandemi ve Post-pandemide Toplum ve Mekân: Görüşler, Öngörüler, Öneriler, 117–119. Ulusal Kitap Bölümü, ISBN: 978-605-06463-0-6.
- Hazar, D. 2018. Rural-Ecological Commons: Case of Pastures in İzmir [Kırsal-Ekolojik Müşterekler: İzmir Mera Alanları Vakası], Doktora Tezi, İzmir Yüksek Teknoloji Enstitüsü, Fen Bilimleri Enstitüsü, İzmir.
- İZKA. 2021. İzmir Development Agency Yarimada Sustainable Development Strategy. Cited 11 August 2021. http://izka.org.tr/wp-content/uploads/pdf/14_yarimada_kalkinma_stratejisi.pdf
- Koç, G., & Uzmay, A. 2015. Gıda Güvencesi ve Gıda Güvenliği: Kavramsal Çerçeve, Gelişmeler ve Türkiye. *Turkish Journal of Agricultural Economics*, 21(1).
- Kurban, S., İ. Mehmetoğlu. 2006. Konjuge Linoleik Asit Metabolizması ve Fizyolojik Etkileri. *Türk Klinik Biyokimya Dergisi*, 4(2): 89-100.
- Serin, Y. ve Tan, M. 2001. Yem bitkileri kültürüne giriş (2. baskı). Atatürk Üniversitesi Ziraat Fakültesi Ders Yayınları No 206, Erzurum.
- TAGEM. 2016. Tarımsal Araştırmalar ve Politikalar Genel Müdürlüğü 2016-2020 Mastır Planı. Cited 10 January 2022. www.tarimorman.gov.tr/TAGEM/Belgeler/yayin/MASTER%20PLAN_2016-2020.pdf
- TÜBİTAK. 2021. TUBİTAK Final Report No 116O95, ERA-NET SusAn action (EcoLamb, ID48).
- TÜİK. 2021. Turkish State Meteorological Service, Ministry of Agriculture and Forestry, Republic Of Turkey. 2020 State of Climate in Turkey.

THEMATIC SESSION 6

Restoring landscapes and forests for communities in Lebanon

Restoring forests and landscapes for communities in Lebanon

Maya Nehme³

Chadi Mohanna¹ | George Mitri² | Abdo Nassar³ | Jean Stephan⁴ |
Eliane Charbel³ | Joseph Bechara³ | Maria Salamouni³ | Leticia Rahhal³

¹Ministry of Agriculture of Lebanon | ² Institute of the Environment, University of Balamand | ³ Lebanon Reforestation Initiative | ⁴ Lebanese University, Faculty of Sciences

Lebanon is known for its high biodiversity and the forests of Lebanon have been mentioned in the Bible as well as several historical records. Decades of degradation have led to serious losses in forest areas. For the last decade, the Lebanese Ministry of Agriculture has been collaborating with FAO and several international and local actors, including NGOs and local experts, to restore Lebanon's natural landscapes, including forests and rangeland. In 2012, the Ministry launched the National Afforestation and Reforestation Plan. Lebanon then defined clearly its targets for CBD, LDN and UNFCCC with a special focus on restoration in a participatory approach.

This paper summarizes the session organized by the Lebanon Reforestation Initiative at the 7th Mediterranean Forest Week in Antalya, Türkiye, covering forest landscape restoration management and practices in Lebanon with a special emphasis on community engagement, including women and youth. The session started with an overview of the current status of forest restoration in Lebanon, moving to high-level planning for forests and landscapes, then showcasing studies and providing concrete examples on local-level land use planning, mapping species suitability, valuing ecosystem services and planning fire prevention on the fireshed level. While engaging community in a participatory approach was mentioned in all the presentations, the last one focused specifically on the Youth Conservation Corps as a way to effectively engage youth in forestry work, and provided examples of active women engagement in the forestry sector in Lebanon.

An overview of forest landscape restoration management and practices in Lebanon were presented to show the full range of management and engagement levels. Different initiatives and research findings on forest and landscape restoration and management in Lebanon were introduced with a special emphasis on the involvement of women and youth in the sector.

Initially, key national policies related to forest management in Lebanon and the importance of an integrated forest management approach that aligns national strategies with local initiatives were highlighted.

Scaling down to the local level, a case study on land-use planning and forest management was presented. The planning and management approaches in this case study took into consideration high-level guidelines,

given that they are presented as replicable models. Through these management plans, data gaps were identified.

Subsequently, research studies such as producing species suitability maps were presented. The data provided by species suitability maps can mainstream species selection into management plans and set priorities within conservation.

Also, an evaluation study of ecosystem service provided by forest areas and how the related results utilized as a communication tool were also presented.

Afterwards, as wildfires are a major threat to forest ecosystem services, the fireshed and firewise approaches were demonstrated as efficient approaches for improved fire risk management. These methods aim to reduce fire risk, protect forests and decrease desertification while promoting positive behavioural change with a focus on gender roles in forest restoration.

Lastly, the Youth Conservation Corps (YCC) programme, implemented in Lebanon for the first time by Lebanon Reforestation Initiative (LRI), by supporting the future green generations of Lebanon demonstrated the crucial role of youth in forestry.

Conclusion

Landscape restoration in Lebanon is a sector that can only develop further with clear scientific knowledge, strong partnerships and active engagement from local communities, especially youth and women. Planning is essential to successful restoration, on the national and regional level, as well as the microlocal level, and a major lesson learned is that planning needs to take in consideration all factors as well as all stakeholders and that the latter should be involved and actively engaged from the initial planning stages, to ensure good progress.

References

UNDP (United Nations Development Programme) & Ministry of Environment. 2020. *National guidelines for forest Management in Lebanon*. UNDP. Beirut.

Restoring forests and landscapes for communities in Lebanon

George Mitri¹

Abdo Nassar² | Jean Stephan³ | Eliane Charbel² | Joseph Bechara² | Maria Salamouni² | Leticia Rahal² | Maya Nehme²

¹Land and Natural Resources Programme at the Institute of the Environment, University of Balamand, Lebanon

²Lebanon Reforestation Initiative, Beirut, Lebanon

³Lebanese University, Faculty of Sciences, Department of Life and Earth Sciences, Beirut, Lebanon

Abstract:

In this work, different initiatives and research findings on forest and landscape restoration and management in Lebanon were introduced with a special emphasis on the involvement of women and youth in the sector. Key national policies are highlighted in relation to forest management in Lebanon, together with the importance of an integrated forest management approach that aligns national strategies with local initiatives. A case study on land-use planning and forest management was presented. A research study for producing species suitability maps was introduced. Then, an ecosystem service valuation study was presented with the aim of basing management plans on ecosystem services. As wildfires are a major threat to forest ecosystem services, the fireshed and firewise approaches were demonstrated to efficient approaches for improving fire-risk management. Concluding with the crucial role of youth in forestry, the Youth Conservation Corps programme that was implemented in Lebanon for the first time by the Lebanon Reforestation Initiative was demonstrated.

Introduction

An overview of forest landscape restoration management and practices in Lebanon is essentially needed to be developed for having a better understanding about the full range of management and engagement levels. In this work, different initiatives and research findings on forest and landscape restoration and management in Lebanon were introduced with a special emphasis on the involvement of women and youth in the sector. Initially, key national policies related to forest management in Lebanon and the importance of an integrated forest management approach that aligns national strategies with local initiatives were highlighted. Scaling down to the local level, a case study on land-use planning and forest management was presented. The planning and management approaches in this case study took into consideration high-level guidelines, given that they are presented as replicable models. Through these management plans, data gaps were identified. Subsequently, research studies such as producing species suitability maps were presented. The data provided by species suitability maps can mainstream species selection into management plans and set priorities within conservation. Adding to the reliance on data for the tailoring of forest management plans, an ecosystem service valuation study was also presented. More specifically, the methodology and framework of this latter study aimed to centre management plans on the ecosystem services provided by forest areas and the related results utilized as a communication tool of their important value. As wildfires are a major threat to forest ecosystem services, the fireshed and firewise approaches were demonstrated as efficient approaches for improved fire risk management. These methods aim to reduce fire risk, protect forests and decrease desertification while promoting positive behavioural change with a focus on gender roles in forest restoration. Concluding with the crucial role of youth in forestry, the Youth Conservation Corps (YCC) programme, implemented in Lebanon for the first time by Lebanon Reforestation Initiative (LRI), was demonstrated. This programme aims to support the future green generations of Lebanon.

High-level planning for landscapes and forests in Lebanon

Forest ecosystems in Lebanon have several strengths and weaknesses, and face opportunities and threats. Selected strengths of relevance to forest and landscape planning include the presence of highly biodiverse terrestrial ecosystems and of many bioclimatic zones. Weaknesses of relevance include (1) the lack of a consolidated and comprehensive national database on forest ecology, carrying capacities and other important aspects of ecological integrity; and (2) the lack of a national research agenda on forests to meet national needs and inform policies. The main opportunities include (1) the importance of resilient tree species to conserve genetic diversity with traits enabling adaptation to harsh environments; and (2) the availability of a range of native species that can be used in reforestation with high adaptation traits. Some of the existing threats involve fragmentation, degradation of forest ecosystems, loss of forest biodiversity, fires, pests and diseases, and soil erosion.

Similarly, the governance of forest ecosystems in Lebanon has several strengths and weaknesses, and faces opportunities and threats. Selected strengths include: (1) existing national partnerships with international non-governmental organizations (INGOs) and (2) high-level planning of land resources with master plans. Some of the weaknesses are: (1) law infringement and law limitations, (2) limited government financial resources, (3) lack of delineation, categorization and registration of forestlands, (4) weak cross-sectoral cooperation and synergies, and (5) unsustainable funding mechanisms. However, several opportunities have recently emerged including (1) existing scientific knowledge and research capability at national universities and research centres, and (2) availability of national guidelines for sustainable forest management. Some of the threats include: (1) emergence of serious economic and monetary crises affecting public administrations at all levels and national commitments; and (2) an unstable political situation affecting existing policies and strategies of relevance to the forest sector.

Multi-level planning for landscape and forests in Lebanon

Multilevel planning for landscapes and forests in Lebanon is shown in Figure 1. At the highest level, the national forest programmes and national plans guide subnational and regional planning. In turn, subregional planning provides guidance for developing local forest management plans.

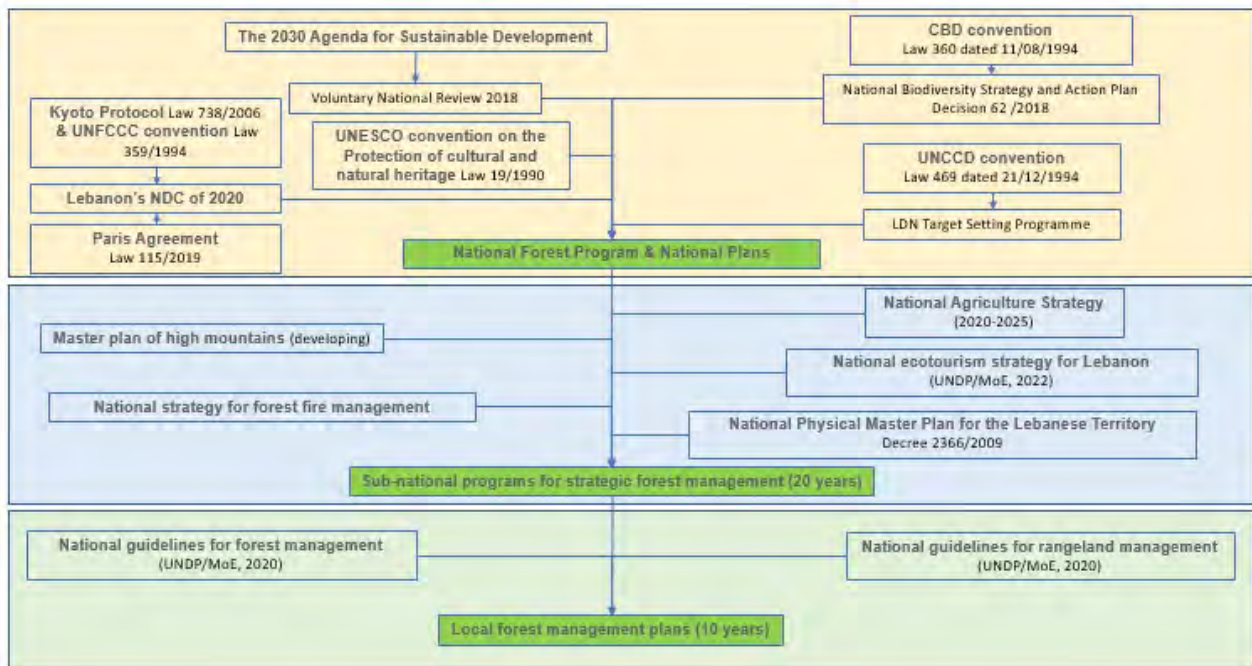


Figure 1. Multilevel planning for landscape and forests in Lebanon

More specifically, the 2030 Agenda for Sustainable Development and other international agreements provide insights into high-level planning for landscapes and forests in Lebanon. As a result, the Lebanese Government has several programmes to restore forests, including the National Action Plan to Combat Desertification and the National Afforestation and Reforestation Programme. Other projects that target biodiversity conservation have also been implemented. In addition, Lebanon has ratified several international agreements, including the CBD, the United Nations Convention to Combat Desertification (UNCCD) and the Ramsar Convention on Wetlands of International Importance.

Furthermore, the updated National Biodiversity Strategy and Action Plan submitted in 2016 selected 13 priority areas, set 18 national targets (NTs) with 91 national actions to ensure the implementation of the NTs, and integrated the new CBD strategic goals and the 2020 Aichi Biodiversity Targets.

In the National Report on Land Degradation Neutrality, the Government of Lebanon has committed to reaching LDN by 2030 and has set several voluntary targets including the implementation of sustainable forest management practices and the restoration of forest landscapes. In this context, the ongoing LDN Project of Mountain Landscapes in Lebanon of the United Nations Development Programme (UNDP) aims to rehabilitate degraded land and prevent further degradation in the mountain areas of Lebanon. Remedial methodologies for restoring the valuable ecological functions of mountain lands are based on sustainable agricultural productivity and enhancing species habitats and ecosystem services.

The 2020 adaptation priorities for nationally determined contribution (NDCs) included promoting the sustainable use of natural resources, restoring degraded landscapes and increasing Lebanon's forest cover while meeting the ecological, social and economic needs of sustainable forest management planning (SFMP).

Consequently, national guidelines for forest management were previously developed to guide the development of regional and local forest management plans (UNDP and Ministry of Environment, 2020). More specifically, strategic forest management issues (20-year time frame) are related to:

- management at national and subnational levels; and
- key elements that are mainly related to conservation-driven forest policies.

Tactical, operational management issues (10-year time frame) involve setting a realistic maximum length for forest management plans (FMPs) at the Forest Management Unit level spanning 10 years (knowing that estimated increments are usually valid for 10 years). A shorter period might not provide the stability that is needed to guide consistent implementation of sustainable forest management activities.

Thus, an integrated forest management approach should be followed from the national to the local level, thereby ensuring alignment of local actions with strategic regional and national provisions and priorities. (see Figure 2).

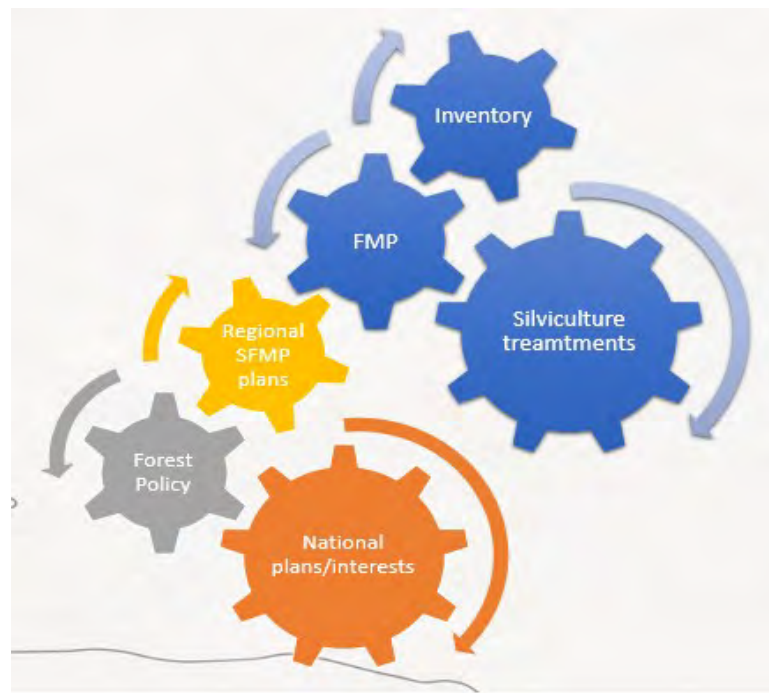


Figure 2. An integrated forest management approach from national to local level

The two case studies presented focused on the development of a forest management plan for the forest of Kherbet Rouha in the southern Beqaa area and a land-use plan for the highlands of Kesrwan in Mount Lebanon, extensively used for grazing and tourism but highly degraded and in need of restoration. Although the studies and plans were developed for these specific locations, the forest management plan was based on the national guidelines, and the land-use plan was developed in a way that is both replicable and scalable. Both planning processes were developed with the support and active engagement of local stakeholders, including local authorities and community members as well as local partner NGOs working in the sector, as having a clear plan approved by all stakeholders is crucial for project success.

In both areas, the work started by setting clear objectives with the local stakeholders. Thorough field visits were then conducted to gather all the needed data to support decision-making. Data collected included technical data on soil, vegetation, wildlife and land cover, as well as socioeconomic data including land use, human activities, number and types of stakeholders, and financial information.

For better engagement of local communities, the Lebanon Restoration Initiative (LRI) adopted a Decision Triangulation Scheme (DTS). The DTS approach is a decision-support tool, in which the decisions made are based on three factors:

- project objectives and targets;
- community needs and current uses; and
- science-based solutions and best practices.

Using the DTS, project risks, challenges and affected stakeholders were identified in the early planning stages. Mitigation activities were thus planned in parallel to the forest and land-use management planning process. Examples of mitigation measures implemented included supporting local shepherds with fuelwood, developing water ponds for shepherds affected by reforestation, planting trees in clusters to limit reforestation areas and reduce land-use disputes, and hiring workers from the local community to support project implementation, thus improving their livelihoods and increasing their commitment to restoration.

As a result, 40 000 native seedlings were planted over 40 hectares (ha) in Mshaa Kesrwan and a pruning licence was acquired for 90 tonnes in the Khirbet Rouha Forest. Implementation has so far supported so more than 32 local residents with more than 1 000 workdays, and the work is still ongoing and is being replicated currently in several other Lebanese locations.

Suitability maps for reforestation using ecological niche modelling

The main challenge for planning restoration in Lebanon has often been the lack of clear data on species distribution and suitability, especially since Lebanon is characterized by highly diverse topographical features, bioclimatic zones and soils, which influence species suitability. To address this gap while engaging youth and giving university students an opportunity to conduct practical research work, a study was conducted over the last three years to develop suitability maps using ecological niche modelling. A list of native species was set with a LRI team, starting with the species most used in restoration projects. Initially the list included 27 native species and was later expanded to include 31 shrub species. Presence points all over Lebanon were collected and data processed, testing a list of predictors and using composite factors. Results showed that new factors, not commonly reported in literature, such as cloud coverage, are very important to Lebanon's species suitability. For shrubs, the **Normalized Difference Vegetation Index (NDVI)** was found to be important to many species while land surface temperature affected many other species as well. Overall, taxa were each determined by different predictors.

This study allowed to identify a distribution range for each of the species tested according to an environmental gradient and then compare species suitability at different altitudes, bioclimatic zones and levels. The results of this study are currently guiding the decision-making process for restoration stakeholders in Lebanon to identify suitable native species to use in restoration projects, and can be replicated for more species as well as for other regions as a main tool for restoration.

Lebanese forest ecosystem services valuation

Considering that activities related to existing forests and newly reforested areas are important to a wide range of stakeholders in Lebanon, finding new funding streams to support forest conservation and restoration becomes critical to maintain and expand such activities.

Affirmed by this consideration, LRI under the USAID-funded Livelihoods in Forestry Project, has completed during the past two years a couple of studies on forest ecosystem services in Lebanon to explore new finance opportunities and mechanisms for forest conservation and restoration.

The first study entitled "Mapping and Valuing Forest Ecosystem Services in Lebanon" attempted to estimate the financial value of a selected set of forest ecosystem services, with specific attention to the forests' spatial contexts and the extent of their services. It highlighted the strong connection between established forests and people's livelihoods and well-being. In addition, it aimed to bring forward strong arguments as to the importance of conserving established forest ecosystems and increasing their areas, by using the value of their contribution to the local and national economy as a common communication ground with the public. Finally, this study intended to unlock the thinking to new financing possibilities that will serve forest conservation and reforestation efforts in Lebanon.

Keeping these purposes in mind, LRI framed the work under this first study based on a methodology adapted from a step-by-step approach proposed by environmental economist Lucy Emerton and inspired

by The Economics of Ecosystems and Biodiversity. This framework focuses on three core connecting dots: the first one is the exercise of framing the context and purpose of the study, the second focuses on assessing the actual ecosystem values, and the third concludes with the ways to showcase the benefits of the existing forests to different audiences and set the stage for action. The COVID-19 lockdown and economic crisis and overall situation in Lebanon conditioned most of the choices made to apply this general framework, with big limitations associated with primary data collection and secondary data access, and lack of a wider engagement of different stakeholders in the application of this framework (contrary to the initial plan). By following the steps of the general framework methodology, four services were identified and selected, with future aspirations to cover more. These services are forest honey provision, forest tourism, carbon sequestration and storage, and air quality enhancement.

Focusing on these specific services, research and decisions were made to specify the type of forests that provide these services, their spatial distribution and their specific characteristics, as well as the different valuation method to be adopted for each service based on the most representative and feasible valuation techniques, followed by the calculation of results. Following data processing, applying the general framework continued with three final steps: (1) stating baseline values and to whom; (2) describing the added value of forest conservation and expansion based on findings; and (3) concluding by disseminating these findings to the target audience while focusing on the key messages and appropriate tools to do so. Findings from this study were communicated to different stakeholders through webinars and workshops and by publishing an interactive story map. Discussions are currently ongoing on different funding mechanisms that can be linked with different ecosystem services and how to build sustainable financing systems for conservation and restoration. This topic was covered in the second study that provided different models for such financing mechanisms that can be adapted based on different situations. LRI is currently working on implementing the model in some of Lebanon's nature reserves.

The firewise approach and fireshed concept

Forest ecosystem services are increasingly threatened by wildfires, which can also cause serious social, environmental and economic damage. As part of LRI's efforts in forest conservation and management, LRI has been involved in supporting communities to reduce risk at both the local forest and fireshed level. The fireshed and firewise approach adopted by LRI aims to **reduce fire risk**, to protect forests and to decrease desertification while promoting **positive behavioural change**. It places a special focus on gender roles in forest restoration, aiming towards a more transformative integration of women in this sector. With that aim, LRI conducted a study to assess the fire risk perception. Direct interviews were conducted with selected stakeholders living in high fire risk areas. The respondents were asked to give their outlook on different aspects of fire risk such as causes, costs, damages and appointed responsibilities. The collected data served to facilitate the understanding of complex social dynamics relating to fires in Lebanon.

The fireshed concept was set as a management unit to upscale the firewise approach. It is equivalent to a watershed and covers areas with similar wildfire threats and in which similar response strategies could influence the wildfire outcome. It is suitable for developing a coordinated programme of work that requires close collaboration with multiple landowners and interested parties.

LRI selected three firesheds based on a pre-selected set of criteria that considered community interests, forest status and the existence of ongoing projects. The Nahr El Kalb watershed was presented as a case study.

Areas with high fire risk were calculated by identifying the amount of fuel and risk of combustion, such as areas with wild pine forests. Accordingly, fire hazard maps were created. The vulnerability which indicates the magnitude of factors that might affect the spread of fire was also calculated. It is important to note that this has more to do with social factors and land use.

High-risk fire zones are characterized by:

- forests that have a lot of combustible fuel;
- dense forests that are not managed due to changes in local lifestyles; and
- a large WUI.

The following steps are applied to identify villages with high fire risks:

- The relative area of high fire risk within each cadastral unit is calculated.
- Villages are identified that have more than 80 percent of land classified as high-risk areas.
- Villages located below 1200 m were highly urbanized. Many of these urbanized areas were intersected with fire-risk areas, therefore increasing demographic vulnerability to fires.
- The top 20 villages (i.e. priority sites) including an area with over 94 ha of high-risk wildland–urban interface are mapped in red.

The fuel management concept is based on the defensible spaces theory, which aims to reduce the threat, slow down and reduce the speed of the approaching fire, and provide an opportunity and space for firefighters to operate effectively.

As part of the fuel management concept, LRI applied several integrated approaches. First, pruning and clearing the understory and in some cases, management of trails to serve as fuel breaks, were implemented in several areas of the fireshed to protect values at risk and dense forests. Second, behavioural change was fostered through recurrent and intensive awareness-raising activities, focusing on permanent awareness (installing signs and disseminating awareness-raising material), and recurrent and occasional awareness (during the fire season, including distribution of books and brochures on fires, awareness events for children, hiking and awareness events for community members, training on fire prevention, social media campaigns, booths at local fairs, workshops, theatre plays and so on). Concurrently, water outlets were mapped and a plan for the enhancement of water access for fire response was developed in addition to the distribution of early intervention tool kits and training on fire response for volunteer squads to improve preparedness and response capacity at the local level.

Youth in forestry – Youth Conservation Corps case study

The presentation discussed the role of youth in the forest sector using a case study of the YCC, a programme funded by the US Forest Service and implemented for the first time in Lebanon by LRI.

The YCC programme is a programme developed by the US Forest Service to address both unemployment and the need for conservation work around the world. For this purpose, LRI recruited 30 young men and women from all over Lebanon, to engage in a 6-month-long programme combining training and job placement activities focused on the management of natural resources.

The programme's slogan was to "Root, Lead and Change", highlighting the participants key role in leading and making a change in the forest sector in Lebanon. It is meant to create a community of young environmentally and socially aware people, who are equipped with individual and collective skills, and knowledgeable on the importance of sustainable development.

The YCC mission is to develop personal responsibility through meaningful work that connects the young individuals to the land, community and one another. The model applied is centred on small, diverse teams, led by highly trained leaders, completing important work that has great impact and benefits the community. Throughout the 6-month residency, LRI offers training on fire risk, conservation, reforestation, sustainability, as well as personal development. There is a wide range of opportunities depending on the participants' interests.

The YCC programme in Lebanon includes:

- strengthening alliances with NGOs working in nearby communities that will eventually recruit, train and provide internships for the graduate YCC participants;
- teach young people leadership, volunteering and personal development;
- teach natural resource conservation and sustainable development, including personal skills;
- interview, resume and job search training; and
- life and soft skills training.

As of 2022, 30 YCC participants have graduated with a certificate accredited by the US Forest Service and the Ministry of Youth and Sports. Many of these participants were able to find jobs and internships quickly after their graduation, at LRI and elsewhere.

Besides the work with youth, a case study on women engagement in forestry and agroforestry in Maqne, North Beqaa, was presented. The group of women belong to a town where women's participation in public decisions is very limited. One of the women engaged since 2010 is now a member of the local environmental committee and has recently created a small herbal tea business with support from the Hanns Seidel Foundation, using the herbs planted in the agroforestry site and engaging six other women from the town in the enterprise. The herbal tea is currently marketed in local stores in Lebanon. This case study shows just one of many examples of how women can effectively engage in the forest sector in Lebanon and around the world.

Bibliography

- Charbel, E. & Rahal, L. 2021. *Mapping and Valuing Forest Ecosystem Services in Lebanon*. Study completed under the USAID-funded Livelihoods in Forestry Project. Lebanon Reforestation Initiative (LRI), Beirut.
- Emerton, L. 2021. *Capturing Ecosystem Service Values: A stepwise approach to sustainable finance planning for forest protected and conserved areas*. Report completed under the USAID-funded Livelihoods in Forestry Project. Lebanon Reforestation Initiative (LRI), Beirut.
- Mitri, G., Chnais, E., Asmar, F., Amidi, J. 2019. Integration of Lebanon's Land Degradation Neutrality (LDN) Targets within the National Action Program (NAP) to Combat Desertification. Ministry of Agriculture and Association for Forests, Development and Conservation, Beirut. 137 pp.
- Mitri, G., Jazi, M., McWethy, D. 2015 Assessment of wildfire risk in Lebanon using Geographic Object-based image analysis. *Photogrammetric Engineering & Remote Sensing*, Vol. 81, No. 6, June 2015, pp. 499–506.
- UNDP (United Nations Development Programme) & Ministry of Environment. 2020. *National Guidelines for forest Management in Lebanon*. Beirut.
- Stephan J, Bercachy C, Bechara J, Charbel E, López-Tirado J. 2020. Local ecological niche modelling to provide suitability maps for 27 forest tree species in edge conditions. *iForest*, 13:230–237. <https://doi.org/10.3832/ifor3331-013>

Suitability maps for reforestation using ecological niche modelling

Jean Stephan¹

Melissa Korban² | Youmna Hammoud² | Christel Bercachy² | Eliane Charbel³

| Joseph Bechara²

¹Lebanese University, Faculty of Sciences, Department of Earth and Life Sciences, Fanar, Lebanon

²Lebanese University, Faculty of Sciences, Department of Earth and Life Sciences, Fanar, Lebanon

³Lebanon Reforestation Initiative, Jdeidet-Metn, Lebanon

Introduction

Ecological niche modelling allows the depiction of major abiotic environmental factors that affect species distribution to understand the environmental requirements of species. This is an important input for further grouping species into associations according to the similarity of their requirements.

One of the major outputs of ecological modelling is the production of suitability maps for reforestation for studied species. These maps can be used to develop the potential for reforestation when combined with socioeconomic aspects such as land tenure, land use and land ownership. This makes them an important tool for strategic land-use planning.

Another use of the outputs of the algorithms used for ecological niche modelling is to estimate the extent of occurrence of studied species, which is key for their assessment for the Red List of Threatened Species of the International Union for Conservation of Nature (IUCN). These outputs are also key to study the changes in their potential distribution based on future climate scenarios.

For this purpose, the Lebanese Reforestation Initiative (LRI) has launched an investigation programme allowing three young researchers and master's students from the Lebanese University to develop their master's theses. The project which lasted 3 years (2018–2020) started by defining the model or algorithm to be used (MaxEnt) and the selection of key predictors (environmental factors) to provide suitability maps for 27 native tree species (Stephan *et al.*, 2020). As a second step, the project refined the model and adapted it for the development of suitability maps for 31 shrub species (Hammoud and Stephan, forthcoming). Suitability maps were developed for 14 tree species, and the predictors were upgraded to develop suitability maps for riparian trees and shrubs.

Material and methods

The first step of the process was to select the species to be studied. Following this, field surveys were conducted for data collection and further completed with accurate coordinates of presence points from the literature, if available. Then, factors used as predictors were defined and processed by running models with MaxEnt. Finally, the data analysis was performed using the outputs of the model (training gain provided from the Jackknife tables showing the contribution of each predictor in the predicted distribution map of the species of interest, as well as generated maps).

The list of selected tree and shrub species and their respective counts at presence points are compiled in Table 1 and Table 2. The predictors that were selected for trees, shrubs and riparian species models are shown in Table 3. For shrubs, these were updated by removing those that did not contribute to the models, and by adding new predictors such as Tmax, land degradation, Normalized Difference Vegetation Index (NDVI) and land surface temperature. As for riparian species, the river flow regime, the distance from the river and the Topographic Wetness Index were also added.

Results and discussion

The results of the paper published by Stephan *et al.* (2020) are the only results shown here. The main results are that not all factors affect each species in the same way, while new predictors such as cloud coverage (CC) or distance from the sea (DFS) are worth considering in ecological niche modelling in the Mediterranean region since they highly contribute to the distribution of species. At the same time, predictors such as the Integrated Moisture Index (IMI) or the Potential Direct Incident Radiation (PDIR) are less important (Table 4).

Another important result is the definition of distribution ranges of species using environmental gradients, and interspecies comparison of average distribution ranges (Figure 1). Moreover, this allowed the plotting of species distribution in an Emberger climagram to better visualize their distribution in relation to bioclimatic zones and vegetation levels (Figure 2). In addition, species from the same genus were compared to better understand their respective distributions according to vegetation levels, as illustrated in Figure 3 and Figure 4 (as in the case of *Pinus brutia* and *Pinus halepensis*).

The data generated from the three studies make an important input for further investigation, such as studying the impact of climate change on future species distribution at the regional level (Vila-Viçosa *et al.*, 2019; Wallas *et al.*, 2019; Lopez-Tirado *et al.*, 2021). Additionally, these findings are useful at the local level for the further planning of ecosystem restoration activities and grouping the species according to their environmental requirement or bioclimatic distribution (Stephan *et al.*, 2020).

These results are valuable for defining the main factors affecting tree distribution, which is important for researchers and non-governmental organizations (NGOs) involved in ecosystem restoration activities. The IUCN Red List based on potential suitability maps allows decision-makers, NGOs and nurseries active in biodiversity conservation to identify priority species in reforestation activities. Moreover, it allows the protected areas and municipalities developing management plans for their forests to mainstream biodiversity conservation in their activities.

References

- López-Tirado, J., Vessella, F., Stephan, J., Ayan, S., Schirone, B. & Hidalgo, P. J. 2021. Effect of climate change on potential distribution of *Cedrus libani* A. Rich in the twenty-first century: an Ecological Niche Modeling assessment. *New Forests*, 52(3), 363–376.
- Vila-Viçosa, C., Gonçalves, J., Honrado, J., Silva, R., Vazquez, F., Stephan, J. & García, C. 2019. Past, Present, and Future of Marcescent Mediterranean Forests. *Biodiversity Information Science and Standards*, 3, e37195.
- Walas, Ł., Sobierajska, K., Ok, T., Dönmez, A. A., Kanoğlu, S. S., Dagher-Kharrat, M. B., Romo, A., Stephan, J., Jasińska, A.K. & Boratyński, A. 2019. Past, present, and future geographic range of an oro-Mediterranean Tertiary relict: The *Juniperus drupacea* case study. *Regional Environmental Change*, 19(5), 1507–1520.

Annex

Table 1. List of tree species and number of collected presence points

Accepted name	Number of points	Accepted name	Number of points
<i>Abies cilicica</i>	576	<i>Pinus halepensis</i>	34
<i>Acer hyrcanum tauricum</i>	214	<i>Pinus pinea</i>	463
<i>Acer monspessulanum microphyllum</i>	250	<i>Pistacia atlantica</i>	23
<i>Acer obtusifolium</i>	293	<i>Pistacia terebinthus palaestina</i>	343
<i>Alnus orientalis</i>	21	<i>Platanus orientalis</i>	85
<i>Amygdalus orientalis</i>	92	<i>Populus alba</i>	12
<i>Arbutus andrachne</i>	535	<i>Populus nigra</i>	17
<i>Arbutus unedo</i>	3	<i>Prunus ursina</i>	181
<i>Cedrus libani</i>	595	<i>Prunus dulcis</i>	130
<i>Celtis australis</i>	33	<i>Prunus korshinskyi</i>	46
<i>Ceratonia siliqua</i>	787	<i>Prunus mahaleb</i>	29
<i>Cercis siliquastrum</i>	348	<i>Pyrus syriaca</i>	335
<i>Crataegus azarolus</i>	249	<i>Quercus cedrorum</i>	105
<i>Crataegus monogyna</i>	253	<i>Quercus cerris</i>	200
<i>Cupressus sempervirens</i>	322	<i>Quercus coccifera calliprinos</i>	1914
<i>Fraxinus angustifolia syriaca</i>	7	<i>Quercus infectoria boissieri</i>	2092
<i>Fraxinus ornus</i>	138	<i>Quercus ithaburensis</i>	644
<i>Juglans regia</i>	30	<i>Quercus kotschyana</i>	126
<i>Juniperus drupacea</i>	1061	<i>Quercus look</i>	116
<i>Juniperus excelsa</i>	1443	<i>Rhamnus alaternus</i>	135
<i>Juniperus foetidissima</i>	61	<i>Salix acmophylla</i>	31
<i>Juniperus oxycedrus</i>	89	<i>Salix alba</i>	66
<i>Laurus nobilis</i>	131	<i>Salix libani</i>	12
<i>Malus trilobata</i>	55	<i>Sorbus torminalis</i>	189
<i>Nerium oleander</i>	30	<i>Sorbus umbellata</i>	46
<i>Ostrya carpinifolia</i>	92	<i>Styrax officinalis</i>	564
<i>Phillyrea latifolia</i>	96	<i>Ulmus minor</i> Mill.	3
<i>Pinus brutia</i>	68	<i>Vitex agnus-castus</i>	11

Table 2. List of shrub species and number of collected presence points

Accepted name	Number of points
<i>Amelanchier ovalis</i>	15
<i>Anagyris foetida</i>	10
<i>Bupleurum fruticosum</i>	3
<i>Calicotome villosa</i>	156
<i>Colutea cilicica</i>	18
<i>Cornus sanguinea</i>	32
<i>Cotoneaster nummularia</i>	91
<i>Hedera helix</i>	99
<i>Jasminum fruticans</i>	14
<i>Lonicera nummularifolia</i>	76
<i>Myrtus communis</i>	62
<i>Paliurus spina Christi</i>	10
<i>Pistacia lentiscus</i>	36
<i>Prunus microcarpa</i>	38
<i>Pyracantha coccinea</i>	3
<i>Rhamnus cathartica</i>	35
<i>Rhamnus libanotica</i>	11
<i>Rhamnus palaestina</i>	26
<i>Rhamnus punctata</i>	98
<i>Rhododendron ponticum</i>	62
<i>Rhus coriaria</i>	114
<i>Rosa canina</i>	68
<i>Rosa corymbifera</i>	96
<i>Rosa foetida</i>	4
<i>Rosa phoenicia</i>	82
<i>Searsia tripartita</i>	6
<i>Spartium junceum</i>	206
<i>Tamarix smyrnensis</i>	26
<i>Tamarix tetragyna</i>	4
<i>Tamarix tetrandra</i>	4
<i>Viburnum tinus</i>	34

Table 3. Predictors used in ecological niche modelling of trees

Code	Factors	Source
DEM	Digital Elevation Model (m)	Contour Line ^a
IMI	Integrated Moisture index	Hill shade
		Curvature
		Flow Accumulation
		Available water holding capacity (adapted from NASSAR, 2016)
PDIR	Potential Direct Incident Radiation (MJ/cm ² /yr)	Slope (extracted from DEM)
		Folded Aspect (extracted from DEM)
		Latitude (GIS coordinates)
EQ	Emberger Quotient	Cumulative Annual Precipitation (mm)
		Mean of Minimal Temperature of the Coldest Month ^b
		Mean of Maximal Temperature of the Hottest Month ^b
NDVI	Normalized Difference Vegetation Index	Mosaic of Landsat images
CC	Mean Cloud Coverage (May through July) (%)	Cloud rasters ^c (from CNRS)
DFS	Distance from the Sea (m)	DEM
MinT	Mean of Minimal Temperature of the Coldest Month (°C)	Mean of Minimal Temperature of the Coldest Month ^b
P	Cumulative Annual Precipitation (mm)	Precipitation Isohyets ^d

Sources: Stephan, J., Bercachy, C., Bechara, J., Charbel, E. & López-Tirado, J. 2020. Local ecological niche modelling to provide suitability maps for 27 forest tree species in edge conditions. *iForest-Biogeosciences and Forestry*, 13(3), 230.

Notes: ^a obtained from the Lebanese Army; ^b obtained from WorldClim (1970–2000); ^c obtained from the CNRS (2002–2013); ^d obtained from the CNRS.

Table 4. Average contribution of each predictor for the respective tree taxa

Taxa	CC	DEM	MinT	EQ	P	DFS	NDVI	PDIR	IMI
<i>Abies cilicica</i>	49.8	29.6	11.6	4.6	2.4	1	0.6	0.4	0
<i>Acer hyrcanum tauricolum</i>	8.8	36.9	7.7	25.7	4	1.2	3.3	12.3	0.2
<i>Acer monspessulanum microphyllum</i>	1.8	64.9	9	0.9	4.7	3.9	9.1	3.4	2.4
<i>Acer obtusifolium</i>	1.9	11.2	8.5	22.5	2.5	17.8	17.5	17.3	0.8
<i>Amygdalus orientalis</i>	2.9	16.1	14.5	7.5	35.5	18.8	0.2	2.9	1.4
<i>Arbutus andrachne</i>	5.2	3.3	12.4	25.2	7.2	6.4	28.8	10	1.5
<i>Cedrus libani</i>	10.7	45.3	10.7	13.4	7	9.1	2.8	0.9	0.1
<i>Ceratonia siliqua</i>	1.9	5.2	17.2	10.2	1.6	57	4.8	0.5	1.5
<i>Cercis siliquastrum</i>	6.1	2.5	10.9	32.8	6.4	1.2	16	21.1	3
<i>Crateagus azarolus</i>	13.4	36.7	5.5	0.6	21.8	11	7.5	1.1	2.5
<i>Cupressus sempervirens</i>	9.3	4.4	7.8	37.7	21.7	11	0.8	6.2	1.1
<i>Fraxinus ornus</i>	11	4.9	16.6	36.9	1.7	1.7	14.7	8.9	3.5
<i>Juniperus drupacea</i>	9.5	15.9	15.7	7.3	37.6	3.3	5.4	4.3	1.1
<i>Juniperus excelsa</i>	6.7	61.6	11.4	1.6	4.6	11.3	1.8	1	0
<i>Laurus nobilis</i>	4.1	5.7	16.5	8.5	4.4	25.6	29.3	4.5	1.5
<i>Malus trilobata</i>	36.4	26.4	15.3	7.1	4.4	2.2	0.5	6.6	1
<i>Pinus pinea</i>	3.8	3.1	23.8	2.7	53.3	6.4	4.9	1.7	0.3
<i>Pyrus syriaca</i>	0.9	34.9	3.2	5.3	31.8	11.7	7.8	1.4	3
<i>Quercus cedrorum</i>	9.7	37.9	10.5	20.6	4.9	0	3.7	12	0.6
<i>Quercus cerris</i>	26.6	20.9	16	8.4	20.6	1.7	2	3.4	0.3
<i>Quercus coccifera calliprinos</i>	4.3	7.6	26.4	19.2	23.9	3.9	10.9	3.5	0.1
<i>Quercus infectoria boissieri</i>	1.6	17.3	20.4	2.1	47.5	1.4	8.2	1.6	0
<i>Quercus ithaburensis</i>	61.5	10.8	1	0.4	10.8	14.3	1.1	0	0
<i>Quercus kotschyana</i>	4.2	32.7	10.5	14.8	32.5	1.2	2.5	1.4	0.2
<i>Quercus look</i>	0.6	47	15	7.6	17.1	9.7	1	0.1	1.9
<i>Sorbus torminalis</i>	11.4	34.7	7.6	9.5	19.5	0.7	8.4	7.9	0.2
<i>Styrax officinalis</i>	9	4.8	13.5	1.3	41.2	2.1	16.2	9.5	2.5

Source: Stephan, J., Bercachy, C., Bechara, J., Charbel, E. & López-Tirado, J. 2020. Local ecological niche modelling to provide suitability maps for 27 forest tree species in edge conditions. *iForest-Biogeosciences and Forestry*, 13(3), 230.

Note: The highest contributing predictor is highlighted in bold for each taxon.

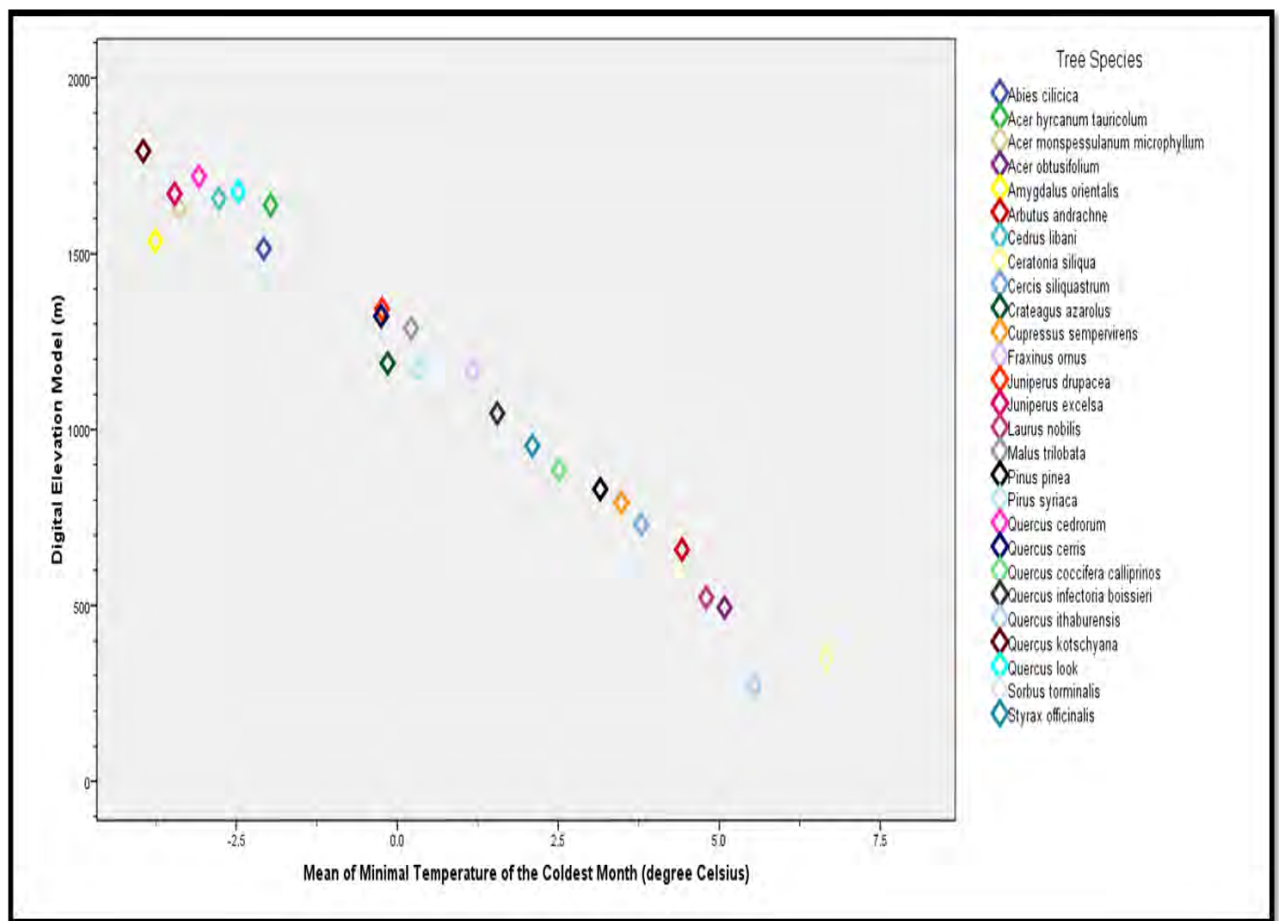


Figure 1. Species distribution by minimal temperature and elevation

Source: Stephan, J., Bercachy, C., Bechara, J., Charbel, E. & López-Tirado, J. 2020. Local ecological niche modelling to provide suitability maps for 27 forest tree species in edge conditions. *iForest-Biogeosciences and Forestry*, 13(3), 230.

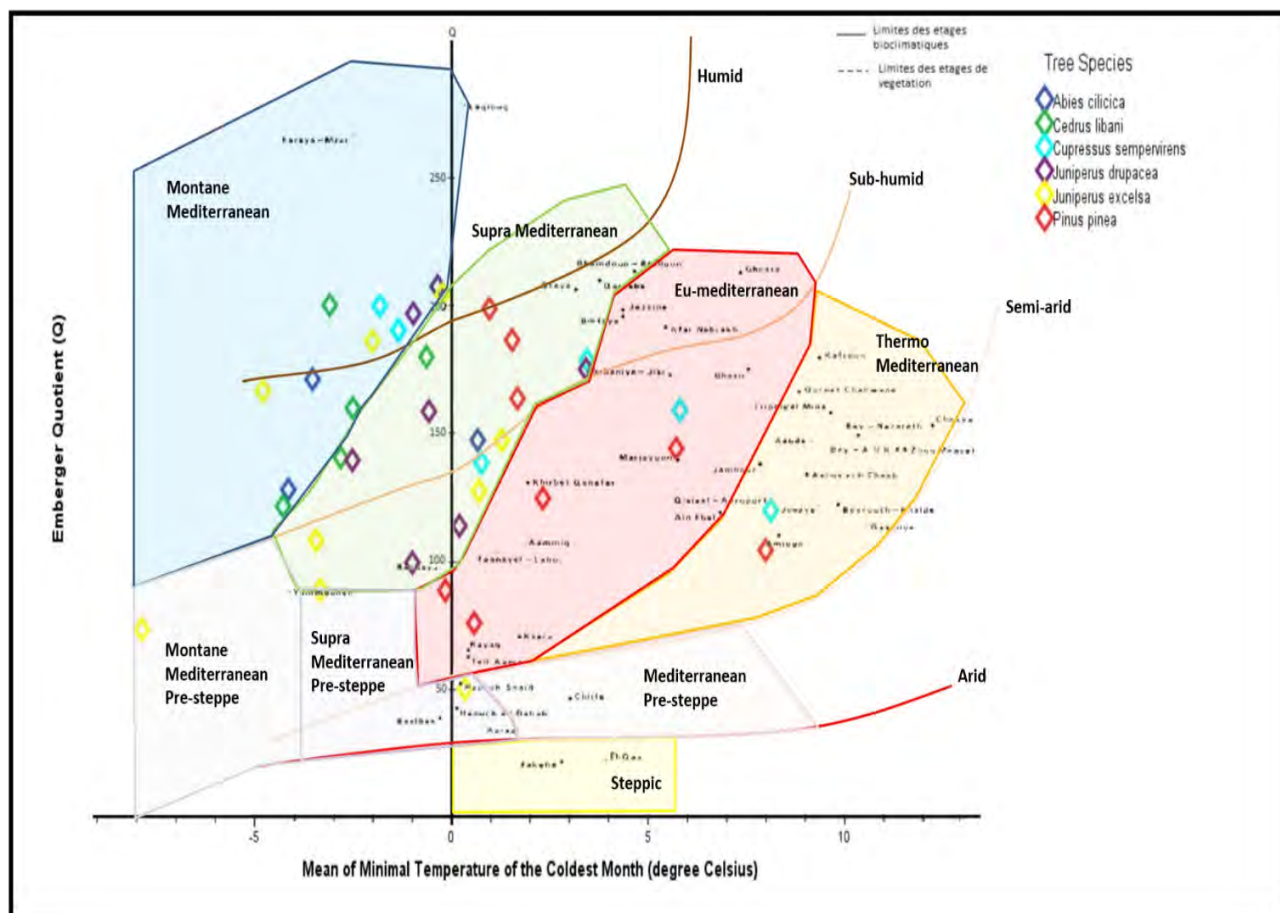


Figure 2. Species distribution in relation to Emberger bioclimatic zones

Source: Stephan, J., Bercachy, C., Bechara, J., Charbel, E. & López-Tirado, J. 2020. Local ecological niche modelling to provide suitability maps for 27 forest tree species in edge conditions. *iForest-Biogeosciences and Forestry*, 13(3), 230.

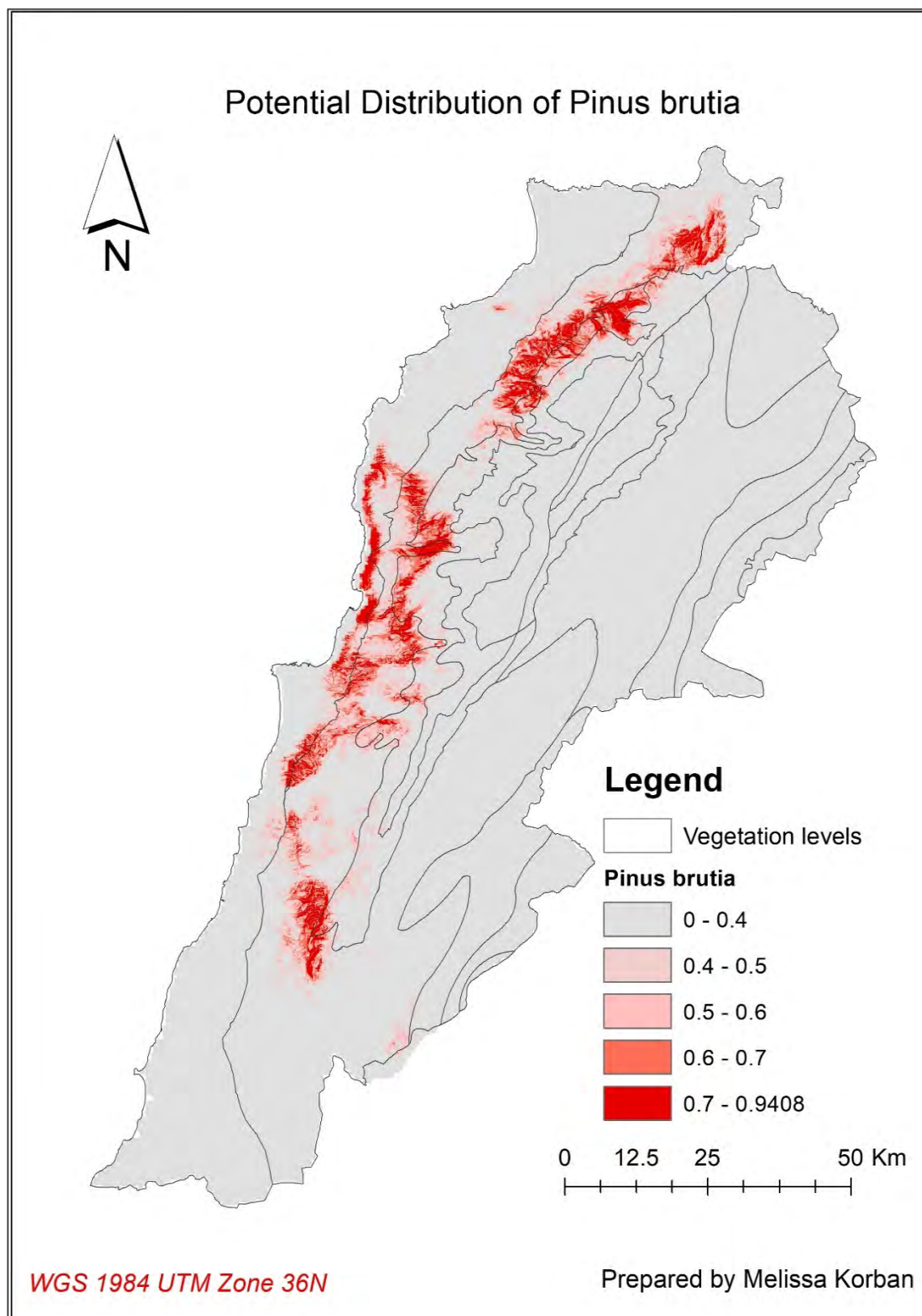


Figure 3. *Pinus brutia* distribution according to vegetation belts in Lebanon

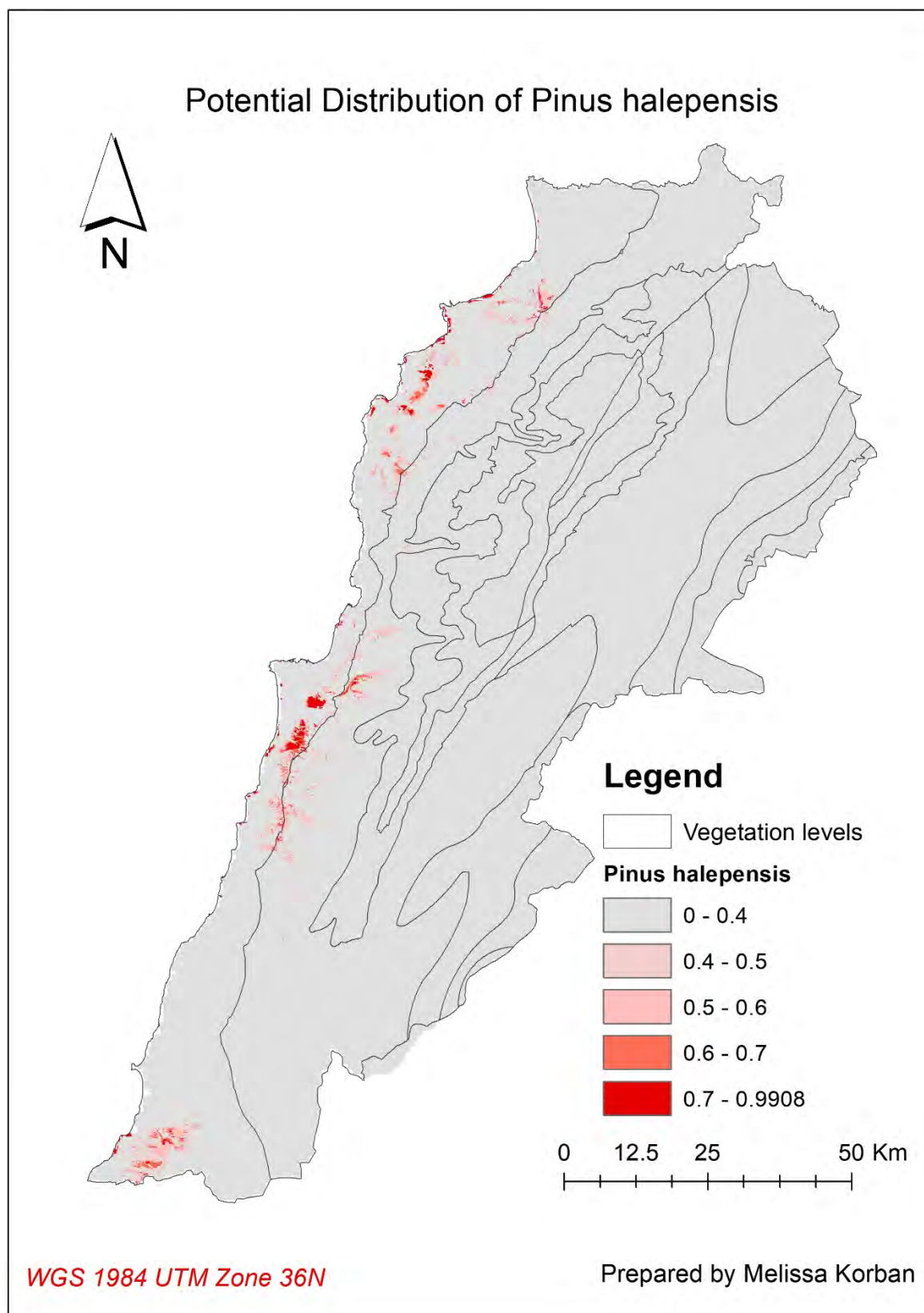


Figure 4. *Pinus halepensis* distribution according to vegetation belts in Lebanon

Racing towards integrated fire management: a case study from Lebanon

George Mitri¹

¹Land and Natural Resources Programme, Institute of the Environment, University of Balamand, Lebanon

Abstract:

The approach adopted to reduce fire risk at the local level was to build a “fire-smart” landscape, such as a rural, mosaic-like landscape, while meeting societal demand for wood and non-wood forest products and services. This included developing multifunctional management systems, a diversified economy, a wide range of goods and services, including carbon sequestration, biodiversity conservation, suitable water supply and quality, and aesthetic values, and promoting the environmental and cultural heritage. Visitors included representatives from national organizations and university students and international visitors, who were excited to visit and learn from this Lebanese community keen to reach environmental and socioeconomic resilience.

Keywords: Integrated fire management, resilience, wood and non-wood forest products

Introduction

Improved fire-risk management involves social, economic and environmental sustainability. This requires moving from the extinction paradox (fire detection and suppression, fire as a threat, unstable forest land, the short-term, limited success and high costs, among other things) to rural development (e.g. rural development and local tourism plans). The latter approach includes fuel management and the reduction of fire-risk vulnerability, targets a stable forest at landscape level, involves long-term impact and yields high levels of success and substantial social benefits through promotion of resilient landscape activities.

In this context, the current case study from Lebanon describes a series of complementary local, subnational and national actions supporting integrated fire management at the local level. All actions of relevance to fire-risk management were aligned with the provisions of Lebanon's national strategy for forest fire management (Decision No. 52/2009) and the 40 million trees programme of the Ministry of Agriculture. The actions revolved around the fire management framework known as the 5Rs: (1) research, information and analysis; (2) risk modification, including fire vulnerability reduction and prevention of harmful fires; (3) readiness, covering all provisions intended to improve interventions and safety in the event of fire; (4) response, including all means of intervention for fire suppression; and (5) recovery, including the rehabilitation and ecological restoration of healthy forest conditions and the support to individuals and communities in the short- and medium-term aftermath of the fire.

Study area description

The study area is the town of Menjez, located in the far northern side of Lebanon (Akkar Governorate). The elevation ranges from 290 metres (m) to 350 m above sea level. The mixed broadleaved forest in Menjez is located on the Lebanese Syrian border within the Al Kabir River basin. It is mostly composed of laurel trees (*Laurus nobilis*) and oak trees (*Quercus infectoria* and *Quercus ithaburensis*).

The study area has a Mediterranean climate, which is characterized by mild rainy winters mainly between October and March and hot dry summers between June and September. The registered mean annual precipitation is between 800–900 millimetres (mm) with an average number of 77 days of rain per year. The mean annual temperature is around 20 degrees Celsius (°C) (MOE/UNDP, 2011). Menjez has a population of 557 permanent inhabitants, counting 121 households.

Research, information and analysis

A full census of all inhabitants of Menjez (those above 14 years old) was conducted to assess environmental and socioeconomic challenges with the objective of identifying risks and needs for improved management of natural resources (UOB, 2014). Consequently, a 10-year management plan was developed for the forest of Menjez, which comprised the largest laurel forest (*Laurus nobilis*) in the country. Various capacity-building workshops were conducted to train locals on the implementation of sustainable actions in forest management. Currently, the sub-National Plan supports the local forest management for strategic forest management planning, which was recently developed for the entire Akkar region, including Menjez forests (UNDP, 2022). Furthermore, a study about greenhouse gas (GHG) emissions and removals from the forest and other land-use sectors in Menjez was conducted (Mitri and Karam, 2016).

Risk reduction

The municipality of Menjez was engaged in promoting sustainable fuelwood collection, providing incentives for farmers and herders not to burn crop residues, and encouraging the exploitation of non-wood forest products, which can play a role in reducing fire risk. More specifically, Menjez received all equipment to process both essential oil from laurel leaves (see Photo 1) and crude oil from laurel berries (see Photo 2). At a later stage, the municipality installed a unit to transform agriculture and forest pruning residues into ecobriquettes for heating, as currently most households use wood for heating. The source of energy for laurel essential oil distillation (see Photo 3) and ecobriquette production comes from burning briquettes following a circular economy approach. In addition, the municipality embarked on a land restoration project

by planting and maintaining more than 25 000 productive forest trees on degraded public lands (e.g. previously subject to recurrent fires). In addition, the role of the agricultural cooperative in fire-risk modification, including land restoration, was promoted.



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Photo 1. Training of local community members on processing essential oil from laurel leaves



© Institute of the Environment, University of Balamand, Lebanon
Photo 2. Training on processing crude laurel oil using laurel berries



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Photo 3. Customized distiller for processing laurel essential oil

Readiness

The community of Menjez distributed firefighting infrastructures at the landscape level. More specifically, water tanks were installed on reforestation sites to irrigate young seedlings and to supply enough water resources for early intervention in the case of a fire event (see Photo 4). The municipality established a 50 000 cubic metre (m³) rainwater harvesting reservoir serving as a reliable water source in the case of a fire event, not only in Menjez, but also in the region. At the same time, the reservoir is used to irrigate agricultural fields while diversifying the tourism offer for the town.



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Photo 4. Water tanks for irrigating tree seedlings and serving as water supply for firefighting

Response

The national fire danger forecast system (Firelab), previously developed by the University of Balamand was also adopted and adapted at the local level in Menjez (Mitri *et al.*, 2017). The Firelab system provides fire danger forecasts up to 9 days in advance, therefore giving enough time to secure all needed resources to respond to any fire event in the area. In addition, Menjez was part of the regional fire response plan, which was developed for the North Akkar Union of Municipalities to support timely response, and coordination of fire suppression activities at all levels.

Recovery

The community of Menjez joined the “Cities Race to Resilience” and committed to numerous resilience-based actions across prioritized sectors, including restoring and sustainably managing inner, nearby and faraway forests. Furthermore, Menjez was a recipient municipality of the guidelines for post-fire restoration and rehabilitations plans, which were recently developed following the disastrous fires of Akkar in 2021. Various awareness-raising material, activities and training workshops (see Photo 5) were designed and implemented to engage the community in the restoration and conservation of natural resources (see Photo 6).



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Photo 5. Training on the propagation of native tree seedlings for use in restoration projects



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Photo 6. Post-restoration site well maintained for fire risk reduction

Conclusion

Until now, Menjez has succeeded remarkably well in avoiding disastrous fires that have affected large parts of its surrounding region and the country at large, and has strived to advance knowledge and actions in sustainable development despite the socioeconomic challenges faced not only in Menjez and Akkar, but also in the entire country (see Figure 1).

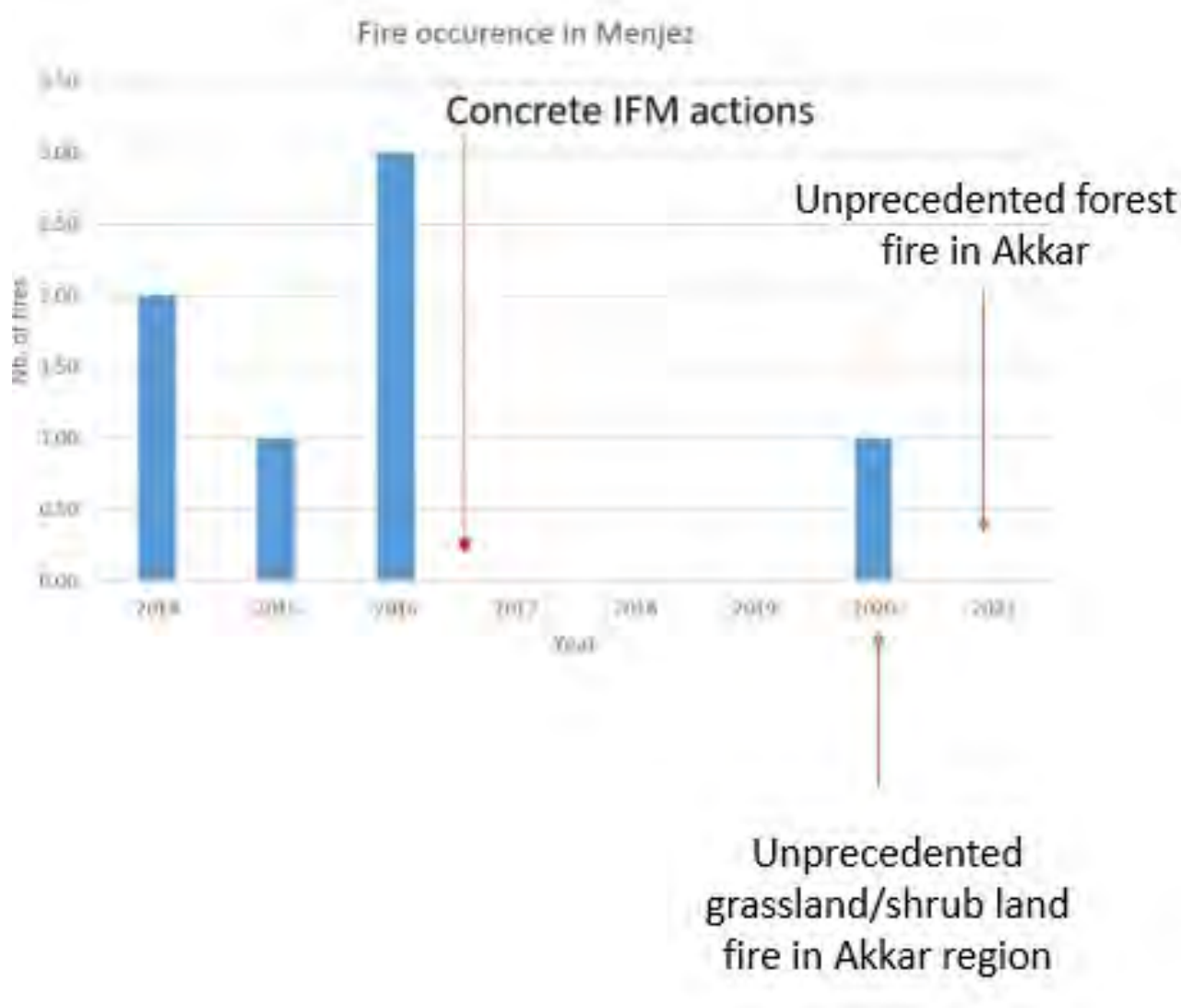


Figure 1. Historical timeline of major fire events in the two of Menjez

Complementing existing integrated fire management efforts, the Menjez community has moved at increasing speed to reach zero GHG emissions (e.g. wind turbine and hydroelectric energy planned, solar energy implemented, ongoing waste treatment facilities and planting of additional 50 hectares of municipal land.). Overall, Menjez is close to being known as the first town in Lebanon to reach zero GHG emissions and becoming a pilot example to replicate in other villages and towns not only in Lebanon, but throughout the Mediterranean.

References

- Mitri, G. & Karam, J. 2016. Mapping greenhouse gas emissions and removals from the land use, land use change, and forestry sector at the local level. In: GEOBIA 2016: Solutions and Synergies. 14–16 September 2016, University of Twente Faculty of Geo-Information and Earth Observation (ITC).
- Mitri, G., Saba, S., Nader, M., and McWethy, D. 2017. *Developing Lebanon's fire danger forecast. International Journal of Disaster Risk Reduction*. Vol. 24. pp 332–339.
- MoE (Ministry of Environment)/UNDP (United Nations Development Programme). 2011. *State and Trends of the Lebanese Environment (SOER) 2010*. Beirut.
- UNDP. 2022. *Strategic Forest Management Plan of the Akkar region*. Beirut.
- UOB (University of Balamand). 2014. *Census in Menjez to identify socio-economic and environmental needs*. Kelhat, Lebanon.

THEMATIC SESSION 7

Young entrepreneurs: How sustainable development and nature-based solution approaches can help protect the climate, society and development in the Mediterranean area

The H2020 “ROSEWOOD4.0” project: wood mobilization and forest digitalization in Europe

Riccardo Castellini¹

¹Head of the International Cooperation Department - Cesefer Foundation
Manager of the Rosewood Southwest Hub

Abstract:

The mobilization of wood in Europe and the exchange of best practices, with a particular focus on digital tools, is the objective of the ROSEWOOD4.0 project, funded by the European H2020 programme. This article reports on the project and provides access to the documentation generated on the best practices identified among the 21 partners involved (from 18 European countries and grouped into five geographical regions or hubs) in the project consortium. It highlights the need for social awareness actions, digital platforms such as Metsään.fi or "La forêt bouge" and the training of professionals through videos and massive online courses (MOOCs), which will feed into the European Forest Advisory System (FORKIS). All the information on the project, which ends at the end of June 2022 with the final project conference organized in Barcelona by the European Forest Institute (EFI), is collected, open and freely available on the dedicated platform, which includes the repository of more than 450 best practices and innovations. This is the main output of the project, which will continue to be updated regularly and which should be considered as the main European reference for finding material on the wood mobilization value chain.

Keywords: Forestry production, mobilization, industry, knowledge transfer, best practices

Introduction

The European Union faces the great challenge of increasing its timber production to boost the bioeconomy, increasing public use and improving carbon sequestration potential in forest areas, based on sustainable forest management, which takes into account other forest functions, such as biodiversity conservation. Wood can play a vital role in the development of a new circular bioeconomy. Promotion and innovation in wood value chains contribute to enhanced competitiveness of the forest industry and vital development in rural areas within the European bioeconomy. The ROSEWOOD4.0 project aims to contribute to this objective by identifying best practices among European countries and contributing to their dissemination. It focuses on the advances that digitalization can offer along with training and building social awareness.

Methods

ROSEWOOD4.0 focuses on digitalization for knowledge transfer, training, coaching and enabling practitioners to share expertise with a much wider impact. The focus on digital training solutions addresses an identified gap where the forest sector lags behind in terms of adaptation and taking up modern information and communication technologies (ICT). The project has highlighted that there are large differences at the European level and that there is a need to work at a more homogeneous regional level.

There is a lack of understanding of actions on forests and doubt about the need to increase production due to its effects on ecosystem services, particularly in southern Europe. Hence, the importance of successful experiences such as the forest communication campaigns "Forest Finland" of the Finnish Forestry Association and others in Central Europe (Metsien Suomi, 2020).

However, the level of take-up of digital solutions differs among European timber producers, and experiences have been identified that would be very interesting to consider. For example, the progress made by digital platforms makes information available on available timber in each of them or at different levels while facilitating contacts between buyers and industry, thereby improving the marketing of products. These digital platforms include the German "Wald-wird-Mobil" (Wald und Holz NRW, 2022a), the French "La forêt bouge" (La forêt bouge, 2022) and the Finnish Metsään.fi (Finnish Forest Centre, 2022), each of which map forest holdings.

New ICTs are continuing to develop rapidly in all sectors of the economy and society. Digitalization in the forest sector is promoted through various European initiatives and projects such as ROSEWOOD4.0, which aim to share the best forestry technologies in Europe since the information and dissemination of forestry activities are key to progress.

Forest Industry 4.0 solutions (including new forest measurement sensors, high-resolution digital maps, forest planning tools, risk monitoring, logistics optimization and real-time data exchange and control, for example) constitute an important field of innovation in the future market, which will enable the continuous exchange of information and monitoring of wood flows from forest harvesting to processed products and their final consumers.

Major challenges include the wide variety of ecosystems, ecological conditions, types of forest owners and entities involved in the supply chain, as well as regional disparities in technology development. The differences are clear at all levels: even in ROSEWOOD4.0, an H2020 project formed by 21 partners from 18 European countries (including the CeseFor Foundation and the European Forest Institute), the technologies identified in Scandinavia and central and western Europe are much more advanced than in the rest. As a result, their products and companies lead the forest industry in Europe. Adapting these innovations in Spain in the rural environment and in small companies is essential to maintaining a high level of competition and future development, along with the knowledge that Spain is also home to some of the most important technological advances linked to the use of remote sensors.

The ROSEWOOD4.0 project identified the best technologies since 2020 and studied the situation of wood mobilization in Europe in five groups; the Cesefer Foundation of Castilla y León is the leader of the southwest group, which includes Italy, Portugal, southern France and Spain.

In the **short term**, ROSEWOOD4.0 helped find solutions to the most pressing knowledge needs, innovation opportunities for sustainable wood mobilization and the use of digital tools for training and coaching. In the **mid and longer term**, this network will foster the environmental and economic performance of forestry across Europe, with impacts on innovation and industry beyond Europe.

Results

ROSEWOOD4.0 has focused on the most relevant innovation opportunities in the following areas:

- **Collaboration** – through the network formed by the project partners, leading companies in the sector can be contacted through talks, workshops and meetings that will continue to be organized until June (Bioregions Facility, 2022), while information is available on the website and on the social networks of the project @NetworkRosewood and Cesefer @FCesefer (Rosewood, 2022a).
- **Road map 2021** – these represent the collection, analysis and strategic direction of the results of the five European groups, and the outcomes are published in the road maps on the website (Rosewood, 2022b).
- **Knowledge platform** – this is an open portal for easy, multilingual access with a searchable query form and more than 450 factsheets available in national languages, including English. The collection of best practices and solutions from across Europe is freely available with contact details, an overview, websites, videos, images and details available in the Resources – Best Practice Database section of the website. It is also possible to register for new technologies and innovations (Rosewood, 2021).
- **Training** – free MOOCs have been created and are available in the Training section of the website in English, German and some in Spanish too (Wald und Holz NRW, 2022b). These simple short video courses cover the following topics: digital support for efficient harvesting operations, digital tools for climate adapted reforestation, hardwood timber management and perspectives for new forest owners, among others.
- **Videos** – a full series of videos of selected best projects and innovations were made available on the ROSEWOOD4.0 YouTube channel (Rosewood, 2022c).

Decision-support systems, training tools and marketing platforms for forest owners are increasingly developed to connect knowledge and practice.). This will have enormous benefits for resource efficiency, sustainable use and climate change mitigation. The need for the wider sharing of technological solutions is urgent to maintain and improve the competitiveness of the European forest industry by transforming it into a 4.0 forest industry.

Conclusion

The difference in development in the different countries and regions is evident. For example, the technologies used in northern and central and western Europe stand out, and make their industries more competitive compared to the rest of Europe. However, they also face problems that are common across Europe: the difficulty of finding trained machine operators and a loss of interest in forestry work. Continuing to innovate in technologies that facilitate harvesting work by providing greater safety and quality are essential to ensure the continuity of work in the forestry environment, most commonly in rural areas. In this field, technologies such as Forwarder2020, HiVision, AVATAR or ForestHQ are noteworthy.

It is precisely the rural environment and the loss of interest in the sector that has led to forests being abandoned or mismanaged. New technologies provide management support tools, collaboration platforms

and access to all kinds of information. They are technological tools that allow the mapping of forest holdings, information on the wood available in each of them and contact with buyers and industry up to the marketing of the products themselves, as seen with ForestMap, for example. They also allow less experienced forest owners to make better use of their plots, for example with digital platforms such as Metsään.fi or La Forêt bouge. There is also a need to accelerate land consolidation in certain cases. There are technologies that facilitate this and are successfully applied in several countries, such as *Áreas Florestais Agrupadas*.

In southwest Europe, technological knowledge and innovation are advanced in the research sector, but their adoption in companies and different areas are uneven, especially in small companies with less access to technology; Therefore, support to the sector and the dissemination of information are necessary for implementation. In the ROSEWOOD4.0 project, efforts have focused on the transfer of information through talks, videos and MOOCs that will feed the European Forest Advisory System (FORKIS). Above all, the knowledge platform that provides details and contact data for the latest technological advances will bring these developments to all points in the value chain of the mobilization of wood.

Resources

- Bioregions Facility. 2022. Events. In: *Bioregions*. Cited March 2022. www.network.bioregions.efi.int/event
- Finnish Forest Centre. 2022. Finnish Forest Centre – Information on Finnish Forests. In: *Metsäkeskus Forest Centre*. Cited March 2022. www.metsakeskus.fi/
- La forêt bouge. 2022. Vous êtes propriétaire d'un bois, d'une forêt In: *La forêt bouge : un outil numérique au service de votre forêt*. Cited March 2022. www.laforetbouge.fr/.
- Metsien Suomi. 2020. In: *Forest Finland [Metsien Suomi]*, Finland. Cited March 2022. <https://metsiensuomi.fi/in-english/>.
- Rosewood. 2021. Knowledge platform for regional forest innovation. In: *ROSEWOOD4.0 Best Practices and Innovation*. Cited March 2022. www.forestinnovationhubs.rosewood-network.eu/.
- Rosewood. 2022a. *ROSEWOOD4.0 Sustainable Wood for Europe*. Cited March 2022. <https://rosewood-network.eu/>.
- Rosewood. 2022b. Road maps. In: *ROSEWOOD4.0 Sustainable Wood for Europe*. Cited March 2022. <https://rosewood-network.eu/resources/roadmaps/>
- Rosewood. 2022c. *ROSEWOOD4.0 Network* [video]. Cited March 2022. www.youtube.com/channel/UCkrSwdfPy7MRVlycTc8xfgA/videos
- Wald und Holz NRW. 2022a. About us: Structure and tasks of the Landesbetrieb Wald und Holz NRW. In: *Landesbetrieb Wald und Holz Nordrhein-Westfalen*. Cited March 2022. www.wald-und-holz.nrw.de/waldblatt/ueberregional/1709-wald-wird-mobil.
- Wald und Holz NRW. 2022b. Login to ILIAS. In: *Landesbetrieb Wald und Holz Nordrhein-Westfalen*. Cited March 2022. https://wald-und-holz-nrw.elearning.de/ilias/login.php?target=cat_1429&lang=en

An example of public–private funding for restoration: the RESTOR'MED FORESTS project

Anaïs Loudières¹

¹ Association Internationale des Forêts Méditerranéennes, France;
contact@aifm.org

Countless funding opportunities for forest and landscape restoration exist. The case study presented below focuses on **public or private funding for a pilot collaborative restoration project** in Morocco and Lebanon. This example will be presented to you in three steps: first, the presentation of the organization carrying the project; then, the project itself; and finally, the public–private financial package in question.

1. The International Association for Mediterranean Forests



**ASSOCIATION
INTERNATIONALE
DES FORETS
MEDITERRANEENNES**

The International Association for Mediterranean Forests (AIFM) is a French association according to the 1901 law, founded in 1996 in Marseille, France. Thanks to this organization, Mediterranean countries have the space to build the future of their forests together.

The association aims to facilitate a transnational exchange of knowledge and experiences pertaining to Mediterranean forests and other wooded areas in a transversal and multidisciplinary way.

The AIFM:

- **leads pilot projects** to preserve and sustainably manage the 75 million hectares (ha) of Mediterranean forests and other wooded areas;
- **develops and maintains the community** of Mediterranean public and private actors and scientists (around 5 000 people) with cooperation projects and the dissemination of their expertise; and
- **raises awareness in the general public** on the importance of a sustainable management of Mediterranean forests.

For its first intervention, the AIFM has set up an innovative project to restore forests and landscapes with its Moroccan and Lebanese partners.

2. The RESTOR'MED FORESTS project

The RESTOR'MED FORESTS project aims to implement actions for the sustainable management of forest ecosystems around the Mediterranean basin to make them more resilient and functional, while training technical staff and raising awareness among local people. It also aims to involve the inhabitants at every stage of development to engage them in the development of their local area.



The project is currently divided into two national components: RESTOR'MED FORESTS Morocco and RESTOR'MED FORESTS Lebanon.

In Morocco, the restoration site is the Talassemtane National Park. In Lebanon, two pilot sites have been selected: the Menjez forest and the Bentaël nature reserve.



Figure 1: Map presenting the three pilot sites and the AIFM head office

The objectives of the project are very clear:

- **contribute to the mitigation of the effects of climate change;**
- **contribute to the preservation of biodiversity**, particularly endemic and emblematic Mediterranean forest species; and
- **actively involve local people.**

Even though the objectives and the intervention rationale are the same on the three pilot sites, the implementation dates, as well as a few activities, differ.

A. The Moroccan project

The project in Morocco started in January 2021 and is due to end on 31 December 2022. It is implemented jointly with the Talassemtane Association for the Environment and Development (ATED), the Moroccan Association of Regional Sciences (AMSR) and the Department of Water and Forests of Morocco.

The actions to be carried out in the Talassemtane National Park are the following:

- designing an ecosystem restoration plan;
- sustainable restoration of the pilot site with the participatory reforestation of 15 hectares;
- scientific monitoring of the plantation by students from the University of Tétouan;
- awareness and capacity-building workshops;

- creation of a village tree-nursery; and
- active and participatory involvement of local populations in all actions.

B. The Lebanese project

The project in Lebanon started in January 2022 and is due to end on 31 December 2023. It is implemented in partnership with the Lebanese Reforestation Initiative (LRI), the management committee of Bentael and the Menjez municipality.

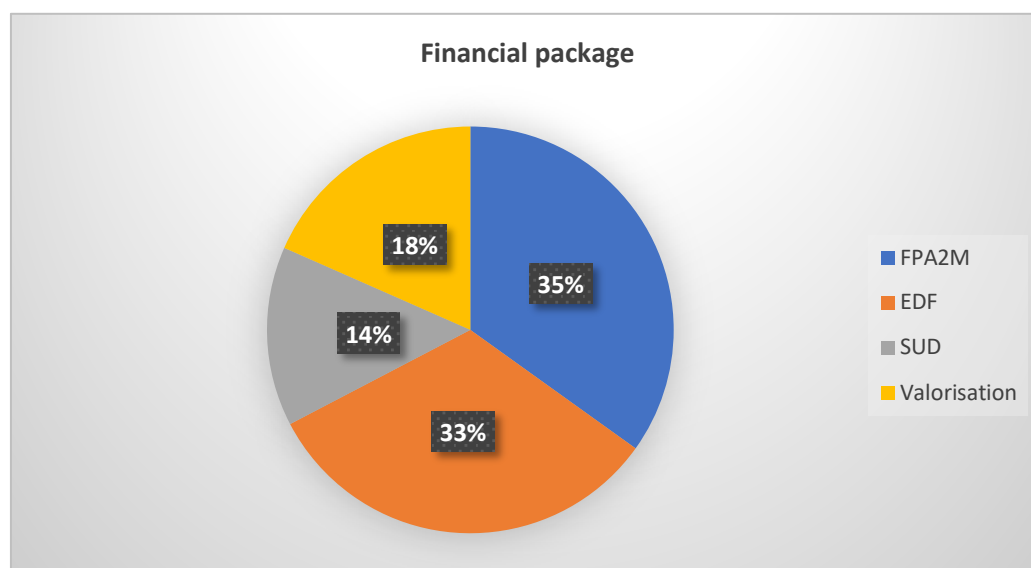
The actions to be carried out in the Menjez forest and the Bentael nature reserve are the following:

- design of the sustainable management plans of two pilot sites;
- implementation of nature-based solutions such as planting, pruning, improved land management, pest control, firebreaks, farm forestry and species selection;
- awareness and capacity-building workshops for the key local stakeholders; and
- active and participatory involvement of local populations in all actions.

3. The public or private financial package

This is a pilot project experimenting with new participative methodology in forest and landscape restoration activities. The objective is to experiment with this new method to then adapt it and replicate it throughout the Mediterranean Basin. At this stage, the global budget for the project is of EUR 185 000 for the implementation of activities on three pilot sites.

RESTOR'MED FORESTS is supported by the **Prince Albert II of Monaco Foundation**, the **Électricité de France (EDF) Group Foundation** and the **Provence-Alpes-Côte d'Azur (SUD PACA) region**. The remaining 18 percent correspond to the value of the time spent by the partners on the project.



A. Prince Albert II of Monaco Foundation



The Prince Albert II of Monaco Foundation (FPA2M) wishes to promote sustainability. To quote its 2020 annual report, its objective is to federate scientists, political leaders, economic actors and civil society around the preservation of the ocean and the earth. Founded in 2006, the foundation is dedicated to the protection of the environment.

Its three priority geographical areas are:

- the Mediterranean basin;
- the polar regions; and
- the least developed countries.

It focuses on three environmental fields:

- to limit the effects of climate change and promote renewable energies;
- to preserve biodiversity; and
- to manage water resources and combat desertification.

In 2020, the global budget of the FPA2M was of almost EUR 6.6 million. In line with the Sustainable Development Goals (SDGs) defined by the United Nations, the financial commitment of the foundation is broken down by SDG:

Value	SDG	Title
EUR 3 225 282	SDG 14	Marine biodiversity
EUR 1 241 397	SDG 15	Terrestrial biodiversity
EUR 586 079	SDG 13	Climate change
EUR 464 970	SDG 6	Water
EUR 382 844	SDG 4	Education
EUR 219 143	SDG 12	Sustainable Consumption and Production
EUR 208 286	SDG 11	Sustainable cities
EUR 112 851	SDG 7	Energy

In 2020, in the environmental theme "Preserving Biodiversity" which concerns the RESTOR'MED FORESTS project, the foundation supported a significant number of projects (566), almost half of which were in the Mediterranean Basin (247 projects).

This foundation is an important pillar for the sustainable management of natural resources and the conservation of species in the Mediterranean and worldwide.

B. The EDF Group Foundation



For several decades, Électricité de France (EDF) has expressed its desire to act as a responsible company by integrating economic, social, societal and environmental dimensions into its activities. It aspires to be both a responsible company and a committed player in civil society by supporting projects with a strong impact.

This line of conduct is part of what is known as corporate social responsibility (CSR), which brings together all the practices put in place by companies with the aim of respecting the principles of sustainable development, i.e. to be economically viable, to have a positive impact on society and to better respect the environment.

To implement it, the EDF Group Foundation was created in 1987, but it was not until 2020 that a new area of intervention on the environment was added to its themes of interest.

The foundation has identified two types of projects: those implementing nature-based solutions (NBS) and those seeking to raise awareness of new behaviours.

In 2020, the Foundation's annual budget to accomplish its mission, including support for projects that work for a shared future or contribute to the SDGs, was over EUR 10 million.

Amount	Title
EUR 4 208 605	Reducing inequalities
EUR 3 240 334	Inclusion
EUR 2 528 891	Education
EUR 1 560 620	Clean energy
EUR 853 000	Fight against global warming

In all, 204 projects were supported by the foundation in 2020, with 22 projects involved in the fight against global warming (including the RESTOR'MED FORESTS project).

The EDF Group Foundation only funds the Moroccan national component of the RESTOR'MED FORESTS project. Indeed, as a part of its economic activities, EDF launched the first phase of the construction of the Taza wind farm in December 2020, which will have 27 wind turbines and an electricity sales contract for a period of 20 years. Our forest and landscape restoration project is, therefore, part of EDF's CSR in Morocco.



C. SUD PACA Region



RESTOR'MED FORESTS fits in with the strategies of private donors as well as public actors. The project is also supported by the decentralized cooperation between the SUD PACA Region and the Tangier-Tetouan-Al Hoce ma Region and is expressly included in their joint action plan.

Decentralized cooperation is understood as a mode of transnational cooperation including all relations of partnership established between the local authorities of the two countries.

The links between these two communities go back a long way, with the signing of a cooperation agreement as early as the 2000s which has been continually renewed to the most recent agreement of 2020, ongoing to this day.

Due to the location of the AIFM's head office in Marseille and the place of intervention in the Talassemtane National Park, Tangier-Tetouan-Al Hoce ma Region, Morocco, it was possible to obtain funding from the SUD PACA Region to complete the financial package of RESTOR'MED FORESTS.

Bibliography

Fondation Prince Albert II de Monaco. 2021. 2020 Annual Report.

Fondation Prince Albert EDF. 2021. 2020 Annual Report.

Commission Nationale de la Coop ration D centralis e. 2022. Atlas fran ais de la coop ration d centralis e et des autres actions ext rieures. In: *France Diplomatie*. Cited 1 March 2022. <https://pastel.diplomatie.gouv.fr/cncdext/dyn/public/atlas/accesFrance.html>

SIDE EVENTS

SIDE EVENT 1

MEDLENTISK, enhancing the value of lentisk trees and non-wood forests products

Side event summary

MEDLENTISK, enhancing the value of lentisk trees and non-wood forests products

Moderator: Alain Chaudron¹

Reporter: Abdelhamid Khaldi¹

¹Association Internationale des Forêts Méditerranéennes (AIFM)

After introducing the topic, four communications were presented:

- the use of *Pistacia lentiscus* for phytoremediation, the Sardinian experience, by **Gianluigi Bacchetta** (University of Cagliari);
- the development of health-promoting products containing lentisk oil derivatives, by **Maria Manconi** (University of Cagliari);
- information about seedling production, establishment of mastic tree plantations and related works done by governmental organizations and the private sector around İzmir, Türkiye, by **Neşat Erkan** (Bursa Technical University); and
- *in vivo* protective effects of *Pistacia lentiscus* fruit fixed oil from the Jijel region, Algeria, against cyto and genotoxicity induced by xenobiotics, by **Lamia Benguedouar** (University of Jijel).

Thereafter, a question-and-answer session mainly focused on the following points:

- the outcome of plants loaded with heavy metals in the event of phytoremediation with lentisk shrubs;
- the importance of creating a lentisk value chain; and
- impacts on local development and involvement of development agents.

Mastic tree seedling production and plantations in Türkiye

Salih Parlak¹, Neşat Erkan¹

¹Bursa Technical University,
Faculty of Forestry, Bursa, Türkiye

Abstract:

The *Pistascia lentiscus* var. *Chia* is one of the most important species for Türkiye not only in terms of mastic production, but also in terms of cultural heritage. For this reason, mastic tree cultivation, which has been on the verge of disappearing in İzmir and the surrounding region, is being revived by the General Directorate of Forestry (OGM), municipalities, non-governmental organizations (NGOs), the private sector and other organizations. In this context, projects and action plans have been carried out to produce mastic tree seedlings for afforestation. According to the results of the research conducted for seedling production, grafting and air layering methods were determined as the most effective methods. In addition, potential areas where mastic tree afforestation can be established in İzmir and surroundings areas were determined by OGM.

1. Introduction

The mastic tree (*Pistacia lentiscus* L.), a member of the Anacardiaceae family, is a species with green and aromatic leaves that grows naturally in the coastal regions of Mediterranean countries, especially in Greece, Türkiye, Italy and Spain (Onay, 2016). Mastic gum is an important vegetable resin produced from *P. lentiscus* variety *Chia*. This plant, which has been cultivated in Chios, Greece, and Çeşme, İzmir in Türkiye for a long time, is now produced and traded only in Chios. While mastic production was carried out in Çeşme until recently, production has almost disappeared due to the decrease in the number of mastic trees. This is due to many different reasons such as the development of tourism, creation and expansion of new agricultural areas, the desire of more affluent people to acquire summer residences and the disappearance of the old production culture (Parlak, 2010). In recent years, reforestation has started with the efforts of the General Directorate of Forestry (OGM), local governments and non-governmental organizations (NGOs) in the İzmir region (OGM, 2013).

The most important factor limiting the cultivation of the mastic tree is frost events. Its water requirements are low and the cultivation is usually done without irrigation. For the production of gum, the area under the trees (crown projection area) is cleared in June and covered with white clay soil containing calcium carbonate so that the drops that fall dry cleanly and quickly. Production of mastic tree gum is carried involves scratching and harvesting from the trunk and thick branches between July and September. Today, gum resin has dozens of uses. These can be broadly classified as for the food, medicine and pharmaceutical industries. In addition, the mastic tree is an economically important plant due to the use of its essential oils and the resin in its leaves and fruit in the industrial and health fields. In some countries such as Tunisia, Algeria and Italy, the oil obtained from this tree has traditional uses and is exported for industrial use.

For mastic tree plantations, long branch cuttings are traditionally used to produce saplings. However, in this type of production, the rooting rates of branch cuttings are very low, and these cuttings require a lot of material since they are 50–60 centimetres (cm) in length. Due to the fact that the limited number of mastic trees in the İzmir region are very old, there is a problem in finding sufficient production materials for cutting production. Considering plantation establishment and commercial mastic tree production, the first thing to do is to perform mass seedling production from clonal male mastic trees. The effective methods of seedling production are traditionally cuttings and graft or tissue culture using laboratory facilities (Parlak, 2010).

In this paper, mastic tree seedling production and plantation activities in Türkiye are evaluated. Information given in this paper will be used by individuals and legal entities for establishment of mastic tree plantations.

2. *Pistacia* species in Türkiye

The genus *Pistacia* has 11 species and four sections (Zohary, 1952). In its natural distribution areas, it can grow up to 500 metres (m) above sea level in a wide area starting from Istanbul to Iskenderun and the Aegean and Mediterranean coasts. The *Pistacia* species naturally distributed in Türkiye are given in Table 1.

Table 1. *Pistacia* species naturally distributed in Türkiye

Species	Common name in Türkiye
<i>Pistacia atlantica</i> Desf.	: Sakızlık, Çitlenbik, Atlantik sakızı
<i>Pistacia eurycarpa</i> Yalt.	: Bendek
<i>Pistacia khinjuk</i> Stocks	: Bittim
<i>Pistacia lentiscus</i> L.	: Sakız ağacı (wild)
<i>Pistacia lentiscus</i> L. var. <i>Chia</i>	: Sakız ağacı (cultivar)
<i>Pistacia terebinthus</i> L.	: Menengiç
<i>Pistacia terebinthus</i> L. subsp. <i>terebinthus</i>	: Menengiç
<i>Pistacia palaestina</i> Boiss.	: Çöğre
<i>Pistacia x saportae</i>	: Çetem
<i>Pistacia vera</i>	: Antep fıstığı

3. Sapling production

3.1. Generative propagation

Pistacia species are widely propagated by seed and used as rootstock for grafting (Figure 1), especially for *P. vera* grafting, which is consumed as a snack and used for traditional desserts. In recent years, *Pistacia* species have been used in afforestation of mining areas (Aydın, 2014) and salty soils (Sayman *et al.*, 2011) due to its resistance to hot, arid and salty conditions (Oral, *et al.*, 2016).

Seed germination is epigeic in the mastic tree (*P. lentiscus* var. *Chia*) and hypogeic in other *Pistacia* species (Zohary, 1952). Many of the fruits are empty and do not germinate. Since the red-white seeds are empty, the black seeds with a higher occupancy rate are used in seedling production (Jordano, 1988; Martinez-Palle and Aronne, 2000; Verdu and Garcia-Fayos, 2002). The seeds are oily and lose their germination abilities in a short time (Garcia-Fayos and Verdu, 1998; Piotto *et al.*, 2003). The weight of 1 000 grains is 20–25 grams (g) and, to increase the germination rate of the seeds, the pericarp must be removed and the endocarp should appear (Oral *et al.*, 2016).

Seeds need to be treated with cold stratification (Garcia-Fayos and Verdu, 1998). It is recommended to plant the seeds in the fall without any stratification or in the spring after 2–3 weeks of cold stratification (Piotto *et al.*, 2003; Prada and Arizpe, 2008). The highest germination rate of 32.5 percent was obtained in different applications of *P. lentiscus* seeds by Karakır and İsfendiyoğlu (1999). Piotto (1995) obtained the highest germination rate of 80.8 percent in his study on *P. lentiscus*. In the study of Hoşer (2018), the highest germination rate was 75 percent. In Koç's 2011 study, the best germination rate of *P. lentiscus* was obtained as 35.3 percent using the GA₃ hormone. In the study of Şenyay (2008), the highest germination rate was 67.5 percent.

Only *P. lentiscus* var. *Chia* is used in mastic production. Since the male individuals of this cultivar give higher quality of mastic, it is not possible to produce seeds without losing their varietal characteristics (Browicz, 1987; Belles, 2008). In a study conducted to determine the essential oil and components, it was determined that the wild mastic tree, which gives resin with a completely different essential oil component structure compared to the cultivar, did not give the desired taste and aroma (Keçeci, 2019). According to Oral *et al.* (2016), essential oils obtained from the leaves and stems of male and female plants differ qualitatively and quantitatively.

In the study conducted in the wild *P. lentiscus* tree, scratching three times showed that the average yield per tree was 98 g per tree. It was determined that the yield in wild trees was inversely proportional to the diameter and height of the tree (Morkan, 2009). Since the mastic obtained from the wild *Pistacia* species is less and of poor quality, efficient and high-quality mastic can be obtained only if it is grafted with var. *Chia*. However, when var. *Chia*, which grows faster, is grafted onto a weak rootstock of *P. lentiscus*, incompatibilities are likely to appear (Parlak and Akbin, 2011).



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Figure 1. Rootstocks of *P. lentiscus* and *P. atlantica*

3.2. Vegetative propagation

The most important feature of this method is that the plants produced have the same genetic structure as the mother plant. Four different methods are used in the reproduction of mastic trees. Since quality mastic is produced only from male individuals (Browicz, 1987; Belles, 2008), clonal seedlings should be used in mastic tree plantations. Seedlings produced with seeds are not used in mastic production due to genetic differences in mother trees (Piotto and Di Noi, 2003).

3.2.1. Propagation by cuttings

Production with cutting cannot be used due to limited material resources, very low rooting rate and reasons of being uneconomical (Al Barazi and Schwabe, 1982). According to Mısırlı *et al.* (2002), the problems encountered in the propagation of *Pistacia* species using cuttings seems to be related to the inability to optimize the physical conditions. Cuttings of *Pistacia* species are usually difficult to root. In these species, sufficient rooting can be achieved with the application of high doses of Indole-3-butyric acid (IBA) in softwood cuttings taken during the active growth period (Pair and Khatamian, 1983; Avanzato and Damiano, 1990; Dunn *et al.*, 1996). The rooting rate of cuttings in *Pistacia* species decreases with the aging of the mother plant (Joley and Opitz, 1971). It is accepted that the reason for this rooting difficulty is the phenolic compounds in the cutting (Hess, 1962). Karakır and İsfendiyaroğlu (1999) found that there is a relationship between the rooting periods of cuttings and flavonoid compounds, and that some physiological and biochemical factors may be effective in rooting.

The *Chia* variety is used for mastic production. Clonal seedlings should be used in plantations established for this purpose. The traditional propagation method of the mastic tree is by planting cuttings taken from thick branches of about one metre directly in the soil where the plantation will be established, in December, when the rainfall is the highest. Cuttings of *Pistacia* species generally get roots better in high aeration environments. They must be watered and fertilized the first summer that they are planted. However, with this method, rooting takes a long time and the success rate is low (Browicz, 1987; Acar, 1989, Belles, 2008). Perikos (1993) reports that 45 percent rooting was achieved in cuttings taken in February.

Rooting of this variety with cuttings using hormones were also studied. Karakır and İsfendiyaroğlu (1999) report that the best time of year to get cuttings for *P. lentiscus* var. *Chia* is February. İsfendiyaroğlu (1999; 2000) carried out rooting studies under hormone treatment and fogging with cuttings taken from 1-year shoots using 20 000 parts per million (ppm) IBA, and he achieved a rooting success of 76.6 percent on cuttings taken on 15 February. It is reported that rooting occurred in a short period and better rooting occurred between 15 February and 1 March. He emphasized that the rejuvenation of the rootstock plant from which the cuttings are taken and higher rooting could be obtained in the cuttings taken from the new

shoots (İsfendiyaroğlu, 2018). In the study of Al Barazi and Schwabe (1982) for *P. vera*, the highest rooting was obtained from 35 000 ppm IBA dose in softwood cuttings.



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Figure 2. Traditional sapling production with thick stem cuttings and mastic tree produced using cuttings.

3.2.2. Propagation by budding/grafting

Karakır and İsfendiyaroğlu (1999) performed grafts on *P. lentiscus* individuals in the natural environment on different dates and no success was achieved in any period. As a result of the examination of the grafting point, it was determined that there was excessive resin secretion and intense oxidative tissue darkening on the cutting surfaces. Secretory channels in *Pistacia* species are located in the phloem tissue (Metcalf and Chalk, 1957; Okay, 1994). It is reported that this epidemic prevents the fusion of the tissues by entering between the eye and the rootstock during grafting (Kuru *et al.* (1986). In addition, in the study conducted by Okay (1994), there was an increase in the secretory channels in the phloem at the beginning of each vegetation period (in March, April and May) in *Pistacia* species. It was determined that there was a stagnation in the secretion during the months of July and August. Okay's study revealed that there was no decisive and definite relationship between resin secretion and vaccine attitude.

Pistacia species can reach the grafting age in 2–3 years (Özbek and Ayfer, 1959). *P. lentiscus* is the slowest growing species among the *Pistacia* species. Average height and diameter of 12.5 cm were found in 1-year seedlings (Karakır and İsfendiyaroğlu (1999). Tutar *et al.* (2016a) reported that rootstocks produced from seed did not reach the grafting thickness in the first year in *P. terebinthus*, while 45 percent and 40 percent of them were suitable for grafting for *P. vera* and *P. atlantica*, respectively.

In recent years, sapling production studies have accelerated by grafting mastic on different *Pistacia* rootstocks (Parlak and Akbin, 2011; Tutar *et al.*, 2016a; Parlak, 2018). It was determined that the most suitable rootstock for *P. lentiscus* var. *Chia* grafting was *P. atlantica*. While the success rate of 56.6 percent was achieved in *P. atlantica* in the inoculations made at the beginning of April in the greenhouse environment, this success was 50 percent in wild *P. lentiscus*. In studies performed outside the greenhouse, 55 percent grafting success was achieved in *P. atlantica*, while the retention rate in *P. lentiscus* rootstock was 55 percent (Parlak and Akbin, 2011; Parlak, 2018). Grafting of wild *P. lentiscus* species in its natural environment made by the Menderes Forestry Directorate was successful in 19 percent of cases (Sağlam, 2019).

The time and method of grafting also affect the success of union. For the *P. Lentiscus* grafting made in the greenhouse environment, the best times of year in var. *Chia* were determined as 15 February in chip grafting, between 1 March and 1 April in split grafting, and between 15 March and 15 April in “T” grafting. Split grafting gave the best results in grafting methods. Survival rates were found to be higher in chip grafting made on *P. atlantica* (Parlak and Akbin, 2011). Tutar *et al.*, (2016a) found the highest union rates

in *P. lentiscus* var. *Chia* grafted on five different rootstocks, as 45.3 percent in *P. atlantica* and 45.8 percent in *P. khinjuk* (Figure 3).

No signs of incompatibility were observed in the grafting of buddings, but grafts inoculated and sustained on *P. lentiscus* rootstocks developed more slowly than those grafted on *P. atlantica*. (Figure 3). *P. lentiscus* var. *Chia* grafted on rootstocks with weak growth characteristics. It is predicted that var. *Chia* will show signs of incompatibility in the long term and that breaking may occur from the graft point. Since *P. atlantica* is a strong rootstock in terms of growth characteristics, it is a suitable species to be used as a rootstock for the propagation of var. *Chia* by grafting if there is no sign of incompatibility in the long term (Parlak, 2018).



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Figure 3. *P. lentiscus* var. *Chia* grafting in the field and in the greenhouse with *P. Lentiscus* and *P. atlantica* respectively

There are also studies on seedling production by micrografting in *Pistacia* species. Within the scope of micrografting studies, four different *Pistacia* species (*P. vera*, *P. terebinthus*, *P. khinjuk* and *P. atlantica*) were used as rootstocks for in vitro micrografting and 100 percent success was achieved in each rootstock (Çalar, 2013; Onay *et al.*, 2014; Can *et al.*, 2006; Tokatlı *et al.*, 2010). Top grafting of *P. atlantica* in the natural environment in thick individuals has been very successful and it has become possible to get mastic from grafted branches that have thickened in a few years. With this method, thick *P. atlantica* rootstocks can be transformed into mastic trees in a short time (Figure 4).





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Figure 4. Orchid established top grafting of *P. lentiscus* var. *Chia* on *P. Atlantica*

3.2.3. Propagation by tissue culture

Plants can also be propagated by tissue culture. This method has also been used for the mastic tree in recent years. Although most of the micropropagation studies in the *Pistacia* genus have been carried out on *P. vera*, which has economic importance, *in vitro* production optimization has also been studied in *P. mutica*, *P. terebinthus*, *P. khinjuk*, *P. palaestina* and *P. atlantica* species (Oral *et al.*, 2016). In these studies, while the methods of germinating seeds *in vitro* were determined (Yıldırım, 2012; Koç *et al.*, 2014), studies on rooting shoots obtained from seeds were also carried out (Yıldırım, 2012; Kılınç *et al.*, 2014a;b; Koç *et al.*, 2014a; Onay *et al.*, 2014).

Production studies were carried out with tissue culture using shoot tips in *P. lentiscus* var. *Chia*, and it was determined that there was no root formation while shoot formation was achieved. However, in this method, it is reported that phenolic compounds present in the plant prevent production by tissue culture (Mısırlı *et al.*, 2002; Taşkın and İnal, 2005). Browning of explants in tissue culture production is a serious problem preventing micropropagation (Thakur and Kanwar, 2008). Due to the cuts made during the explant preparation process from the mastic tree plant cells, compounds that are oxidized and can cause the darkening of the environment or the browning of the explant are released (Yalçın, 2011). These compounds inhibit enzyme activity and cause the explant to die, thus causing the problem of darkening (Ellialtıoğlu, 2000). Although different techniques such as Thin Cell Layer Technique (TLC) were used, it was not possible to completely block the blackening problem (Çetin, 2021).

There are also successful rooting studies with the tissue culture method. Kılınç (2013) rooted at a rate of 94 percent in the micropropagation of four young genotypes cloned in *P. lentiscus* using shoot tips. In the study of Şenyay (2008), on the other hand, the rooting success of *P. lentiscus* was 53.3 percent in Murashige and Skoog (MS) nutrient medium in shoots obtained from seeds.

3.2.4. Propagation by layering

Rooting a part of the plant without leaving the mother plant and then separating it to obtain a rooted new plant is called layering. The shape made by laying a piece of branch close to the ground in the soil is called trench layering, and the layering made by attaching rooting material on the plant branches is called air layering (Figure 5). It has been observed that in the natural distribution areas of *P. lentiscus*, the branches in contact with the soil take root, while aerial roots are formed in the old trees.

In order for the layering to be successful, the rooting medium must be suitable for water and air conditions. Extremely wet and dry conditions prevent rooting. In addition, the method and time of layering also change the success of rooting. In order to encourage rooting, wounding on the branch or taking a bracelet provides rooting. For trench layering, branches must be close to the ground so that they can be tilted into the soil. Therefore, the amount of seedling production is limited. Acar (1989) reported that the most suitable layering time of year was between February and March.

In aerial layering, many more saplings can be produced depending on the development status of the rootstock plant. In the application of this method, it should be preferred that the branch to be rooted is thicker than 1.5 cm. It is applied by removing 1.5–2 cm wide bark from the branch and wrapping around one litre of moist peat at this point. While rooting takes 2.5–3 months in the aerial dip made in the beginning of summer, it can be rooted in 1.5 months and 85–90 percent of seedlings can be obtained in the ones made in the middle of summer. It is recommended to have a maximum of one-third of the branches suitable for overhead layering in order not to tire the mother plant excessively (Tutar *et al.*, 2016b). Whether the rooting is sufficient or not can be understood from the hardening of the wrapped peat.



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Figure 5. Application of air layering and aerial immersion

4. Mastic tree plantations in Türkiye

4.1. Work by OGM

OGM carries out general forestry and afforestation activities in Türkiye and also works on mastic trees plantations. It started works to revive the growing of mastic tree, which is on the verge of disappearing, at the beginning of the year 2000. For this purpose, it has carried out many sapling production and afforestation works in and around the Çeşme Peninsula, an area ecologically suitable for the mastic tree. In the İzmir region, OGM carried out these works through the Gaziemir Forest Management Directorate and Torbalı Nursery Directorate.

The Gaziemir forest district has planted 15 328 trees using 12 067 air-layering seedlings and 3 261 grafting seedlings in 123.85 hectares (ha) of different locations around the Çeşme peninsula by 2022 (Ananym1, 2022).

The Torbalı Forest Nursery produces 7 000 air-layering, 3 000 grafting and a total 10000 saplings per year as well as distributes to individuals, entities and companies for plantation (Figure 5).

The Çeşme municipality also has some activities for mastic tree plantations. The municipality planted hundreds of mastic trees in parks and roadside (Figure 6).



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Figure 6. Mastic trees planted in parks and roadsides by Çeşme Municipality

In the İzmir region, OGM prepared and conducted a mastic tree action plan between 2014 and 2019. The action plan aimed to revive the culture of growing the mastic tree in the area. Under this action plan, OGM carried out the following (OGM, 2013):

- inventory of potential areas;
- production of mastic tree sapling;
- establishment of mastic tree plantations;
- contribution to investments for sapling production;
- planting of 10 462 saplings in Çeşme peninsula;
- grafting of 5 000 cuttings on natural *P. atlantica* trees around İzmir; and
- identifying 20 000 ha of potential plantation area for *P. Lentiscus* var. *Chia*.

In addition, the İzmir Development Agency provided funds for the project “The Establishment of Mastic Tree Using Cutting Method in the Cesme Peninsula”.

4.2. Work by non-governmental organizations and the private sector

Non-governmental organizations have also made efforts to maintain the mastic tree culture in the İzmir region. For example, the TEMA foundation has started a clone park project in Urla, İzmir with the clones selected due to the need to protect the existing mastic trees within the scope of rural development activities. Within the scope of the clone park project, a gene pool consisting of a total of 1 000 ramets was created in 2012, consisting of a total of 100 clones (75 male and 25 female) represented by at least 10 ramets (Onay *et al.*, 2016).

The Aegean Forest Foundation, which is another NGO active around İzmir, has a mastic tree plantation programme in İzmir. The foundation established a plantation on behalf of individuals, private or legal entities for TL 400 per tree (Figure 7).



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Figure 7. *P. Lentiscus* var. *Chia* plantation established by the private sector (a) and the Aegean Forest Foundation on behalf of individuals, private or legal entities (b)

References

- Acar, İ. 1989. Sakız (*Pistacia lentiscus* var. Chia) Üretiminin Geliştirilmesine Esas Olmak Üzere Sakızın Fiziko-Kimyasal Yönden İncelenmesi, Ormancılık Araştırma Enstitüsü, Teknik Raporlar Serisi No:35.
- Al Barazi, Z., ve Schwabe, W.W. 1982. Rooting softwood cuttings of adult *Pistacia vera*. *Journal of Horticultural Science*, 57(2): 247-252
- Ananyam1, 2022. Data provided by Gaziemir Forest District, İzmir.
- Avanzato, D., Damiano, C. 1990. Study of rooting of *Pistacia atlantica*. Desf. Abstracts of Contributed papers 2. Posters. In: XXIII. International Hort. Congr., Firenze, Italy, August 27-September 1, No. 4032.
- Aydın, Y. 2014. Ören (Milas-Muğla) Yöresindeki Pasa Ve Bozuk Maki Alanlarında Sakız (*Pistacia Lentiscus* L.) Yüksek Lisans Tezi , Denemeleri. Süleyman Demirel Üniversitesi Fen Bilimleri Enstitüsü, 81 s.
- Belles, C. 2008. Mastiha Island, 2nd ed. (Chios, Greece: G.N.Merousis Publishers), p. 333.
- Browicz, F.A. 1987. *Pistacia lentiscus* L. var. Chia (Anacardiaceae) on Chios island, *Pl. Sys. Evol.*, 155(1-4), 189–195.
- Can, C., Ozaslan, M., Toremén, H., Sarpkaya, K. & Iskender, E. 2006. In vitro micrografting of pistachio, *Pistacia vera* L. var. Siirt, on wild pistachio rootstocks. *J. Cell Mol. Biol.*, 5, 25-31.
- Çalar N., 2013. “Sakız ağacı (*Pistacia lentiscus* L.)’nın *Pistacia* anaçları (*Pistacia vera* L., *Pistacia khinjuk* Stocks, *Pistacia atlantica* Desf., *Pistacia terebinthus* L.) üzerine in vitro mikroaşılanması.”. Yüksek Lisans tezi, Dicle Üniversitesi Fen Bilimleri Enstitüsü, Diyarbakır 82 s.
- Çetin, N. 2021. Sakız (*Pistacia lentiscus* var. Chia) Bitkisinde İnce Hücre Tabaka Tekniği ile Farklı Eksplant Kaynaklarından In Vitro Rejenerasyonların Sağlanması. Yüksek Lisans Tezi, Ege Üniversitesi, Fen Bilimleri Enstitüsü, 140 s.
- Davis, P.H. 1967. *Flora of Turkey and East Aegean islands*. Vol. 2: 425–450. UK, University of Edinburgh.
- Dunn, E.D., Cole, J.C., Smith, M.W. 1996. Position of cut, bud retention and auxins influence rooting of *Pistacia chinensis*. *Sci. Hortic.*, 67: 105–110.
- Ellialtıoğlu, Ş. 2000, Doku Kültürü Yoluyla Vegetatif Çoğaltmada Doku Kararması Sorunu, Nedenleri ve Çözüm Yolları. Ankara, Ankara Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölümü.
- Garcia-Fayos, P., Verdu M. 1998. Soil seed bank, factors controlling germination and establishment of a Mediterranean shrub: *Pistacia lentiscus* L. *Acta Oecologica*, 19: 357–366.
- Hess, C.E. 1962. A physiological analysis of root initiation in easy and difficult to root cuttings, Proceeding of the XVIth International Horticultural Congress, Brussels, 4: 382–388.
- Hoşer, A., 2018. Jüvenil Aksenik Sakız Ağacı (*Pistacia lentiscus* L.) Eksplantlarından Süspansiyon Kültürlerinin Başlatılması ve Optimizasyonu. Batman Üniversitesi Fen Bilimleri Enstitüsü, Msc. 74 s.
- İsfendiyoğlu, M. 1999. Sakız Ağacının (*Pistacia lentiscus* var. Chia Duham.) Çelikle Çoğaltılması ve Kök Oluşumunun Anatomik – Fizyolojik İncelenmesi Üzerine Araştırmalar Doktora Tezi, Ege Üniversitesi Fen Bilimleri Enstitüsü, İzmir.
- İsfendiyoğlu, M. 2000. Cutting Propagation of Mastic Tree. Fao-Ciheam Nucis Newsletter.
- İsfendiyoğlu, M. 2018. Propagation of Mastic Tree: From Seed To Tissue Culture. Fourth International Symposium of Medicinal and Aromatic Plants, 2–4 October 2018 Çeşme, İzmir, s 209–213.
- Joley, L.E., Opitz, K.W. 1971. Further experience with propagation of *Pistacia*. Combined Proceedings of the International Plant Propagators’ Society, 21: 67–76.
- Jordano, P. 1988. Polinizacion variabilidad de la produccion de semillas en *Pistacia lentiscus* (L) (Anacardiaceae). *Anales Jará. Bot. Madrid*, 45(1), 213–231.

- Karakır, M.N., İsfendiyaroğlu, M. 1999. Sakız Ağacı (*Pistacia lentiscus* L.)'nın Vegetatif Yöntemlerle Çoğaltılması ve Kök Oluşumunun Anatomik-Fizyolojik İncelenmesi Üzerine Araştırmalar. İzmir (Doktora Projesi) TÜBİTAK, TOGTAG-1511 Nolu proje, s: 97.
- Keçeci, A. 2019. Çeşme Yarımadasında Yetişen Yabani (*Pistacia lentiscus* L.) ve Kültür Sakızı (*Pistacia lentiscus* var. Chia. Duham.) Ağaçlarının Uçucu Yağ Özelliklerinin Karşılaştırılması. Yüksek Lisans Tezi, Tekirdağ Namık Kemal Üniversitesi Fen Bilimleri Enstitüsü, 46 s.
- Kılıç, M.U. 2021. Farklı Sakız Ağacı (*Pistacia lentiscus* L.) Genotiplerine Ait Sürgün Ucu Eksplantlarında İn vitro Kültürlerin Başlatılması ve Mikroçoğaltım Olanaklarının Araştırılması. Yüksek Lisans Tezi, Aydın Adnan Menderes Üniversitesi Fen Bilimleri Enstitüsü, 58 s.
- Kılınç, F.M., 2013. Sakız Ağacı (*Pistacia lentiscus* L.)'nın in Vitro Klonal Mikroçoğaltılması, Dicle Üniversitesi Fen Bilimleri Enstitüsü, Msc. 96 s.
- Kılınç, F.M., Süzer V., Özden Çiftçi Y., Koç İ., Akdemir H., Yıldırım H., Tilkat E. & Onay A. 2014b. Improved shoot multiplication of lentisk (*Pistacia lentiscus* L.) Using different carbohydrates and media. *Acta Horticulturae*, 1028, 145–151.
- Kılınç, F.M., Süzer V., Özden-Çiftçi Y. Onay A., Yıldırım H., AltinkutUncuoğlu A., Tilkat E., Koç İ., Akdemir Ö.F. & Karakaş-Metin, Ö. 2014a. 'Clonal micropropagation of *Pistacia lentiscus* L. and assessment of genetic stability using IRAP markers. *Plant Growth Regulation*. <https://doi.org/10.1007/s10725-014-9933-9>.
- Koç, İ. 2011. Sakız Ağacının (*Pistacia lentiscus*) in vitro Koşullarda Mikroçoğaltımı ve Saklanması. Gebze Yüksek Teknoloji Enstitüsü Mühendislik ve Fen Bilimleri Enstitüsü, Msc. 107 s.
- Koç, İ., Akdemir, H., Onay A. & Özden-Çiftçi, Y. 2014. Coldinduced genetic instability in micropropagated *Pistacia lentiscus* L. Plantlets. *Acta Physiologiae Plantarum*, 36(9), 2373–2384.
- Koç, İ., Onay, A. & Özden-Çiftçi Y. 2014a. In vitro regeneration and conservation of the lentisk (*Pistacia lentiscus* L.). *Turk J Biol.*, 38, 653–663.
- Kuru, C. 1993. Dikimden Hasada Antepfıstığı, Ar Ajans Gaziantep.
- Martinez-Palle, M.E. & Aronne, G. 2000. Reproductive cycle in southern Italy of *Pistacia lentiscus* (Anacardiaceae). *Plant Biosyst.*, 134(3), 365–371.
- Metcalf, C.R. ve Chalk, L. 1957. *Anatomy of The Dicotyledons*, 1:684, Oxford at The Clarendon Press, London, 691 s.
- Mısırlı, A., İsfendiyaroğlu, M., Gülcan, R., Özeker, E., Köktürk, U., Yılmaz, H., Yıldırım, F. 2002. Manisa Yunt Dağı Bölgesindeki *Pistacia* Genetik Materyalinin Tanımlanması, Vegetatif Çoğaltım Olanakları ve Tozlayıcı Özelliklerinin Belirlenmesi, Türkiye Bilimsel ve Teknik Araştırma Kurumu, Türkiye Tarımsal Araştırma Projesi.
- Morkan, L. 2009. *Pistacia lentiscus* L. (Sakız Ağacı)'da Ağaç Çapı, Boyu ve Üretim Döneminin Sakız Verimine Etkisi. Yüksek lisans tezi, Karadeniz Teknik Üniversitesi, Fen Bilimleri Enstitüsü, 59 s.
- Okay, Y. 1994. Antepfıstığında (*P. Vera* L.) Sakız Salgısı (mastika) İle Aşı tutumu Arasındaki ilişkiler, Doktora Tezi, Ankara Üniversitesi Fen Bilimleri Enstitüsü, Bahçe Bitkileri Anabilim Dalı, 173 sayfa.
- OGM. 2013. Sakız Eylem Planı - 2014-2019, Publication of General Directorate of Forestry, Ankara.
- Onay, A., Özden-Çiftçi, Y., Yıldırım, H. & Tilkat, E. 2014. "Sakız Ağacının (*Pistacia lentiscus* L.) Juvenil ve Olgun Eksplantlarının Mikroçoğaltımı, Kriyoprezervasyonu ve Genetik Kararlılığının Belirlenmesi" Proje Sonuç Raporu (Proje No: 110T941).
- Onay, A., Yıldırım, A., Uncuoğlu Altinkut, A., Özden Çiftçi, Y., Tilkat, E. 2016. Sakız Ağacı (*Pistacia Lentiscus* L.) Yetiştiriciliği. Kitap, Dicle Üniversitesi Yayını, Diyarbakır.

- Oral, B., Han, B., Süer, S. 2016. Sakız Ağacı (*Pistacia lentiscus* L.) Yetiştiriciliği. Dicle Üniversitesi Basımevi ISBN: 978-975-7635-92-5. 114 s.
- Özbek, S., Ayfer, M. 1959. Türkiye’de Antepfıstığı (*Pistacia vera*) anaçları ve aşı tekniği. Ankara Üniversitesi Ziraat Fakültesi Yayınları, 14: 189–214.
- Pair, J.C., Khatamian, H. 1983. Propagation and growing of the Chinese pistache. *Proc. Int. Plant Prop. Soc.*, 32: 497–503.
- Parlak, S.; Albayrak, N. 2010. Sakız (*Pistacia lentiscus* var. *Chia*)’ın Aşılama Yoluyla Çoğaltılması - Mastic tree vegetational propagation by grafting, Publication of Aegean Forest Research Institute, Technical Bulletin No:49. İzmir, Türkiye.
- Parlak, S. 2018. Clonal propagation of mastic tree (*Pistacia lentiscus* var. *Chia* Duham.) in outdoor beds using different rootstock and grafting techniques. *J. For. Res.*, 29(4): 1061–1067.
- Parlak, S., ve Akbin, A.N. 2011. Sakız (*Pistacia lentiscus* var. *Chia*)’nın Aşılama Yoluyla Çoğaltılması. Orman ve Su İşleri Bakanlığı Orman Genel Müdürlüğü, Müdürlük yayın no: 65, Teknik Bülten no: 49, İzmir, Türkiye.
- Perikos, J. 1993. *The Chios Gum Mastic*. Print All Ltd. Athens.
- Piotto, B. 1995. Influence of scarification and prechilling on the germination of seeds of *Pistacia lentiscus*, *Seed Science and Technology*, 23: 659–663.
- Piotto, B., Di Noi, A. 2003. Why Propagate Trees and Shrubs of the Mediterranean Flora from Seed. In: B. Piotto and A. Di Noi, editors, *Seed Propagation of Mediterranean Trees and Shrubs*. Agency for the Protection of the Environment and for Technical Services (APAT), Rome. p.7.
- Prada, M. A., Arizpe, D. 2008. *Pistacia lentiscus* L. In: *Riparian tree and shrub propagation handbook*. pp. 90–93.
- Sağlam, Y.S. 2019. Sakız (*Pistacia lentiscus* var. *Chia*) Fidan Üretim Tekniklerinin Maliyet Analizi. Yüksek lisans tezi Kastamonu Üniversitesi, Fen Bilimleri Enstitüsü, 99 s.
- Sayman, M., Kılıcı, M., Akbin, G., Parlak, S. 2011. Tuzlu ve Alkali Topraklara Sahip Olan İzmir-Sasalı’da Ağaçlandırmada Kullanılacak Uygun Bitki Türlerinin Beirlenmesi. Orman ve Su İşleri Bakanlığı Orman Genel Müdürlüğü, Müdürlük yayın No. 68, Teknik Bülten No. 51, İzmir, Türkiye.
- Şenyay, D. 2008. Sakız Ağacının (*Pistacia lentiscus* L.) In vitro Koşullarda Rejenerasyonu Üzerine Araştırmalar. Yüksek Lisans Tezi, Ege Üniversitesi Fen Bilimleri Enstitüsü, 69 s. Bornova İzmir, Türkiye.
- Taşkın, T., İnal, A. 2005. Sakız Ağacı (*Pistacia lentiscus* var *Chia* Duhamel)’nın İn Vitro Mikroçoğaltımı Üzerine Araştırmalar, *Ege Tarımsal Araştırma Enstitüsü Dergisi*, Cilt 15 (1): 1–15.
- Thakur, A. and Kanwar, J.S. 2008. Micropropagation of 'Wild Pear' *Pyrus pyrifolia* (Burm F.) Nakai. I. Explant Establishment and Shoot Multiplication. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca* 36: 103–108.
- Tokatlı, Y.O., Akdemir, H., Tilkat, E., Onay, A. 2010. Current status and conservation of *Pistacia* germplasm. *Biotechnology Advances* 28: 130–141.
- Tutar, M., Aksoy, D., Şafak, C., Çiçek, F. 2016b. Damla sakızının (*Pistacia lentiscus* L. var. *Chia* Duham.) havai daldırma yöntemiyle üretilmesi. *Bahçe*, Cilt 1, 45: 867–866.
- Tutar, M., Şafak, C., Aksoy, D., Çiçek, F. 2016a. Damla sakızına (*Pistacia lentiscus* L. var. *Chia* Duham.) anaç Olarak kullanılabilecek *Pistacia* Türleri. *Bahçe*, Cilt 1, 45: 230–235.
- Verdu, M. & Garcia-Fayos, P. 2002. Ecologia reproductiva de *Pistacia lentiscus* L. (Anacardiaceae): anacronismo evolutivo en el matorral mediterraneos. *Rev. Chil. Hist. Nat.*, 75(19), 57–65.

- Yalçın, G. 2011. *In vitro*'da sakız ağacı (*Pistacia lentiscus* VAR. Chia) Eksplantlarında Görülen Kararmaların Çözümü Üzerine Araştırmalar. Ege Üniversitesi, Mühendislik Fakültesi, Biyomühendislik Bölümü İzmir, Türkiye.
- Yıldırım, H. 2012. Micropropagation of *Pistacia lentiscus* L. from axenic seedling-derived explants, *Scientia Horticulturae*, 137: 29–35.
- Zohary, M. 1952. A monographical study of the genus *Pistacia*, *Palestine, Journal of Botany Jerusalem*, 5, 187–228.

SIDE EVENT 2

How model forests can contribute to the development of youth entrepreneurship based on nature-based solutions

Istria Model Forest – Modelna šuma Istra

Barbara Sladonja¹ | Ana Fornažar²

¹ PhD Scientific Advisor, Institute of Agriculture and Tourism, Karla Huguesa 8, 52440 Poreč, Croatia;
² Master in Silviculture, forest pedagogue, President of the Model Forest Istria, Trg slobode 2, 52 000 Pazin, Croatia

Istria Model Forest ID

Official model forest name:

Istria Model Forest

Country: Croatia

Year of establishment: 2013

Number of members: 30

Website:

<https://www.slivrijekemirne.hr/>

Abstract:

The model forest (MF) concept is a partnership of individuals and groups with a common vision of sustainable development in forested landscapes. Istria and Croatia geographically belong to the Mediterranean area. The Istria Model Forest in the Mediterranean Model Forest Network was established in 2013 and today has 30 members. It seeks to have a broad representation of all relevant stakeholders in the area and proposes initiatives to encourage positive economic changes and develop the value chain for forest products. The Istria MF has implemented several projects including: Traceability of the Products in the Model Forest, Forest Pedagogy in Istria and the Forest and Forest Fruit Festival. Although youth entrepreneurship activities with nature-based solutions (NBS) is a topic that is not currently present in our MF, we have plans to move in the following directions: developing activities involving local youth, educating new educators in forest pedagogy, enhancing the production and presentation of natural products, creating a basis for future entrepreneurs, raising awareness about nature-based problems (NBP), involving new generations and creating new employment opportunities for young people.

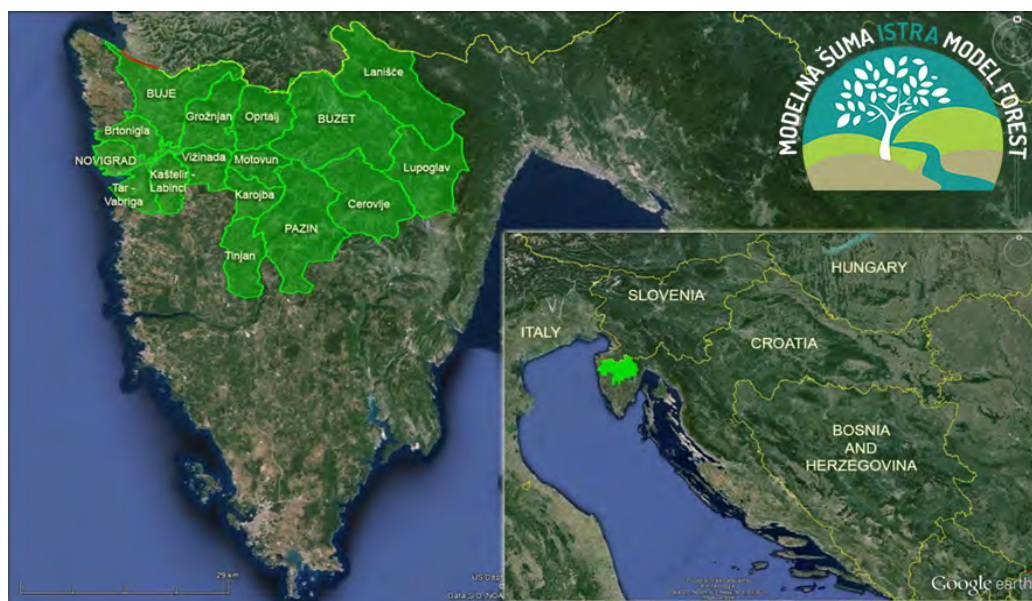


Figure 1. Geographical position of the Istria Model Forest Istria

The main motivations for creating the Istria Model Forest (MF) are:

- sustainable use of forest products in the River Mirna Basin;
- enhancement of the rural tourism activities; and
- greater cooperation of the stakeholders at the territory.

VISION

In the area of the Istria MF, we strive to achieve the sustainable management of forests and the Mirna River in order to initiate economic activities to enhance the value of forests and agricultural assets while promoting the cultural and natural values of this area.

MISSION

The Istria MF is run based on open and responsible cooperation of partners whose interests and needs are different, united by the desire to contribute to the economic, social and environmental well-being of the area where they live and work.



© Mediterranean Model Forest Network

Figure 2. Istria Model Forest landscape

Istria Model Forest structure and funding

The MF statute defines the structure. In this statute, the main and responsible person for the MF is the President, while the body is a Steering Committee consisting of five members. The members are the Institute for Agriculture and Tourism, Zigante Truffles Ltd., the vice president, the president and one representative of the territory.

The MF assembly consists of 30 members: the region of Istria, cities and municipalities, public institutions, private enterprises, associations and individuals. The assembly is held every year in person or online. The limits of the model forest are the administrative boundaries of cities and municipalities covering a total of 116 616 hectares (ha), of which 66 500 ha (60 percent) is considered forest area.

The Istria MF was funded in 2022 by the following entities:

- the Istria Regional Authority, Department for Agriculture and Forestry;
- cities and municipalities of the MF;
- EU programmes such as Erasmus + (FoRoots and Cooperation and education as a key to sustainable development) (HORIZON 2020);
- membership fees; and
- donations & other national and international foundations.

In recent years, funds from the EU projects have increased, which is a result of the efforts put into international collaboration.

Projects implemented or designed by the Istria Model Forest

Among all the ongoing projects, the three most representative projects are the following:

- Forest Pedagogy in Istria (workshops and handbook);
- Forest and Forest Fruit Festival (producer fair of forest fruit products such as food, cosmetics, art, education and fun); and
- Product Traceability in the Model Forest (as the products can “tell” the story of their origin).

FOREST PEDAGOGY

In recent years, the MF association has been intensively involved in environmental education and forest pedagogy, as it has been implementing the project "Forest Pedagogy in Istria" since 2018. One project initiative included numerous workshops held with children in schools and kindergartens along with lectures and workshops for educators and teachers. Forest pedagogy educates children on forest ecosystems by highlighting the connection between people and the environment. Evidence shows that children learn best through group work, playing, research and interaction with the living world, which is lacking in school and preschool education.

The project "Forest Pedagogy in Istria" intends to compensate for the lack of such educational content by teaching educators how to design and implement such programmes.

The aim is to improve the development of knowledge sharing in order to encourage the networking of actors who contribute to it. At the same time, the capacity of our association is strengthened and becomes recognized in Istria as an entity that knows how to transfer best practices in working with children and youth in the natural environment. As part of the “Forest Pedagogy in Istria 2022” project, which is continuing for the fifth year in a row, the model forest area (the north and centre of Istria) will be covered as well as other interested parts of Istria to contribute to learning about forest pedagogy.

Educating experts influences the quality of life in rural areas. The transfer of knowledge to younger generations contributes to a recognition of the importance and benefits from forest ecosystems. The association is currently working on creating a handbook entitled *Forest pedagogy – for educators, teachers and parents*. The handbook describes the concept of forest pedagogy, contains practical exercises for

preschool and school age children, and is intended for everybody who wants to work with children on the principle of forest pedagogy.

The manual will contain a series of practical exercises for children from ages 4 to 9 and examples of workshops for children from ages 9 to 12. The handbook describes the benefits of forest pedagogy and methods of working with children of which are grouped into cognitive research, motor, sensory and creative methods. In the implementation of the manual, we have applied our previous experience in this field and carried out extensive research to create the first handbook on forest pedagogy in Croatia. The published handbook will be presented in schools and kindergartens in the county, and workshops in forest pedagogy will be held.

The workshops with children or adults encourage creativity and cognitive learning by design because the methods used correlate with the most modern practices in integrated pedagogy and education for sustainable development.

Experts from the MF who deal with forest pedagogy hold their workshops and lectures outside the Istria region as well. In 2018 and 2020, the MF association were invited to other counties in eastern Croatia where we instructed educators and teachers. In 2021, in the area of the Model Forest, we educated experts employed in the nature protection institution *Priroda* from the county of Primorsko-Goranska, Croatia, about how to use forest pedagogy methods in their work with visitors.

Since 2014, the association has been involved in the work of the European Network for Forest Pedagogy, which operates within the United Nations Economic Commission for Europe. Every year, the MF association participates in the organization of an international conference on forest pedagogy (<http://forestpedagogics.eu/portal/>), which will be held this year in Switzerland.

FOREST AND FOREST FRUIT FESTIVAL

Key actions in the Forest and Forest Fruit Festival are:

- workshops and lectures on forests and forest fruits;
- a forest therapy workshop, "forest bathing";
- workshops on forest pedagogy and forest games for children; and
- a land art show.

ACTIVITIES OF ISTRA MF GROUPED BY AIMS OR TYPE

EDUCATION & KNOWLEDGE SHARING

- "Truffle habitats are endangered" (2018), a campaign;
- "Forest Pedagogy in Istria" project (since 2018), a workshop;
- "Education of educators and children about forest pedagogy" (2019);
- *Mushrooms of the River Mirna Basin* (2020), a book; and
- *Forest pedagogy – for educators, teachers and parents* (2022), a handbook.

AWARENESS RAISING & DISSEMINATION

- Forest and Forest Fruit Festival (2022).

ADDING VALUE AND DIVERSIFICATION

- Forest Stewardship Council (FSC) certification of ecosystem services in private forest (2022).

INTERNATIONAL PROJECTS

- Erasmus + “Education for sustainable development in Mediterranean model forests”, knowledge sharing 2021, 2022;
- Erasmus + “Cooperation and education as the key to sustainable development”, knowledge sharing 2021, 2022;
- Horizon 2020 “One Forest – a multicriteria planning system for joint forest management”, 2022; and
- Erasmus + “FoRoots – walk through the woods and discover your roots, 2022”.

Cooperation was established with the office of the Forest Stewardship Council (FSC) in Italy, which is in charge of developing FSC certification in Croatia and the wider Adria-Balkan region since 2020. The aim is to launch FSC certification for private forest owners in the Istria MF. The FSC certification promotes sustainable forest management. For example, through FSC certification, value will be added to products from forests such as truffles, game or wood (primarily).

As a part of this programme, it will first be necessary to have certification for forest management in private forests and then to certify ecosystem services (such as tourism, soil and non-timber forest products) if there will be any interest from private forest owners in Istria. The office in Italy is already looking for foreign sponsors who want to pay for the certification of ecosystem services in Istria. Here, we will also need the support and cooperation of municipalities and cities in the area of the model forest, as well as the county of Istria, Department of Agriculture and Forestry, in identifying private forest owners who will be interested in entering such a programme.

From 2021, we are implementing two European projects from the Erasmus + programme where our goal is to exchange practices in education on forests and sustainable development for children and adults:

- “ForestEd: Education for sustainable development in the Mediterranean model forests” is lead in partnership with the Provence Model Forest. In the last year, we have travelled to Provence and Tuscany as a part of this project, and, in March 2022, board members and associates travelled to Portugal. The partners in this project are Montagne Fiorentine Model Forest from Tuscany, the Regional Development Fund of Western Macedonia from Greece, the Regional Environmental Education Network from Provence, the Centre for Services and Promotion of Forestry and Forest Industry from Spain, and the Environmental Education Organization from Portugal.
- “Cooperation and education as the key to sustainable development is a project implemented in cooperation with the Provence MF, the Forestry School and the Forest Administration of the Maskulińskie Region of Poland. In 2021, the MF association travelled to Provence and Poland as a part of this project. An international meeting was held in Istria from 31 May to 2 June 2022 as part of this project.

With other colleagues from the model forests of the Mediterranean, the MF association is involved in two more projects, which start in 2022 and will be implemented during the next two years.

- Horizon 2020 One Forest – a multicriteria planning system for joint forest management: strengthening forest resilience, aligning stakeholder interests and ensuring a sustainable timber flow, to share the experience of creating a MF with partners from South Germany and other partners involved in the project.
- Erasmus + project “FoRoots – take a walk in the woods and discover your roots was recently approved for funding, for which we will create a GIS in each MF territory within the Mediterranean Model Forest Network (IMFN) (www.medmodelforest.net/en/) and create an interpretive path of the landscape and its natural resources. These will be trails that talk about culture, gastronomy, and traditional and natural heritage with the understanding of the territory as an ecosocial landscape.

Youth entrepreneurship in nature-based solutions

Our MF at present does not have a project on youth entrepreneurship based on nature-based solutions (NBS).

However, we plan to move into this direction to:

- develop activities involving youth from the territory;
- educate new educators in forest pedagogy;
- enhance the production and promotion of natural products by new generations of agricultural producers;
- educate kindergarten teachers about forest pedagogy in the area of the MF and beyond, creating basis for future entrepreneurs;
- raise awareness about nature-based problems (NBP) involving new generations; and
- create new employment opportunities for young people.

New project applications

The Istria MF has submitted two new projects for 2022 to the tender of the county of Istria, Department of Agriculture and Forestry:

- The new project of the MF is the Forest and Forest Fruit Festival, which will be held in October 2022 in the municipality of Oprtalj.
 - The festival will be held every year and change locations across various municipalities and cities in the area of the MF. The festival will include a presentation by forest fruit producers of food, cosmetics and decorations. We will organize workshops for adults on making jams and spreads from wild herbs and forest fruits, producing handmade cosmetics, a workshop on mushroom knowledge, navigating hiking trails, lectures on forests and a forest therapy workshop. The festival will last one day and is meant to attract a lot of people and be fun by offering the opportunity for festival visitors to learn how to cook and prepare dishes from forest fruits and mushrooms. Leaders of workshops and lectures will be MF association members and external associates, with "forest chef" Anton Rudan and "forest therapist" Darko Vukelic, for example. The aim is to establish cooperation with as many members of the association as possible in organizing this unique and innovative Forest and Forest Fruit Festival.
- "Forest Pedagogy in Istria" is a project that is continuing since 2018, for which there are plans to complete the handbook *Forest pedagogy – for educators, teachers and parents* and hold forest pedagogy workshops in schools and kindergartens. This is a handbook that was in development in 2021, but there were not enough funds to finalize publication.

The Istria MF has also submitted two new Erasmus + projects:

- In the project "Land-Use Satellite Monitoring System", the applicant is CeseFor of Spain, and the project involves members of the Mediterranean Model Forest Network. The main goal of the project is to provide the Mediterranean Model Forest Network (IMFN) with a tool (web platform) to monitor changes and trends in land use and, therefore, identify potential areas under degradation or land suitable for carbon depletion or absorption.
- In the second project, "Carbon Sequestration Satellite Monitoring System," the applicant is the Institute of Agriculture and Tourism from Poreč (a member of the Istria MF) and the MF is a partner in the project. This project stems from the need of local communities for advanced tools that allow proper planning of their resources and assessment of carbon stored in their forests. In this sense, an accurate estimate of the carbon stored in forests can increase the value of these forests as carbon sinks to mitigate climate change.

Opportunities and challenges

The most important problems in the development of Istria MF is the lack of continuous funding, lack of human resources, global crises, difficulties in motivating people to stay in rural areas and the emergence of different individual interests.

Our main goals for the future are similar to other MFs: to disseminate and promote the MF idea and its values, widen our membership and share principles that combine the social, environmental and economic needs of local communities with long-term sustainability (Ventre, Vannini and Mori, 2021).

References:

Ventre, T., Vannini, S. & Mori, P. 2021. *Mediterranean Model Forest Network*. MMFN Secretariat, Florence, Italy.

Montagne Fiorentine Model Forest: 10 years of landscapes, partnerships and sustainability

Stefano Berti¹

¹Forest Engineer, FMMF
President, Via Poggio alla Cuna 7,
50060 Londa (FI), Italy

Abstract:

A model forest (MF) is a voluntary association of people living together in the same area and participating in the implementation of the sustainability of that area.

In 2012, the International Model Forest Network recognized the first model forest in Italy, the Montagne Fiorentine Model Forest (FMMF), located in Tuscany, close to the city of Florence.

Many projects have been carried out in these 10 years of activity. Among these projects are the quality standards for forestry companies, a promoting location to show and enhance local forestry products, the creation of a brand registered with the Ministry for Economic Development called "Foresta Modello- Il Legno", and a series of walking tours (Tre Passi a Monte) dedicated to environmental education and the knowledge of the cultural, historical and natural heritage of the FMMF area.

The FMMF is devoting a great deal of attention to the development of youth entrepreneurship linked to natural resources and has chosen to invest in forest therapy, considering it one of the most important ecosystem services of forests.

The adventure of the Montagne Fiorentine Model Forest (FMMF) began in 2009 when the Tuscany region joined the International Model Forest Network (IMFN) and led to the accreditation of the association in 2012. In fact, it took three years to prepare a strategic plan reporting on the needs of the various inhabitants of the territory of the Union Valdarno and Valdisieve municipalities (UCVV), the area chosen to test this initiative. The strategic plan was drafted according to IMFN principles based on a broad partnership and working on the sustainability of the forest, and is a preferential and strategic way to increase, through innovation and governance, the quality of life in rural areas.

In the Tuscany region, woods and forests cover half of the land area. In the FMMF, there are beeches, firs, pines, oaks, hornbeams, ashes and chestnuts, reaching 70 percent coverage. The environmental benefits are huge, both for the resident population – linked to the metropolitan area of Florence – and for those who benefit indirectly as tourists, hikers and citizens.

The forest landscape is located on a hilly and mountainous rural area, with a strong connection to history and the use of natural resources, including soil, water, stone, wood, agriculture and infrastructure.

In and around the forest, many activities are traditional: the production of timber, mushrooms, chestnuts, and herbs; tourism and sports; hunting; hydrogeological protection; habitat conservation; livestock breeding and beekeeping. In addition, the agricultural activity and the production of oil and wine are particularly well known.

However, there are limits to the growth and sustainable development of the FMMF area. With an area of 548 square kilometres (km²), there is a low population density (116 inhabitants/km²), socioeconomic marginalization and a lack of services.

The FMMF is a voluntary based, non-profit association dedicated to active land management. The governance of the association is represented by the assembly of members (currently 103, including municipalities, universities, research centres, associations, enterprises, professionals and private citizens), an executive council, which elects the president and vice-president, and a secretariat. In practice, activities are carried out by four thematic commissions on:

- environment and society;
- culture and tourism;
- production chains; and
- international relations (which has been assisting the Tuscany region in the management of the secretariat of the Mediterranean Model Forest Network since 2019).

Main projects achieved

During its 10 years of activity, FMMF has developed several projects. However, the most important ones are Avvio del Processo di Foresta Modello (Start of the Model Forest Process) (APROFOMO), Definizione di un modello sperimentale per la commercializzazione dei prodotti forestali della foresta modello delle montagne fiorentine (Definition of an experimental model for the marketing of forest products from the Montagne Fiorentine Model Forest) (DEMOSCOPE) and Tre Passi a Monte.

Several forestry companies are involved, such as the UCVV and the National Research Council (CNR-IVALSA); APROFOMO has produced quality standards for forestry work and is an innovative tool for classifying local structural timber. This project introduced high-quality standards of work to enhance the technical skills in the area by producing a qualification that exceeds legal requirements and allows the positive recognition of those who acquire the wood products (Magherini *et al.*, 2015). The innovative grading machine is VISCAN FMMF. It is suitable for the timber species present in the FMMF territory and was officially certified as a strength-grading machine in March 2014. At the same date, the settings for Douglas fir and black pine were approved, while fir and chestnut were approved in October 2014. So far, this is the first and only machine in Europe able to grade a hardwood.

The VISCAN FMMF was thought to be cheaper than what is commonly used in larger companies and

portable and can thus be shared by several small sawmills (Brunetti *et al.*, 2015).



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Photo 1. Demonstration of structural timber grading with the VISCAN FMMF portable grading machine

The DEMOSCOPE project aims to restructure the local forest sector. In fact, there is a lack of a stable markets for wood products and low-value uses for local wood mainly as fuelwood and low availability for the small sawmills present. Fuelwood and chips now account for the bulk of production, but the fact that most downstream actors source their wood supply from external sources makes it desirable and necessary to enhance sawntimber production (Torreggiani *et al.*, 2015). For this purpose, the brand Foresta Modello - Il Legno was created, and it is registered with the Ministry of Development, owned by the UCVV and managed by the FMMF. In addition, a promotion building “show wood” was constructed to show the various wood products in the FMMF area. A web portal for the wood chain products was also created.



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Photo 2. The "Show wood" promoting location built from local wood to exhibit FMMF's forestry products.

The Tre Passi a Monte project involves walking tours dedicated to environmental education and to the knowledge of the cultural, historical and natural heritage of the FMMF area. Since 2014, these walking trips have been organized to deepen the knowledge of the sites, and the physical and cultural heritage connected to them. Considering the influence of the seasons on the environment, excursions are always organized in both spring and autumn (IMFN, 2018).

Project developed in recent years

The main projects that FMMF has carried out in recent years are:

- The Progetti Integrati di Filiera (Integrated supply chain project) (PIF) started in 2019 and ended in May 2022. It focused on the wood brand FMMF IL LEGNO for which all companies (more than 20) that have joined the brand have activated financial measures from Programmi di Sviluppo Rurale (rural development programme) (PSR) of the Tuscany region for purchases connected to the development of a local wood supply chain.
- ForestEd (EU Erasmus +) started in 2020 and ended in June 2022. The project was an exchange of good practices with a comparison of environmental education tools between Mediterranean countries. Three international meetings dedicated to environmental education took place in France, Italy and Portugal.



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Photo 3. Walking tour dedicated to environmental education and to the knowledge of the FMMF area.

- Foresta delle Meraviglie started in 2020 and ended in 2022. The project involved the creation of routes to discover the forest, plant and animal species that grow there with the support of information points and educational games. The routes can be enjoyed on foot, horseback or bicycle, and there are different levels of difficulty.
- Agrinfo18 started in 2020 and ended in 2022. Founded by PSR of the Tuscany region, the project included the holding of several seminars and videos across Tuscany dedicated to the dissemination of the MF concept and information on the FMMF and its members.
- ONEForest (EU Horizon 2020) started in 2021 and will end in 2024. The aim of the project is to exchange information for the prevention of biotic and abiotic damage (digitization of information), exchange of good practices for timber harvesting and encouraging multistakeholder forest management through the MF approach (four new pilot sites in the European Union).

Development of youth entrepreneurship based on nature-based solutions

Looking for new ways to offer opportunities to young people and stimulate youth entrepreneurship, the FMMF is focusing on forest therapy as one of the ecosystem services that the forest can offer. In particular, a project is being carried out with the aim of creating a new community service that can be provided by the FMMF area. The project is supported scientifically by the National Research Council of Italy (CNR), Club Alpino Italiano (CAI) and the Regional Reference Centre for Phytotherapy (CERFIT) so that the regional health structures can accept the practice of forest therapy. The implementation of the project involves building a network of themes and sites able to welcome forest therapy beneficiaries in order to provide new opportunities for the area and those who work there. Notably, the initiative could provide a concrete response to the needs generated by the COVID-19 pandemic, with particular reference to the most urbanized part of the population. Three areas were identified to carry out forest therapy activities:

- municipality of San Godenzo (Castagno d'Andrea area);
- municipality of Londa (Rincine area); and

- municipality of Reggello (Vallombrosa area).

The activities may require an overnight stay in the area for both the operators and the participants, thus creating an economy also for the activities not directly involved (e.g. environmental guides).

We are trying to encourage young people in the area, both those who already have a business and those who are looking for work, to take advantage of this opportunity based on natural solutions.

In reference to the development of youth entrepreneurship founded on NBS, the FMMF has chosen to entrust the management of the brand Foresta Modello - Il Legno to Bluebiloba, an innovative start-up of young professionals from different sectors who have chosen to work together to develop Forest Sharing (an innovative and sustainable service for the management and enhancement of the forest heritage) and BlueDrone activities (a tailor-made and on-demand service for the implementation of activities with drones).

Conclusion

An MF aims to build a voluntary partnership of people living in the same area with a broad range of interests and needs, working together towards the implementation of the sustainability concept in their own context of forest landscape. The MF approach is having a positive impact in terms of sustainable land management in Montagne Fiorentine, Tuscany, near Florence (Berti *et al.*, 2015). Founded in 2012, the FMMF has carried out various activities and projects focused on several sectors: productive chains and markets, environment, tourism, culture, recreation, and sharing know-how.

Moreover, some projects focused on timber management and marketing, such as actions to create new tools to make the use of local timber more convenient for use in construction. Others sought to develop marketing of local forest products by means of modern instruments.

Several projects also concerned environmental education and the knowledge of the local area, including historical knowledge.

The FMMF is devoting a great deal of attention to the development of youth entrepreneurship linked to natural resources and has chosen to invest in forest therapy, considering that it is one of the most important ecosystem services that forests can offer and that it should be further developed in the future.

Bibliography

- Berti, S., Brunetti, M., Nocetti, M., Paletta, D. & Ventre, A. 2015. *The approach of Model Forest in the territory of Montagne Fiorentine, Italy*. Proceedings of XIV World Forestry Congress, Durban, South Africa, 7–11 September.
- Brunetti, M., Nocetti, M., Bacher, M., Berti, S. & Burato, P. 2015. *Machine strength grading of Italian structural timber: the results of A.Pro.Fo.Mo. Project*. Sherwood, 208: 9–12. (in Italian).
- IMFN. 2018. Montagne Fiorentine Model Forest Pioneering Ethical Certification of Wood And Sustainable Tourism. <https://imfn.net/montagne-fiorentine-model-forest-pioneering-ethical-certification-of-wood-and-sustainable-tourism/>.
- Magherini, V., Berti, S., Brunetti, M., Marchi, E. & Ventre, A. 2015. *Opportunities to increase the potentiality in forestry. A.Pro.Fo.Mo. Project*. Tecniko&Pratiko, 110: 8-10. (in Italian).
- Torreggiani, L., Mori, P., Torrini, S. & Brunetti, M. 2014. *The timber sector in the Montagne Fiorentine. Results of the survey of the DEMOSCOPE project*. Sherwood, 204: 13-17. (in Italian).

SIDE EVENT 3

How can Mediterranean natural heritage be preserved in the face of mass tourism?

Side event summary

How can Mediterranean natural heritage be preserved in the face of mass tourism?

Moderator: Abdelhamid Khaldi¹

Reporter: Anaïs Loudières¹

¹ Association Internationale des Forêts Méditerranéennes

The Interreg MED integrated project "INHERIT: Sustainable Tourism Strategies for Conserving and Enhancing the Mediterranean Coastal and Maritime Natural Heritage" aims to strengthen measures to protect and sustainably enhance natural heritage.

One of its objectives is to draw on the experiences of good practices in the Mediterranean coastal areas to reproduce and develop, at local, regional and national levels, sustainable and effective policies for the protection of natural heritage, compatible with the development of sustainable tourism in the Mediterranean area.

Under this project, pilot actions have been set up to test and capitalize on protection measures that enhance the natural heritage and biodiversity in the selected territories.

The aim of the side event was to present good practices in sustainable tourism that could inspire forest managers and interested partners to implement activities to preserve natural heritage while still making it possible for people to access it.

Joëlle Bailet: progress on the INHERIT project

The Mediterranean is the world's leading tourist destination, mainly in its coastal areas, of which almost 30 percent are covered by forests. Tourism is a source of employment (11 percent) and economic growth, which contributed USD 333 billion in 2016. By 2030, 500 million tourists are expected to have visited the Mediterranean area.

However, tourism can also cause environmental degradation. In spring and summer, the number of visitors exceeds the capacity of the sites. All this produces waste and leads to excessive built-up areas, which destroy the coastline and its natural heritage.

The INHERIT method, implemented on the pilot sites of the 15 project partners, aims to preserve and enhance the Mediterranean natural heritage through bottom-up initiatives through collaboration between public and private actors. These pilot sites were then grouped according to their different characteristic themes.

Finally, the "INHERITURA recognition" has been awarded by the project to highlight tourist sites committed to developing sustainable tourism.

In application of the INHERIT method, three experiences were presented to the audience.

Alain Chaudron: the experience of the Côte Bleue site

This degraded natural site is located near Marseille, the second largest city in France. Its history is exemplary. The site was owned by two real estate companies that had a major urbanization project. A large road was built without permission. After the project was cancelled by the municipality, the Conservatoire du Littoral was finally able to buy the land.

On this pilot site of the INHERIT project, partners and managers lacked data on visitor numbers. They therefore asked for ecocounters to be installed to measure the frequency of use, and ten slabs were installed on the paths.

Lucia Nieto Gonzalez: the experience of the Murcia region, in Calblanque

An example of a participatory approach was presented with the setting up of two multistakeholder working groups for the management of the area of the future INHERITURA site (Calblanque): planning – in particular integrated management – of coastal areas and sustainable tourism.

Thought was given to avoiding negative impacts of tourism and developing sustainable and responsible tourism activities, which can balance protection and tourism: bicycle companies, construction of two roads accepted by all actors, parking regulations for wind surfing, with the creation of an official pass to be shown to the authorities during the summer months, to avoid conflicts with other beach users.

Jean Stephan: the MenJEZzine project in Lebanon

This project seeks to replicate the INHERIT project in the eastern Mediterranean and implement it in Mediterranean forest ecosystems. It includes two sites with unique natural assets and very active and engaged local governance: Menjez in the North, near the Syrian border, and Jezzine, in the South. The project's aim is to guide local tourism stakeholders and communities towards sustainability while preserving biodiversity and the forest. To achieve this, educational trails on local biodiversity will be developed (with signposts) following a scientific inventory. Key players will be trained, and children will be educated by going on the trails to learn about the flora of their village.

These experiences presented could be replicated in other countries of the Mediterranean Basin. The successes and challenges encountered by the actors who have implemented these projects are experiences, assets and knowledge to be shared.

What balance between protection of natural heritage and sustainable tourism: the Interreg MED INHERIT project

Joëlle Bailet¹

¹Association Internationale des Forêts Méditerranéennes (AIFM)
14 rue Louis Astouin, 13002
Marseille, France

Abstract:

The European Interreg Med INHERIT project aims to support responsible and sustainable coastal and maritime tourism in the Mediterranean.

The INHERIT approach, which cooperates to identify and develop bottom-up measures for the protection of natural heritage sites, has been implemented in 15 pilot sites that are linked using thematic circuits.

The INHERITURA label is a recognition awarded by the 15 project partners to coastal areas where measures are implemented to:

- promote environmental protection;
- reduce the seasonality of tourism; and
- foster the development of sustainable tourism through bottom-up approaches and collaborative efforts with local stakeholders.

The INHERITURA areas are considered alternatives to the most visited places.

By the end of April 2022, 23 Mediterranean coastal areas had obtained INHERITURA recognition.

Young people are involved in the promotion of sustainable tourism, either through specific actions or in brainstorming workshops.

1. Data on tourism in the Mediterranean region

1.1. The Mediterranean region is the world's leading tourist destination

Every year – barring the period related to the COVID-19 pandemic– more than 300 million national and international tourists visit the tourist areas of the various countries bordering the Mediterranean Sea.

In 2017, there were 360 million tourists, which accounted for 27 percent of the total number of tourists in the world and of which 170 million, almost 50 percent, visited the Mediterranean coastal areas ([Plan Bleu RED, 2020](#); UNWTO, 2019).

We know that **28 percent of these coastal regions are covered by forests** or other wooded areas.

The Mediterranean Basin is also the second largest cruise destination in the world.

The tourist flow is constantly growing. Indeed, 58 million tourists visited in 1970, 349 million in 2015 and 360 million in 2017.

The number of tourists is estimated to reach 500 million by 2030 (UNWTO, 2019).

1.2. Tourism: a pillar of the Mediterranean economy

The COVID-19 pandemic has highlighted and confirmed the importance of tourism for the economies of the countries around the Mediterranean ([UNWTO, 2020](#)).

In Mediterranean countries, the tourism sector is one of the most important economic sectors. It is:

- a **permanent source of employment**, making up 11.5 percent of total employment in 2014;
- a **source of economic growth**, contributing 11.3 percent of the region's gross domestic product (GDP), 11.5 percent of exports and 6.5 percent of investments (WTTC, 2015); and
- In 2016, tourism generated USD 333 billion (UNWTO, 2017).

Over the last 20 years, the direct contribution of tourism to GDP in the Mediterranean region has increased by 53 percent for economies of coastal regions (Pan Bleu, 2017; FAO and Plan Bleu, 2020).

1.3. Tourism: a driver of land degradation

The tourist flow is highest in July and August. The **seasonal nature** of tourism has resulted in an **overcapacity** in the target regions. This has led to the increasing development of tourism-related infrastructure, such as resorts, hotels, ports, airports and more. This excessive construction has increased land degradation and deforestation.

During this same period, there is an **excessive production of waste**, causing adverse effects on human health and the environment. These include water and sea pollution, especially from wastewater discharge and cruises; air pollution and greenhouse gas (GHG) emissions, especially from transport, heating and air conditioning; and noise and light pollution in urban areas.

Finally, the peak water consumption for tourism coincides with the irrigation period for agriculture, which can create conflicts over the use of water resources and lead to **desertification**. Pollution and desertification lead to a **loss of biodiversity** and even the disappearance of fauna and flora.

The **cultural heritage** of these regions has also been **altered**.

The **standardization of tourist facilities and products**, the proliferation of gift and souvenir shops, degrades the cultural heritage.

There is often an **imbalance in relations** between locals and tourists due to cultural, social and economic gaps. Tourists often have a superficial experience of the places they visit, which does not offer a fruitful and fair exchange with the local population.

2. The Interreg MED INHERIT project

On the one hand, tourism is essential to the Mediterranean economy and is even a factor of growth. On the other hand, it has negative consequences for the coastal and maritime cultural and natural heritage of the Mediterranean Basin.

The question is to find a balance between the protection of the natural heritage of the Mediterranean region **and** sustaining tourism development.

2.1. The project

In this context, the INHERIT project, entitled "Sustainable Tourism Strategies for Conserving and Enhancing the Mediterranean Coastal and Maritime Natural Heritage" seeks to address this and has set the overall goal of encouraging **responsible and sustainable** coastal and maritime tourism in the Mediterranean.

INHERIT is an integrated [Interreg MED](#) project, cofinanced by the European Regional Development Fund (ERDF).

The [INHERIT project](#) involves 15 state, regional and thematic partners² from ten European Mediterranean countries: Croatia, Cyprus, France, Greece, Italy, Malta, Montenegro, Portugal, Slovenia and Spain. The overall budget for the project is EUR 5.6 million. It started on 1 February 2018 and ended on 30 April 2022.



² Peloponnese Region (Greece) – lead partner; Larnaca and Famagusta District Development Agency (Cyprus); Ministry of Tourism (Croatia); Institute of Agriculture and Tourism (Croatia); Region of Murcia (Spain); SENECA Foundation (Spain); International Association of Mediterranean Forests (France); Department of Hérault (France); University of Patras (Greece); Emilia Romagna Region (Italy); Puglia Region (Italy); Foundation for Dialogue and Regional Development of Malta (Malta); Dinarides Park (Montenegro); Association for the Preservation of the Heritage of Mertola (Portugal); Public Agency for the Promotion of Entrepreneurship and Project Development of the Municipality of Izola (Slovenia).

2.2. The INHERIT approach

There are three pillars supporting the INHERIT project's approach:



Preserve: The aim is to protect the natural maritime and coastal heritage, up to 60 kilometres (km) inland) from the harmful effects of tourism.

Here are a few examples of the actions undertaken:

- delineate paths so that tourists do not trample on the vegetation;
- alert to fire risks; and
- collect litter and ban cigarette butts.

Promote: The aim is to promote the natural heritage, to consider it as an asset for developing sustainable tourism activities and itineraries.

Here are a few examples of the actions undertaken:

- enhance a remarkable site; and
- promote the development of ecotourism activities.

Cooperate: The aim is to strengthen the collaboration of private and public tourism stakeholders to harmonize the protection of the natural heritage around the Mediterranean.

Here are a few examples of the actions undertaken:

- All of the stakeholders in tourism, both professional and private, are brought together so that together they can propose measures to protect the natural heritage and develop tourism.
- These are so-called "bottom-up" measures, meaning that they are not enforced through laws or regulations but are voluntarily adopted by stakeholders in a participatory process.

These three actions are not successive but **concomitant**.

2.3. The study phase of the INHERIT project

There were two stages in this phase of the project, both led by the AIFM:

1. Data collection

In August 2018, "a methodology and tools for collecting data on the best measures to protect the Mediterranean natural heritage from the effects of mass tourism" was disseminated to all partners.

Theses were based on a survey as and a bibliographic research tool. Results from 210 participants from all Interreg MED countries were compiled.

2. Data analysis



The comparative analysis report entitled "Policy analysis report on the protection of the Mediterranean natural heritage against the effects of mass tourism" was finalized in February 2019, validated by all partners in March 2019, and then translated into French by the AIFM (available for download upon request from the AIFM).

This report compiles and explains the best bottom-up measures for the protection of natural heritage from the negative effects of tourism.

3. Conclusion

The results concluded that negotiated agreements are the most effective bottom-up approach to protecting natural heritage from the negative impacts of tourism, followed by voluntary public schemes. Unilateral commitments and private agreements are only considered effective in the absence of market externalities.

2.4. The trial phase of the INHERIT project: the pilot sites

Each project partner has chosen a pilot site, together with local stakeholders, to test and implement the INHERIT method.

Objectives

- Raising awareness of **the principles of sustainable tourism among stakeholders in the tourism sector.**
- Identifying and implementing **measures to protect natural heritage**, forests and biodiversity in the Mediterranean coastal regions **with a bottom-up approach.**

Working groups have been set up, which include representatives of national, regional and local authorities depending on the local context, as well as economic operators in tourism, tourist offices, trade unions in the tourism sector, community-based associations, scientists, academics and research institutes, hiking groups, hunting groups and more.

Two examples of pilot sites are discussed in the following articles:

- Installation of ecocounters on the paths of the Côte Bleue on the outskirts of France's second largest city, Marseille.
- Regulation of tourist activities as agreed by all to preserve the natural heritage in the Murcia region in Spain.

2.5. Linked pilot sites, sorted by theme

The different pilot sites have been grouped according to **different themes** of interest to tourists:

- birdwatching³ for educational and conservation purposes or to see birds of different species;
- "the beauty of outdoor activities":⁴ forest walks, treetop adventure parks, birdwatching, organized bike tours, river cruises or water sports such as diving and snorkelling;
- "experience nature one step at a time":⁵ hiking trails with maps, information on geology and wildlife;
- "history and outdoor sports":⁶ enjoying outdoor sports in regions with a rich cultural heritage;
- "historical tourism routes":⁷ visiting places that have stood the test of time, learning about the history of these regions;
- "vineyards and the art of living in the Mediterranean":⁸ viticulture is part of Mediterranean history, learning about viticulture by visiting vineyards; and
- "local food and wine itineraries":⁹ tasting local food and wine, getting to know the local gastronomy (in the low season).

The thematic grouping of sites is expected to lead to networking for sharing experiences and good practices.

³ Six sites: Mata National Forest (Portugal), Calblanque, Peña del Águila y Monte de Las Cenizas (Spain), Larnaca Salt lake (Cyprus), Majjistral Nature and Historical Park (Malta), Pavlopetri (Greece) and Caroux Mountains Nature Area (France).

⁴ Four sites: Majjistral Nature and Historical Park (Malta), Pavlopetri (Greece), Caroux Mountains Nature Area (France) and Vivi Romagna Toscana (Emilia-Romagna, Italy).

⁵ Nine sites: Calblanque, Peña del Águila y Monte de Las Cenizas (Spain), Kornati National Park (Croatia), Majjistral Natural and Historical Park (Malta), Mata National Forest (Portugal), Coastal Dune Park (Apulia, Italy) and Caroux Mountains Nature Area (France).

⁶ Four sites: Majjistral Natural and Historical Park (Malta), Mata National Forest (Portugal), Coastal Dune Park (Apulia, Italy) and Pavlopetri (Greece).

⁷ Eleven sites: Calblanque, Peña del Águila y Monte de Las Cenizas (Spain), Kornati National Park (Croatia), Krajinski Strunjan Park (Slovenia), Larnaca Salt Lake (Cyprus), Majjistral Nature and Historical Park (Malta), Mata National Forest (Portugal), Coastal Dune Park (Apulia, Italy), Pavlopetri (Greece), Vivi Romagna Toscana (Emilia-Romagna, Italy), Ramla Il-Hamra (Gozo Island, Malta) and Brijuni National Park (Croatia).

⁸ Four sites: Larnaca Salt Lake (Cyprus), Caroux Mountains Nature Area (France) and Vivi Romagna Toscana (Emilia-Romagna, Italy).

⁹ Six sites: Kornati National Park (Croatia), Larnaca Salt Lake (Cyprus), Coastal Dune Park (Apulia, Italy), Caroux Mountains Nature Area (France), Vivi Romagna Toscana (Emilia-Romagna, Italy) and Brijuni National Park (Croatia).

2.6. The recognition of INHERITURA

1. What is it all about?



"INHERITURA" is a **recognition** awarded by the 15 project partners to a Mediterranean coastal area with a rich natural heritage where measures have been implemented for the following reasons:

- to promote environmental protection;
- to reduce the seasonal imbalance of the tourism industry; and
- to promote the development of sustainable tourism through bottom-up approaches and collaborative efforts with local stakeholders.

INHERIT pilot sites can become INHERITURA sites.

2. What are the prerequisites to apply?

First, there are criteria relating to location:

- The region must count between 150 000 and 800 000 inhabitants.
- It must have a coastline or be considered a coastal area, with more than half of the population living within 50 km of the sea.
- It must have sites with different types of natural heritage, for example:
 - coastal and maritime environments (lagoons, posidonia meadows, estuaries, etc.);
 - freshwater ecosystems (natural lakes, temporary ponds, artificial lakes, etc.);
 - forests (broadleaved forests, sclerophyll forests, coniferous forests, etc.);
 - rocky sites (caves, volcanoes, underwater caves, etc.); and
 - other sites of tourist interest (lighthouses, wrecks, prehistoric sites, etc.).

Secondly, candidate areas must meet **environmental and sustainability criteria**, grouped into four categories:

- **Environmental management and protection measures:**
 - implementing bottom-up protection measures to prevent or reduce pollution on the natural heritage site;
 - ensuring that beaches and marinas meet national water quality requirements (only for coastal areas);
 - implementing investments to promote the protection of the environment and natural heritage; and
 - preventing activities that disturb the natural heritage environment.
- **Promotion activities:**
 - designing thematic routes specific to each area to highlight certain aspects of the site's natural heritage; and
 - implement investment measures to increase the visibility of natural heritage.
- **Governance and strategic planning:**
 - designing and implementing a strategy for the protection and enhancement of natural heritage through public consultation with key stakeholders;
 - implementing integrated coastal and marine management; and

- creating a framework for monitoring and measuring the environmental, economic and social impact of tourism on natural heritage.
- **Education and awareness-raising activities:**
 - setting up activities to raise awareness of sustainable tourism development and natural heritage protection;
 - displaying information about the natural heritage of the sites in certain key points of the area; and
 - communicating a charter of conduct for visitors to the sites in question that reflects the principles of sustainability and complies with environmental regulations.

The promotion of **sustainable mobility** is an important point in the sustainability criteria of a tourist destination.

Some examples of the most common valued actions include the following:

- the promotion of public transport;
- the promotion of cycling and bicycle rental; and
- the creation of walking and cycling routes.

3. The first areas to receive INHERITURA recognition

At the time of the presentation (22 March 2022), ten areas in the northern Mediterranean had obtained the INHERITURA label:

- [Pavlopetri—Elafonisos](#): one of the oldest sunken settlements, next to the island of Elafonisos in the Peloponese region (Greece);
- [National Park of the Kornati Islands](#): 89 islands in this 217 square kilometres (km²) of marine and terrestrial park area in the Kornati archipelago (Croatia);
- [Vivi Romagna Toscana](#): a wide variety of natural and historical sites in the Emilia-Romagna region (Italy);
- [Calblanque, Peña del Águila y Monte del Cenizas](#): beaches, coves and forests are part of this park in the region of Murcia (Spain);
- [Parco Dune Costiere](#) (Coastal Dune Park): natural park in the Puglia Region (Italy);
- [Pôle de pleine nature Montagnes du Caroux](#) (Caroux Mountains Nature Area): multiple outdoor activities in a breath-taking setting in the Hérault department (France);
- [Krajinski Park Strunjan](#): the cliffs and wooded areas of this nature reserve can reach 80 metres (m) above the sea of Izola (Slovenia);
- [Larnaca Salt Lake](#): an important area for the habitat of waterbird species in the districts of Larnaca and Famagusta (Cyprus);
- [The Majjistral Nature and Historical Park](#): this national park in Malta hosts a great diversity of habitats; and
- [The Mata National Forest](#): located in the Mertola region (Portugal), the best preserved of the Algarve coast, this forest is famous for its chameleons.

4. Other areas have since gained INHERITURA recognition

The INHERIT partners have promoted the INHERIT approach to the public authorities in their countries and encouraged applications for recognition. At the end of April 2022, **13 new INHERITURA areas** have obtained this recognition:

- the [Mljet National Park](#) in Croatia;
- the [Nin Lagoon](#) in Croatia;
- the [Unione della Romagna Faentina e Modigliana](#) in Italy;
- the [Albufera National Park](#) in Spain;

- [the Corbières-Fenouillèdes Regional Natural Park](#) in France;
- the “Opération Grand Site” (OGS), ["Cité de Minerve, gorges de la Cesse et du Brian"](#) in France;
- [the Debeli rtič landscaped park](#) in Slovenia;
- [the Ramla Bay](#) in Malta;
- [the Pembroke Park](#) in Malta;
- the [Helmes-Vouraikos Geopark](#) in Greece;
- the [coastal area of the town of Aigio](#) in Greece;
- the [Brijuni National Park](#) in Croatia; and
- [Luka Budava](#) in Croatia.

INHERITURA sites are considered alternatives to the most visited places.

3. Youth engagement

There are currently several types of mobilization aimed at young people.



3.1 Local, one-off initiatives

Some associations have branches specifically for young people, such as [DéfisMed Jeunes](#), a close-knit, multicultural and multidisciplinary group that implements numerous concrete actions to make ecotourism more accessible.

Young people are increasingly involved in actions initiated by environmental associations.

One example is the waste collection campaigns in the Mediterranean coastal area.

For more than 20 years, a yearly waste collection day ([Calanques propres](#)) at La Ciotat (near Marseille), is organized by institutions and private entities of the region.

On 6 February 2022 in Marseille, as a part of the Forum of Mediterranean Worlds (*Forum des mondes méditerranéens*), "Le Grand Ramassage" took place. Four associations organized it, joined by two other organizations.

More than 1 000 volunteers collected 1.5 tonnes of waste!

The beaches of the “Espace Borelly” were cleaned in a few hours.

Also in Marseille, in May 2019, kayakers and divers picked up 1.2 tonnes of waste for a rubbish collection competition.

Many voluntary beach cleaning activities are also taking place in Greece; the cleaning of the public beach of Kastelkampos in Patras involved the participation of two primary schools, among others.

These actions are important because tourism is a major source of waste on the Mediterranean coast. July is the month with the highest amount of litter on beaches: an average of 450 000 pieces of litter per km² per day on tourist beaches and 200 000 pieces of litter per km² per day on isolated beaches are thrown away ([Project Interreg MED Blue Islands](#) and [RED 2020](#)).

3.2. Discussion workshops and exchange forums

Since 1992, the Major Group for Children and Youth has been the United Nations (UN) General Assembly's



Major Group for
Children and Youth
A space for children and youth in the United Nations

mandated and self-organized mechanism for youth to engage meaningfully in certain UN processes.



The "Youth Commission for the Future of the Mediterranean" workshop took place on 2 March 2022, at the initiative of the Plan Bleu, which brought together young people aged between 15 and 27 years from each of the countries around the Mediterranean to reflect on and discuss the future of the region up to year 2050.



The seventh Mediterranean Forest Week offered an opportunity and platform to promote exchanges between young people on the restoration of ecosystems and forests, ensuring a bottom-up approach.



Finally, several initiatives, events and competitions were organized by young people or for young people during the XV World Forestry Congress held in Seoul, Republic of Korea, from 2 to 6 May 2022.

Bibliography

Interreg Mediterranean INHERIT. 2022. *Interreg Mediterranean INHERIT*. Cited March 2022.

<https://inherit.interreg-med.eu/>

FAO and Plan Bleu. 2020. *State of Mediterranean Forests 2018*. Rome and Marseille, France.

UNEP (United Nations Environment Programme) and Plan Bleu. 2020. *SoED 2020 State of the Environment and Development in the Mediterranean Report*. Marseille, France.

UNWTO (United Nations World Tourism Organization). *International Tourism Highlights*. 2017 and 2019 Editions.

Fosse, J. & Le Tellier, J. 2017. *Tourisme durable en Méditerranée : état des lieux et orientations stratégiques*. Cahier du Plan Bleu, 17. Valbonne, France, Plan Bleu.

The installation of ecocounters on the Côte Bleue, a pilot site of the Interreg MED INHERIT project

Alain Chaudron¹

¹Association Internationale des Forêts Méditerranéennes (AIFM)
14 rue Louis Astouin, 13002
Marseille, France
www.aifm.org
Vice-Président AIFM

Abstract:

The Côte Bleue, a vast natural area located at the gates of Marseille, was chosen as the pilot site for the INHERIT project, which aims to identify and implement protection measures in Mediterranean coastal regions.

The owner, the managers and the user associations lacked reliable data on site visits. However, these data are necessary for good management of this area and for the prevention of natural risks (landslides, rockfalls).

They therefore asked the AIFM to install ten ecometers on the paths of the site, as part of the project. These slabs were laid in 2020 and they now make it possible to measure the attendance of walkers, path by path, day by day. In 2021, 500 000 passes were counted, double what was generally estimated.

This Côte Bleue site has a remarkable history. In the 1960s, two civil real estate companies had bought 3 000 hectares (ha) of land there, for a large real estate project, with more than 50 000 beds planned and numerous infrastructures.

This was the era of the Glorious Thirties, marked in France by several real estate scandals, but also the beginning of ecological awareness, with the publication in 1972 of the Meadows report “The Limits to Growth”.

Following strong local opposition, the project was finally abandoned, and the land was then purchased in 1978 by the Conservatoire du Littoral, which had just been created.

The site was threatened 50 years ago . It is now public land and a classified site. The INHERIT project has contributed to positive management and control of attendance.

What about in 50 years’ time? Time is on our side. We firmly believe that these two large nature conservation sites, the Calanques and the Côte Bleue, will still be there as examples of good management and for people to enjoy.

Everyone knows Marseille, with its old port, the basilica Notre-Dame de la Garde – affectionately called “our good mother” – and its velodrome stadium. Yet who knows that on the outskirts of France’s second largest city with 1.6 million inhabitants, there are remarkable protected natural areas.

Southeast of the city, there is the **Calanques National Park**, created in 2012. It is the first European peri-urban national park on both land and sea. Ten years after its creation, it welcomes 3 million visitors a year and suffers from overtourism, perhaps a victim of its own success. The national park has put in place a “demarketing” strategy in collaboration with a partner.

Northwest of Marseille, there is the Blue Coast (**Côte Bleue**), the maritime front of the Estaque mountain range. Less known, and less frequented than the Calanques, this area has a singular and exemplary history, which deserves to be told.

Indeed, in the 1960s, two civil real estate companies bought 1 700 hectares (ha) of land on the commune of the Rove and 1 300 ha on the commune of Ensues-la-Redonne.

Their project included 51 000 beds, or 12 000 dwellings, a campsite, a trailer park, individual isolated detached houses, grouped houses, a holiday resort, hotels, shops, two artificial lakes with 400 metres of beach, a train station, a heliport, three large seaports, a racetrack, a golf course, an equestrian centre, a zoological park, far west villages and more.

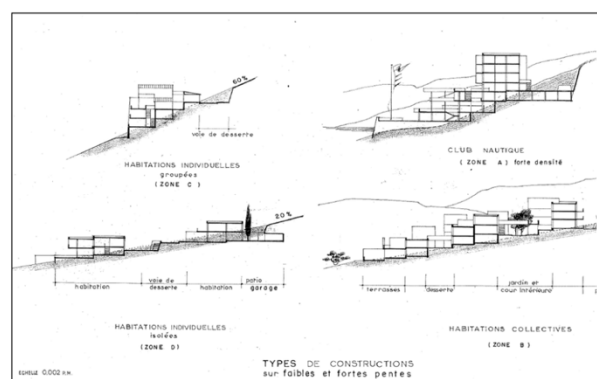


Fig. 12 Projet d'aménagement de différents types de constructions par AMEROVE, Mai 1968. Copyright : Archives municipales du Rove

Fig. 18 Photos avant/après retrait des glissières de sécurité de la route Pompidou par le CdL – Janvier et Juin 1985. Copyright : Archives du CONSERVATOIRE DU LITTORAL



They even built a road without any authorization, no doubt to put pressure and make the project irreversible.

However, they faced strong and unexpected local opposition. The resistance organized itself, like David facing Goliath, with strong financial and political interests at play.

In 1974, the lands were classified as non-constructible (ND) zones of the land-use map (POS) of the Rove commune.

This happened during a time of economic and demographic boom after the war, marked in France by several property scandals.

At the time, there was little ecological awareness, and nature conservation was not a priority. However, in 1972, the Meadows report “The Limits to Growth” was published, the fiftieth anniversary of which has just been commemorated.

In 1975, the French Government created a coastal conservatory (Conservatoire du littoral), the first public institution of its kind in Europe, whose mission was to acquire degraded plots of coastal land threatened by urbanization in order to turn them into sites that respect the natural balance and welcome the public through different activities (see <https://www.conservatoire-du-littoral.fr/134-acquerir.htm>).

In 1978, the coastal conservatory decided to acquire these plots of land, using its right of pre-emption. Since 1980, 3 500 ha (40 cases) have been acquired. This land is now state-owned and inalienable.

The site was finally legally classified in 2013 under the law of 2 May 1930 on the protection of natural monuments and sites.

After this brief historical reminder, let us come back to our project, INHERIT.

The project aims to identify and implement protective measures in the coastal Mediterranean region using a bottom-up approach. The International Association for Mediterranean Forests (AIFM) had to look for a pilot site in the department of Bouches-du-Rhône, which is cofinancing the project. After consulting several local stakeholders, Côte Bleue was selected as an obvious candidate.

On site, a consultation was organized with the coastal conservatory (the owner), the communes (the managers), the Office National des Forêts (ONF) (technical support), and civil society organizations (hunters, hikers, etc.). All of them highlighted the lack of data on the number of visitors to the site. However, such data are necessary for the proper management of the site and of natural risks (landslides, rock falls, etc.).

The AIFM was asked to install ten ecocounters: they are buried tiles that capture vibrations in the ground linked to people's movements and enable them to know the frequency of visits to ten places chosen on different paths. Half of the ecocounters were installed in February 2020 and half in August 2020.

The first installation immediately yielded results, which showed the importance of the use of the *sentier du douanier*, which goes from Niolon to the Cap Méjan, compared to other paths. Furthermore, the number of visitors to the site dropped considerably during the first COVID-19-related confinement, starting in mid-March.

The review for 2021, the first year of installation, is shown on this slide:



The total number of passes, based on actual counts and not estimated, surprised all partners. Nobody expected there to be 500 000 passes a year. Even if this is far from 3 million visitors to the Calanques, it is double the number initially estimated.

These figures confirm the importance of the path selected, which accounts for half of the total number of visitors.

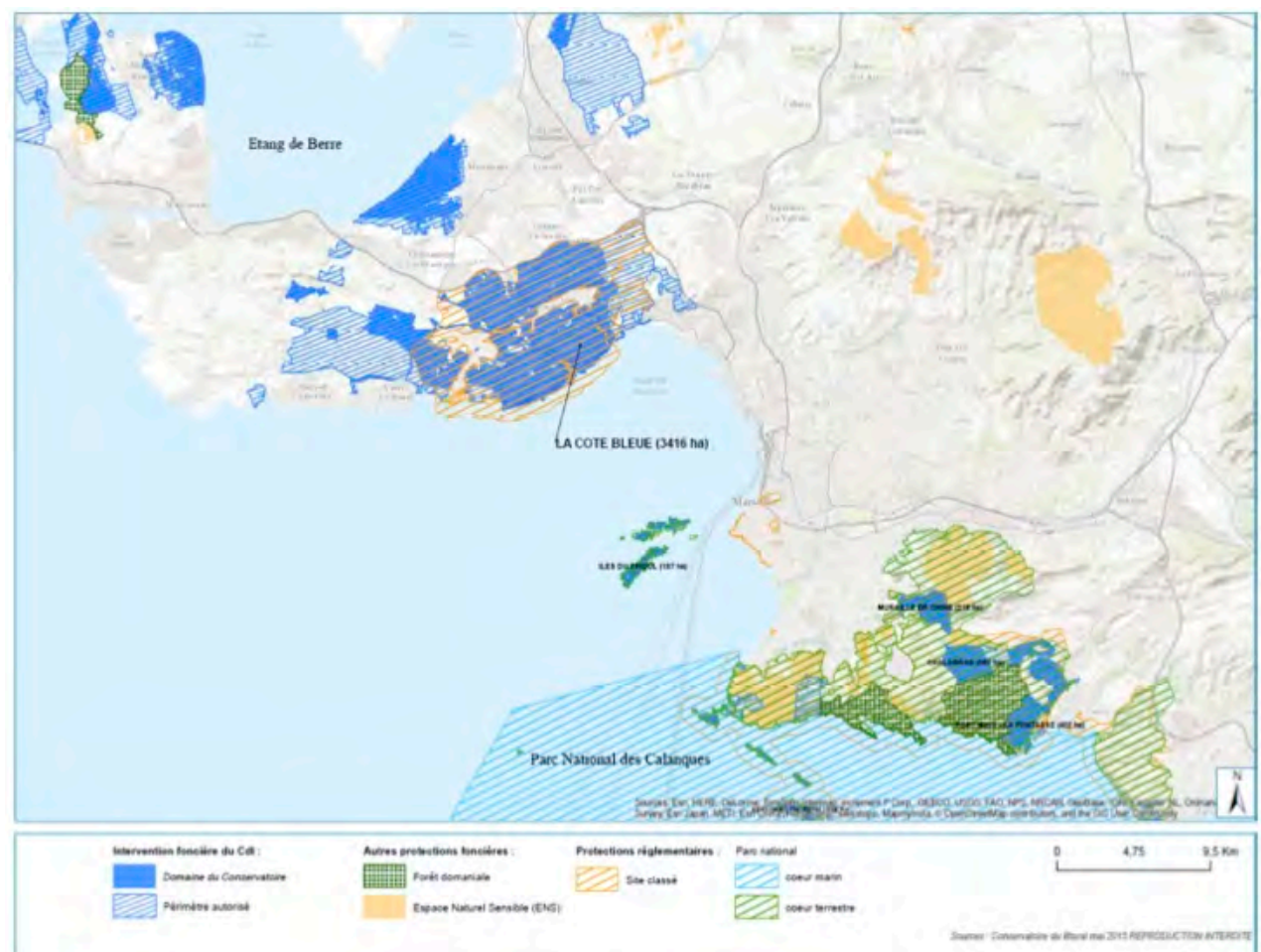
Finally, the owner and managers obtained daily (with peaks on weekend days), weekly and monthly data for each separate trail. The highest number of visits were in spring and autumn, while there was a relative decrease in summer when forest areas are generally closed to the public.

The installation of these ten ecometers on the Côte Bleue site as part of the INHERIT project will therefore have been useful to the owner, the site managers, as well as users. In retrospect, the choice of this site in the Bouches-du-Rhône department was very appropriate.

At the gates of France's second largest city, there are natural areas, mass tourism, excessive visits and use conflicts. There are two very different situations:

- The Calanques are a terrestrial and marine national park since 2012, but have been a classified, state-owned site for a long time.
- The Côte Bleue is a regional marine park since 1980.

As we have seen above, the history of the Côte Bleue site is a perfect case study. Just 50 years ago, in the era of post-war prosperity, the site was threatened. Now, the land is inalienable and prohibited for construction.



The map above is from the brochure of the coastal conservatory and the ONF, entitled “The Côte Bleue mountain range: partnership management of one of the coastal conservatory’s sites, a stone’s throw away

from Marseille” (Le massif de la Côte Bleue: gestion partenariale d'un site du Conservatoire du littoral aux portes de Marseille).

It shows the site's current, positive status.

What will the situation be like in 20, or even 50, years?

Only time will tell, but I am personally convinced that the situation is under control and that time is ultimately on our side!

Bibliography

Gataniou, D. 2013. *Synthèse sur le site de la Côte Bleue*. Conservatoire du littoral, 41 pp.

Conservatoire du littoral & ONF (Office National des Forêts). 2020. *Le massif de la Côte Bleue : gestion partenariale d'un site du Conservatoire du littoral aux portes de Marseille*. 3 pp.

SIDE EVENT 4

Scaling up forest and landscape restoration to restore biodiversity and promote joint mitigation and adaptation approaches in the Mediterranean region

“The Paris Agreement in Action” project: the status of the Mediterranean regional component

Valentina Garavaglia¹ | Christophe Besacier²

¹International consultant, Forest and Landscape Restoration Mechanism, Forestry Division, FAO

²Senior Forestry Officer, Forest and Landscape Restoration Mechanism, Forestry Division, FAO

Abstract:

The Mediterranean region holds over 80 million hectares of degraded land, including forests. Mediterranean forests play a key role in providing and protecting ecosystem services and biodiversity. The maintenance of healthy forested landscapes is essential for reducing the impacts of climate change. Effective planning, implementation and monitoring of large-scale programmes promoting joint mitigation and adaptation approaches, along with mainstreaming forest and landscape restoration, are critical to achieving climate and restoration goals in the Mediterranean region. The Mediterranean regional component of the project “The Paris Agreement in Action” aims to enhance the regional dynamic by sharing experiences, expertise and knowledge. This article presents the results of the Mediterranean regional component, the provisional agenda for the next year and a half and linkages with the regional and global scene.

Introduction

Overexploitation, degradation and conversion to other land uses, primarily agriculture, are threatening forest landscapes at global level. Around 3.3 million hectares (ha) of forests were lost every year between 2010 and 2015 (FAO, 2016). Dryland ecosystems, occupying 41 percent of the Earth's surface, are among the most vulnerable and home to 2 billion people, mostly those in developing countries (FAO, 2019). At the same time, land degradation affects more than 2 billion ha of land worldwide (GPFLR, 2011).

At the regional level, the Mediterranean region holds over 80 million hectares of degraded land (Figure 1). More than 400 000 ha of forests are burnt each year, and at least 16 animal and plant species in Mediterranean forests are at risk of extinction due to environmental threats such as climate change (FAO and Plan Bleu, 2018).

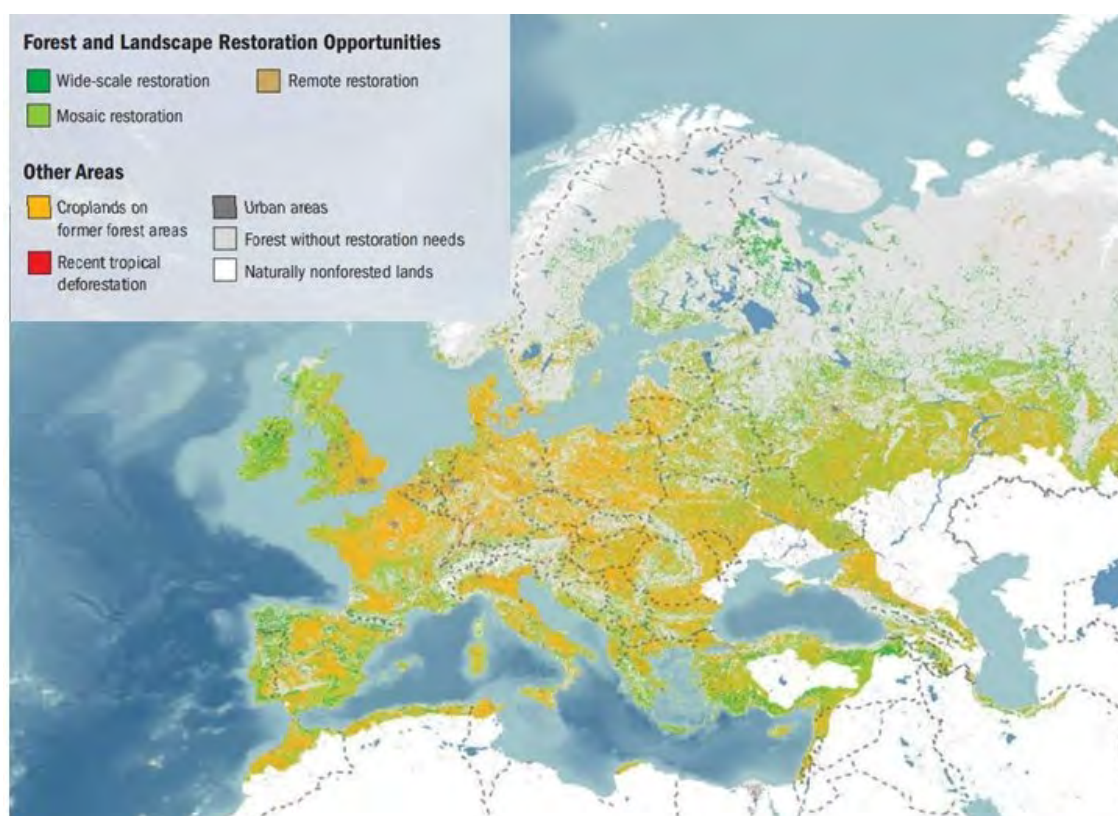


Figure 1. Forest and landscape restoration opportunities in the Mediterranean region and Europe

Source: Adapted from: GPFLR (Global Partnership on Forest and Landscape Restoration). 2011. *A World of Opportunity*. www.iucn.org/sites/dev/files/import/downloads/gpflr_opportunity_a4_6.pdf

Restoration of degraded forests and landscapes can help take the pressure off existing forest land, provide forest products, conserve biodiversity, improve hydrological flows and soil fertility, reduce soil erosion and contribute to climate change mitigation through carbon sequestration, substitution and conservation. Forest and landscape restoration (FLR), as defined by the Global Partnership on Forest and Landscape Restoration (GPFLR), is in fact “an active process that brings people together to identify, negotiate and implement practices that restore an agreed optimal balance of the ecological, social and economic benefits of forests and trees within a broader pattern of land uses”.

Forest and landscape restoration seeks a balance between restoring ecosystem services and supporting the productive functions of land for agriculture and other related uses while operating at a larger – or “landscape” – scale. Crucially, the combination of restoration activities across a landscape should increase productivity and the provision of environmental services while serving the needs of people.

Mediterranean forests play a key role in providing and protecting ecosystem services and biodiversity. The maintenance of healthy forested landscapes is essential for reducing the impacts of climate change. Effective planning, implementation and monitoring of large-scale restoration programmes promoting joint mitigation and adaptation approaches and mainstreaming FLR are, therefore, critical to achieving climate and restoration goals in the Mediterranean region.

The Food and Agriculture Organization of the United Nations (FAO) contributes to global reforestation efforts through the programme entitled the Forest and Landscape Restoration Mechanism (FLRM). The FLRM is built with the advantages of a UN Agency with expertise and experience in several of the land-use sectors and its extensive network of country, subregional and regional offices.

The FLRM aims at scaling-up, monitoring and reporting on FLR activities to contribute to the Bonn Challenge and biodiversity targets. It helps to coordinate and facilitate the development and implementation of projects, programmes and related activities in FAO member countries in full collaboration with other key actors. The FLRM operates globally by developing financial intelligence functions (raising awareness on FLR and fundraising actions towards key donors), preparing guidelines and standards for baselines to verify successful efforts, and contributing to more effective reporting to the Rio Conventions.

In the Mediterranean region, the FLRM works in strict collaboration with the Secretariat of the Committee on Mediterranean Forestry Questions *Silva Mediterranea* that has as an objective the implementation of activities leading to the sustainable management of Mediterranean forests and woodlands and the contribution to sustainable development in general.

For more details on the status of restoration in the Mediterranean region, please see the article “Setting the scene: the role of restoration in the Mediterranean region, the regional and global context”.

The project “The Paris Agreement in Action”

The global project “The Paris Agreement in Action: Upscaling Forest and Landscape Restoration to achieve Nationally Determined Contributions” led by FAO FLRM and funded by the International Climate Initiative (IKI) of the Federal Ministry for Economic Affairs and Climate Action (2018–2023) is built on the ten principles of FLR (FAO, n.d.).

The project's goal is to increase restoration efforts through the creation of an enabling environment focused on pilot activities that apply suitable FLR approaches on how best to contribute to the achievement of national and global restoration targets, as set out by the national determined contributions (NDCs), the Bonn Challenge, Aichi Targets and the Sustainable Development Goals (SDGs).

The project is building regional and national capacity in three designated regions. This also includes the Mediterranean region that demonstrates significant potential to increase the provision and protection of ecosystem services via large-scale FLR.

The project supports Mediterranean countries in the achievement of the Agadir Commitment, a landscape-restoration and landscape-degradation initiative endorsed in Agadir, Morocco, in 2017 that aims to restore, on a voluntary basis, 8 million ha of land in the region by 2030, facilitated and monitored by the FAO Committee on Mediterranean Forestry Questions *Silva Mediterranea*. It also strengthens the regional efforts that contributes to the United Nations Decade on Ecosystem Restoration 2021–2030.

At the level of the regional component of the project, Mediterranean countries benefit from specialized technical assistance to integrate FLR into the investment frameworks of their NDCs and build capacity on the preparation of concept notes and project proposals for dedicated land degradation and climate financing instruments.

For its relevance at the Mediterranean level, the project was labelled by the Union for the Mediterranean (UfM), as it directly contributes to the implementation of the Ministerial Declaration of the UfM on environmental and climate action, which was adopted by the 42 countries of the UfM in Cairo, Egypt, on 4 October 2021.

The status of the activities under the Mediterranean regional component of the project

Key regional activities started in 2019 with the launch of a call for technical assistance. The provision of targeted specialized technical assistance was offered to Mediterranean countries to integrate FLR in investment frameworks of the NDCs and to build capacity on the preparation of concept notes and project proposals for dedicated land degradation and climate financing instruments. Lebanon benefitted from this technical support to build two tools to (1) include FLR into the NDCs and to (2) estimate greenhouse gas (GHG) emissions capture through FLR projects. These two tools are available for the Ministry of Agriculture (MoA) and Ministry of Environment (MoE) for all their restoration projects. These tools help MoA and MoE to record, monitor and report on FLR projects, build a database of FLR projects, monitor and track progress and achievements, report progress of the 40 million tree programme, report on land degradation neutrality (LDN) targets and follow up on development of nationally appropriate mitigation actions in the forestry sector.

A key activity of the regional component is promoting capacity building with the organization of a series of regional workshops related to FLR implementation:

- In November 2019, a workshop was co-organized in Barcelona by FAO FLRM, UfM and the United Nations Convention to Combat Desertification (UNCCD) on green and climate finance opportunities in the Mediterranean region, with a view to explore and share the opportunities for the Green Climate Fund and to achieve LDN in Mediterranean countries.
- After a long stop due to the COVID-19 pandemic, in May 2022 a workshop was co-organized in Montpellier by FAO FLRM, GIP Ecofor, UfM and the Mediterranean Facility of the European Forest Institute (EFIMED) on carbon benefits of FLR and contribution to NDCs.

Both workshops were attended by staff of the ministries of agriculture or environment of Mediterranean countries, responsible for or technically involved in initiatives and/or restoration projects, researchers and scientists from universities and research institutes, working on the restoration of degraded landscapes of the Mediterranean, experts in charge of monitoring and evaluating sustainable forest management initiatives.

During the peak of the COVID-19 pandemic, Mediterranean countries were also invited to join online regular webinars organized in partnership with The Restoration Initiative on sustainable finance for FLR in collaboration with the World Wide Fund for Nature (WWF) Landscape Finance Lab. Between January 2021 and June 2021, several webinars were organized; for example, in February 2021, one webinar was held in English on sustainable business with 295 participants from 45 countries (the top four countries being Algeria, France, Morocco and Lebanon) (IUCN, n.d.).

At the same time, the project “The Paris Agreement in Action” and its regional component were presented at international events like the Sixth Mediterranean Forest Week organized in Brummana, Lebanon, in March 2019 and more recently at the Seventh Mediterranean Forest Week in Antalya, Türkiye, in March 2022. The activities implemented in the Mediterranean were also presented at the XV World Forestry Congress in Seoul, South Korea, in May 2022, reaching out to a wider, global audience.

What’s next?

In 2022 and 2023, the project will keep organizing regional capacity-building events on technical topics related to FLR. Next in the agenda is a regional workshop on assisted natural regeneration, the use of forest genetic resources and other FLR activities that can be used to restore degraded Mediterranean forests and landscapes. The workshop will take place in early autumn in Morocco.

In 2023, two other workshops will be organized in collaboration with Mediterranean partners on topics still to be confirmed.

Conclusion

The Mediterranean regional component of the project “The Paris Agreement in Action” will keep promoting occasions to share experiences and expertise, thus contributing to the regional dynamic and knowledge sharing. This regional dynamic will actively contribute to the global movement on ecosystem restoration started by the United Nations Decade on Ecosystem Restoration and will promote the role of the Mediterranean region, for which knowledge of the restoration of degraded forests and landscapes can be promoted at more global level.

Acknowledgements

The authors would like to thank the International Climate Initiative (IKI) of the Federal Ministry for Economic Affairs and Climate Action that funded the project “The Paris Agreement in Action: Upscaling Forest and Landscape Restoration to Achieve Nationally Determined Contributions”.

References

- FAO. 2019. *Trees, forests and land use in drylands: the first global assessment – Full report*. FAO Forestry Paper No.184. Rome.
- FAO. 2016. *Global Forest Resources Assessment 2015*. How are the world’s forests changing? Rome.
- FAO and Plan Bleu. 2018. *State of Mediterranean Forests, 2018*. Rome.
- FAO. n.d. The Paris Agreement in Action. In: *The Forest and Landscape Restoration Mechanism*. Rome. Cited March 2022. www.fao.org/in-action/forest-landscape-restoration-mechanism/our-work/projects/bmuiki-paris/en/.
- IUCN. n.d. Protected Areas and Land Use. In: *Our Work*. Gland, Switzerland. Cited March 2022. www.iucn.org/theme/forests/projects/restoration-initiative-tri.

ANTALYA DECLARATION

联合国
粮食及
农业组织Food and Agriculture
Organization of the
United NationsOrganisation des Nations
Unies pour l'alimentation
et l'agricultureПродовольственная и
сельскохозяйственная организация
Объединенных НацийOrganización de las
Naciones Unidas para la
Alimentación y la Agriculturaمنظمة
الغذية والزراعة
للأمم المتحدة

AFWC/EFC/NEFRC COMMITTEE ON MEDITERRANEAN FORESTRY QUESTIONS – *SILVA MEDITERRANEA*

THE ANTALYA DECLARATION FOR THE ROLE OF FOREST AND ECOSYSTEM RESTORATION FOR FUTURE MEDITERRANEAN GENERATIONS

We, the participants of the high-level segment of the Seventh Mediterranean Forest Week, held in Antalya, Turkey, on 24 March 2022, support the orientations of the Seventh Mediterranean Forest Week regarding the role of forest and ecosystem restoration for future Mediterranean generations.

Noting the importance of forest and ecosystem restoration for the achievement of global commitments made by Mediterranean countries within the framework of the Rio Conventions, the 2030 Agenda for Sustainable Development and the United Nations Forum on Forests (UNFF):

- The forest sector plays a prominent role in the nationally determined contributions (NDCs) of Mediterranean countries and the European Union to mitigate and adapt to climate change.
- Mediterranean countries have prepared their National Biodiversity Strategies and Action Plans (NBSAPs) in the context of the Convention on Biological Diversity (CBD)'s Aichi Targets 5 and 15, reporting on their efforts towards forest rehabilitation and the fight against deforestation, and they are now preparing to fulfil the post-2020 global biodiversity framework.
- All national action programmes (NAPs) prepared by Mediterranean countries to implement the United Nations Convention to Combat Desertification (UNCCD) explicitly refer to land restoration as a major dimension to achieve land degradation neutrality (LDN) and enhance societal resilience to drought.
- Restoring forests and preventing deforestation and forest degradation to address climate change are both expressed in Global Forest Goal 1 of the United Nations Strategic Plan for Forests 2017–2030.

This document is printed in limited numbers to minimize the environmental impact of FAO's processes and contribute to climate neutrality. Delegates and observers are kindly requested to bring their copies to meetings and to avoid asking for additional copies. Most FAO meeting documents are available on the internet at www.fao.org

Noting in the 2021 Glasgow Leaders' Declaration on Forests and Land Use adopted at the Twenty-Sixth United Nations Climate Change Conference of the Parties (COP26) the commitment of parties to conserve forests and other terrestrial ecosystems and accelerate their restoration,

Noting the recommendations of the 2021 Ministerial Declaration on the Environment and Climate Action of the Union for the Mediterranean (UfM) regarding protection, restoration and sustainable management of biodiversity and ecosystems, and integrating youth considerations into climate and environment policies, actions and investments,

Recognizing the importance of the adoption of the Brummana Declaration in 2019, which highlights the need to empower young entrepreneurs by turning project ideas into viable businesses in the green economy,

Recognizing the link between the restoration of degraded forests and ecosystems and job creation in rural areas, which also contributes to Sustainable Development Goal 8 of the United Nations' 2030 Agenda for Sustainable Development to "promote inclusive and sustainable economic growth, employment and decent work for all",

Recognizing that the restoration of degraded forests and ecosystems is an essential pathway to recovery from the COVID-19 pandemic and that green recovery investments not only create jobs and income, but also mitigate the risk of future zoonotic diseases,

Highlighting that forest and ecosystem integrity plays a crucial role in keeping societies healthy and on a path towards sustainability,

Recognizing the importance of forest fire management, prevention and post-fire restoration in the context of climate change,

Echoing the endorsement of the Mediterranean regional statement on wildfires at the Seventh International Wildland Fire Conference in 2019, which urges the fostering of transboundary and regional cooperation in fire management as a major driver of land degradation,

Endorsing the Agadir Commitment in 2017, towards a Mediterranean regional initiative on forest and landscape restoration,

Welcoming the United Nations Decade on Ecosystem Restoration 2021–2030 adopted by the United Nations General Assembly on 1 March 2019 and launched on 5 June 2021, to offer an unparalleled opportunity for reviving damaged Mediterranean ecosystems and addressing climate change, food security and job creation,

Recognizing the critical role of World Restoration Flagships and the potential of restoration activities in the Mediterranean region as being among the world's most significant restoration efforts,

We, the participants of the Seventh Mediterranean Forest Week, recognize the importance of forest and ecosystem restoration for future Mediterranean generations.

We underline that the restoration of degraded forests and ecosystems ensures a healthy ecosystem structure and function, and plays a vital role in climate change mitigation and adaptation.

We underline that restoration can create employment and economic diversification, reconnect Mediterranean people to their landscapes, and promote capacity building, experience and knowledge sharing.

We underline the importance of youth empowerment and engagement in building climate resilience in the Mediterranean region.

We underline the importance of gender equality and women's empowerment in decision-making on forest and ecosystem restoration in the Mediterranean region.

We underline that COVID-19 recovery strategies must promote productive and sustainably managed forests and ecosystems as essential nature-based solutions to avert a climate and biodiversity crisis, and for achieving the Sustainable Development Goals.

We, therefore, call on the political and administrative authorities at regional, national and local levels to reinforce and promote the restoration of forests and ecosystems in their strategies and plans.

We also encourage all stakeholders involved in the management of forests and ecosystems in the Mediterranean region to implement and scale up restoration actions, and to support younger and future generations to contribute to biodiversity conservation, climate change mitigation and adaptation.

We invite FAO to facilitate the exchange of technical knowledge and experience on forest and ecosystem restoration in the Mediterranean region through the transfer of human resources by developing partnership programmes, agreements and cooperation mechanisms.

We invite further discussions on drought and desertification in the Mediterranean region, considering their link with restoration opportunities, and to enhance collaboration on these issues with other regional actors.

In this spirit, we encourage the political and administrative authorities at the national level to:

1. Strengthen bilateral regional cooperation, partnerships and joint action to:
 - address common environmental and climate challenges, build capacities and exchange knowledge and best practices; and
 - mainstream the role of Mediterranean forests and ecosystems in the international framework of the United Nations Decade on Ecosystem Restoration 2021–2030 by submitting a nomination for a Mediterranean Flagship Initiative.
2. Engage stakeholders, including civil society, political and administrative authorities, the private sector and the scientific community in the planning, development, implementation and monitoring of restoration actions.
3. Promote the management of Mediterranean forests and landscapes towards a vision where social, environmental, economic and cultural benefits are equally integrated, such as in the Model Forest approach.
4. Continue to reinforce, with the support of the scientific community, knowledge and experience sharing on forest and ecosystem restoration, with a view to:
 - periodically and systematically assessing the potential efforts for forest and ecosystem restoration in the Mediterranean region;
 - assessing the role of youth and gender equality in restoration efforts; and
 - assessing the costs and benefits of restoration for current and future generations.
5. Create with the support of international organizations, academic institutions and the private sector, incentives and opportunities for youth to participate in diversified educational programmes focusing on forest and ecosystem restoration, and sustainable management, including through the creation of job opportunities, to:

- increase the access of young entrepreneurs in the Mediterranean region to the restoration of degraded forests and ecosystems; and
 - promote networks of Mediterranean young entrepreneurs for turning innovative ideas into business opportunities.
6. Mobilize funds with the support of stakeholders and relevant agencies, including the Adaptation Fund, the Green Climate Fund and the Global Environment Fund, which entails:
- preparing investment frameworks, integrating restoration as a nature-based solution to climate change mitigation and adaptation; and
 - diversifying strategies for restoration financing efforts.

YOUTH STATEMENT

Youth Statement of the Seventh Mediterranean Forest Week

This statement contains the main challenges and recommendations presented by youth who participated in the Mediterranean Youth Dialogue of the Seventh Mediterranean Forest Week (7MFW) on 22 March 2022.

Five key themes and topics arose from the discussion, which was guided by four questions. Under each of these topics, recommendations are included to be considered for the high-level segment of the 7MFW.

1. Inclusive participatory and decision-making processes at all levels

We, the youth in the Mediterranean region, face a lack of inclusion, participation and representation in policy dialogues and decision-making processes. There is a generalized gap between politicians and youth, and a lack of decentralized governance where youth can participate. Our expertise and scientific contributions within this sector are often not taken into consideration in policymaking, project designing, and law implementation. In addition, gender and age gaps define the forest sector, which should be more inclusive, diverse and representative. It is highly male dominated and not easily accessible by younger generations. We recognize the risk of “youth mainstreaming” practices where the role and involvement of youth is “tokenized,” and youth representatives are asked to speak but are commonly not given access to collaborate with high-level officials and decision-makers.

We therefore recommend:

- Multisectoral support to be given to existing (and to support the creation of) youth committees, networks, and organizations where youth can contribute, lobby, and be consulted for inputs.
- Governments to build trust and ensure communication with youth representatives, youth-led organizations, youth networks, civil society and citizen assemblies composed by youth to increase youth consultations, involvement, and participation in policy-making processes in the forest sector.
- Governments to increase the accessibility of public sector initiatives for youth, and to involve young people in projects and activities in the forest sector.
- Governments to promote and support decentralized governance where youth can participate.
- International organizations, the private sector, civil society, and governments to properly recognize youth as agents of change.
- State and non-state actors to make bigger efforts to reduce the gender and age gap in the forest sector by employing and supporting activities including young people and women.

2. Economic and financial resources and opportunities

We, the youth, face a lack of decent employment opportunities and financial support in the forestry sector. This limits a smooth transition from education to the world of work, and the socio-economic integration of young generations into Mediterranean societies. The scarce financial opportunities for entrepreneurship and research are often accompanied by difficulty in accessing such support due to a lack of information and excessive bureaucracy.

We therefore recommend:

- Multisectoral collaboration and private-public partnerships that can provide decent youth employment opportunities and increase the financial attractiveness of forest restoration efforts through the creation of green jobs.
- Multisectoral collaboration to provide quality technical vocational education and training opportunities for youth that combining on-the-job training and off-the-job learning (such as traineeships, internships, mentorship programmes and other capacity building activities and specialized trainings) on sustainable forest management practices to ensure a smooth entry into the workforce for youth.
- Governments to include forestry professions in aid mechanisms, as well as grants and overall support to competitions and boot camps to develop youth start-ups and projects in the forest sector.

3. Education programmes, capacity-building, and training opportunities for youth on forestry

We, the youth, identify a lack of academic university programmes on forestry in the region. Existing programmes often lack to prepare us, the youth, to enter the workforce and to develop our careers in the forest sector. Furthermore, there is a gap in knowledge exchange between academics and research organizations, and forest-based industries in the private sector and in decision-making processes. Outside of the academic sector, we also identify a lack of technical training and capacity building opportunities in the forestry sector, and a lack of information and communication on such opportunities.

We therefore recommend:

- The academic sector to build programmes that are accessible to youth and that prepare them on technical knowledge but also on socio-economic and global political economy perspectives of the forest sector.
- The academic sector to provide career guidance for students to ensure a smooth transition into the world of work in the forest sector.
- Multisectoral collaboration between governments, the private and academic sectors to create and promote capacity building, and training opportunities in the forest sector for youth that prepare youth to acquire technical skills and tools enter the workforce.
- Governments, the private and academic sectors to ensure the exchange of best practices and knowledge-sharing experiences among and with youth.
- Primary and secondary education to raise awareness to younger generations to introduce the benefits and opportunities of careers in the forest sector, both in rural and urban areas, as well as to expose the challenges and issues related to climate change and unsustainable forest management practices.

4. Mediterranean youth in the rural – urban divide

We, the rural Mediterranean youth, encounter greater challenges in accessing educational and professional opportunities. There is a large gap between rural and urban zones, which encourages rural abandonment and migration to urban areas. This also causes the loss of intergenerational knowledge of forest management practices and traditions within our local communities, and simultaneously, the loss of biodiversity conservation practices. In addition, we face mobility challenges as forest and rural areas are difficult to access without proper public infrastructure and/or private transportation.

We therefore recommend:

- Governments to recognize, consult and involve local organizations composed by local youth into decentralized decision-making mechanisms.
- The private and the academic sector to provide more opportunities for rural youth and in rural areas.
- Governments and the private sector to support local and rural communities in their integration into the forest sector.
- Governments to develop public transport systems to increase the accessibility of rural and forest areas.

5. Communication and transparency of information about forestry issues

We, the youth, are often excluded from transparent communication processes regarding local forest management practices and decisions. In addition, many young people are unaware and unengaged in environmental issues that affect their local ecosystems. This missing connection is also due to an absence of information from trusted sources. There is a lack of communication on international forest-related issues at a socio-cultural, economic and political level that limits our knowledge on global forestry issues, such as on land grabbing of local communities and Indigenous Peoples ancestral domain, as well as on wildfire vulnerability of local communities.

We therefore recommend:

- All local and regional stakeholders to improve communication and information sharing on forest management practices to reach youth and promote youth engagement.
- State and non-state actors to create and promote advocacy campaigns to raise awareness on environmental issues and on sustainable development and forest management practices that recognize local practices.
- State and non-state actors to use modern dissemination outlets, such as social media and podcasts, to reach more of the youth audience and allow for easier and quicker outreach and communication.
- State and non-state actors to raise awareness for global forestry challenges such as land rights of local communities and indigenous peoples as well as forest fire management.
- The private sector, governments, and the civil society to respect the traditional and ecological knowledge of Indigenous Peoples and local communities, to consult and include them in decision-making processes and to ensure free-prior and informed consent when liaising with them.

Conclusion

We, the youth, acknowledge the collaborative nature of these recommendations and we call upon key sectors and stakeholders (governments, international organizations, non-governmental organizations, the scientific community, the academic sector, and the private sector) to provide an enabling environment for us to unlock our potential in the forest sector.

We call for better communication and coordination among all actors to consider, value and include us, the youth and our networks, associations and organizations, as essential partners. We call for more open and decentralized spaces that encourage and respect youth participation and dialogue, so that we can contribute to improve the status quo, and solve the five challenges presented above.

Welcome message

Mohamed Boufaroua

Director General of Forests of Tunisia

Ladies and gentlemen, dear participants,

I am pleased to participate with you, as the representative of Tunisia, in the Seventh Mediterranean Forest Week and the twenty-fourth session of the Mediterranean Forestry Committee *Silva Mediterranea* in Antalya, Türkiye. I would like to thank our Turkish friends and colleagues for their warm welcome and for taking care of the organization of this event. We fully endorse the recommendations and results that will advance forest and landscape restoration (FLR) efforts for future generations in the Mediterranean. Together, we were able to explore a wide range of issues related to FLR in the Mediterranean region. The youth's input highlighted the vital role young people play in the mechanisms that govern FLR strategies. The importance of this role was recognized in the official youth declaration. Moreover, an article writing competition was organized to give young people a platform to make their voices heard.



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The Antalya Declaration, adopted at the end of the week, called on countries and relevant stakeholders to increase restoration efforts and work together to address common environmental and climate challenges. These efforts will be evaluated and will constitute the basis of the next Mediterranean Forest Week that we have the honour of organizing in Tunisia.

The Eighth Mediterranean Forest Week will be an opportunity for member states to discuss what they should do in the future, as well as to reflect on the success of initiatives related to the restoration of Mediterranean forests in a global collaborative framework. It will be an opportunity for all of us to facilitate cooperation between forest administrators, policy makers, the scientific and academic community, representatives of the private sector, several organizations involved in restoration and all beneficiaries involved in the process.

In Tunisia, forests and rangelands cover almost a third of the total area of the country and extend over 5.7 million hectares (ha), 1.3 million ha of which are forests and 4.4 million ha rangelands. Around 80 percent of forests belong to the public forest estate, with 500 kilometres (km) of which follow the borders. Today, forests cover about 8.44 percent of the territory. At the country's independence in 1956, they only covered about 2.5 percent of lands. About 1 million inhabitants live in forests or near them. The forest sector contributes up to 25 percent of fodder needs and provides about 7 million days of work a year. It contributes up to 30 percent of the average family's income in these forested areas.

Forests hold the largest reserves of animal and plant genetic resources. There are around 2 200 varieties of plants and 500 animal species. The forest sector therefore contributes to the ecological balance thanks to a network of reserves comprising 17 national parks, 27 nature reserves and 256 wetlands, 41 of which were designated of world importance under the RAMSAR Convention.

Ladies and gentlemen, dear participants – partnerships and investment are the future of forest resources development. We propose that these aspects, as well as the co-management of resources, be the focus of the next Mediterranean Forest Week.

Social, economic and material support have become of paramount importance in promoting forest resources. Together, as long as it is still possible, we will work for the implementation of a strategic plan for the development and sustainable management of Mediterranean forest resources through new elements such as public–private partnerships, co-management, enhancing the value of forest glades, investment contracts and the development of ecosystems and nature reserves. These themes will be discussed during the next forestry week in Tunisia.

In conclusion, I would like to take this opportunity to thank all national and international institutions and organizations for their cooperation and continuous support in working towards a better Mediterranean environment. See you soon in Tunisia.



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