Building FIRE-SMART LANDSCAPES in the Mediterranean Region

OIKOS

Executive Summary

IMPRINT

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Recommended Citation

Pedro Regato, Lilian Car, Enes Drešković, Christina Georgatou, Dany Ghosn, Ranko Kankaraš, Alessio Martinoli, Aleksander Mijović, Ilektra Remoundou, Aline Salvaudon, Azra Vuković (2023). Building fire-smart landscapes in the Mediterranean region: executive summary. Project "MediterRE3 (REstoring REsilience of Mediterranean landscapes to REduce GHG emissions from wildfires)". Istituto Oikos ETS (Milan, Italy), Parc naturel régional du Luberon (Apt, France), Green Home (Podgorica, Montenegro), CIHEAM-MAICh (Chanià, Greece).

This project is part of the European Climate Initiative (EUKI). EUKI is a project financing instrument by the German Federal Ministry for Economic Affairs and Climate Action (BMWK). The EUKI competition for project ideas is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. It is the overarching goal of the EUKI to foster climate cooperation within the European Union (EU) in order to mitigate greenhouse gas emissions.

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THE PROBLEM

Extreme weather events, such as heat waves and drought, resulting from climate change have already triggered a dramatic increase of wildfire intensity, with devastating environmental and socio-economic impacts, which are predicted to intensify in the coming decades.

Despite decreasing fire events in recent years, thanks to an increase in suppression investments, overall burnt areas are increasing due to few large-scale catastrophic wildfires, known as ***sixth generation fires***, which are practically impossible to be controlled. The combined effect of very high fuel load accumulation in the landscape and fire weather exacerbated by climate change results in a perfect storm in which wildfires become completely uncontrollable, boosting greenhouse gases emissions and causing major ecological, socio-economic and human lives losses.

Within this scenario, the main approach to prevent sixth generation fires and keep them within manageable limits is the restoration of the social, economic and ecological resilience of mosaic-like forest landscapes, in which incentives to increase the rural population support innovative green business models around ecosystem' goods and services linked to fire-smart landscape practices.

The Landscape Fuel Load: Land Use / Land Cover (LU/LC) Changes in the Past Decades

For about 6 decades important socio-economic, demo- graphic and ecological changes have been occurring in rural areas of the European Mediterranean countries, which have contributed to exacerbate fire risk, including:

- a migratory flow to urban areas since the 1960s, fostering depopulation of rural areas
- a prevalence of maladaptive practices with high fire risk in depopulated rural areas
- medium- to large-scale public and private forestation plans between 1960s and 1990s for fast-growing tree plantations
- increase of the wildland-urban interface
- lack of integration and conflictive relationship among different land uses, caused by lack of participatory integrated landscape planning and governance processes, limited incentives for land users in rural areas, limited public and private funding for innovation research and lack of know-how and innovation transfer to practitioners

Climate Change Trends and Fire Dynamics

Climate models predict substantial temperature increase and precipitation decline for the Euro-Mediterranean region - which has already caused heat stress and reduced water availability in the southern European countries - and sharp increase in climate variability, with more frequent and intense weather events, such as heatwaves, droughts, strong winds and intense rainstorms. Heatwaves, droughts and strong winds determine the so-called fire weather, conditions enabling sixth generation wildfire outbreaks, supported by the accumulation of a fuel load of dry and dense biomass. In all cases, planning of resilient landscapes must consider management, restoration and protection measures that facilitate the adaptation of habitats to the changing climate and its consequences, including wildfires. The best adaptation strategy should support the increase of biological diversity at all levels ***(genus, species, communities and landscape)***.

THE CHALLENGE

Throughout the last 4 decades there has been a great debate on policies, strategies and mechanisms for managing forest fires, with growing criticism of the ineffectiveness of concentrating resources on fire suppression and the need to develop integrated strategies around five axes ***(5 Rs)***, namely risk reduction/prevention, readiness, response, post-fire restoration and research. However, there are still significant barriers that prevent the large-scale planning and dissemination of integrated fire prevention plans and measures that allow landscapes to shift from fire-prone to a fire-smart situation. Specifically, the following barriers can be summarized.

Landscape Fire Management Barriers

Little capacity and/or willingness for cross-sectoral integration that help mainstream harmonized fire-risk reduction measures in the policies and development plans regulating rural development.

Economic Barriers

Limited attention and budget allocation to fire-risk reduction or prevention in national and local fire management policies/strategies and absence of comprehensive cost-benefit analyses to engage policy makers, landowners, land users and potential investors on the diverse set of benefits generated by fire-smart LUs and management practices, and on the interest to invest in sustainable biomass management innovative business models.

Governance Barriers

The socio-economic drivers of wildfires should be tackled from a multi-stakeholder and multi-disciplinary perspective so that innovative governance mechanisms for cooperation on fire-risk reduction and prevention can be established.

Know-How Transfer Barriers

Although wildfire growing impacts have prompted a paradigm shift toward proactive wildfire management that prioritizes prevention instead of response, the landscape stakeholders remain unprepared to mainstream collaborative fire-risk reduction objectives and prevention measures into the day-to-day work.

THE SOLUTION

Increasing the resilience of landscapes to wildfires is based on the planning of fire-smart land uses and natural resources management practices. In resilient landscapes, the extension and distribution pattern of fire-smart LU/LC types in the landscape help minimize the risk of fire ignition ***(avoidance of maladaptive practices)*** and fire spread ***(LU/LC fuel load reduction)*** and increase post-fire recovery.

In this document, we outline how to plan ***fire-smart landscapes (FSL)*** through the conceptual framework and principles of ***Forest Landscape Restoration (FLR)***. FLR is defined as

"a large-scale and long-term process leading to the recovery of the ecological functionality and the improvement of human livelihoods in degraded landscapes, in a way that increases the ecological and socio-economic resilience against environmental risks – such as large wildfires - and the ecosystem services upon which we all depend."

The FLR Principles and Their Correspondence with the Proposed FSL Planning Principles

FLR Principles

Proposed FSL Planning Principles

FSL PRINCIPLE 1

Participatory Landscape Planning of Fire-Smart LU/LC Types, Management Practices and their Landscape Distribution Pattern

Defining the Landscape Boundaries

Fire-smart landscape planning takes place within and across entire landscapes, not individual sites, representing large mosaic-like territories characterized by spatially complex interactions between ecological systems, land uses and management practices under various tenure and governance systems.

The landscape boundaries often do not correspond to the administrative limits. Therefore, a new governance layer ***(embedded in the existing ones)*** for the fire-resilient landscape planning and management process may be needed.

Establishing Multi-Stakeholder and Multi-Disciplinary Landscape Planning Teams and Governance Mechanisms

Fire-smart landscape planning requires an ***"institutional hub"*** supporting a multi-sector and multi-stakeholder collaborative approach, and thus ensure credibility in the process, appropriation of the results and a framework for its implementation.

Root-Cause Analysis of Wildfire Impacts in the Landscape

A root-causes analysis highlights the need to understand and to remove the underlying socio-economic and political causes that drive large-scale wildfire impacts in the landscape. The primary objective is to address these fundamental questions about the pervasive trend toward high fire risk in the target landscapes.

- What are the underlying socio-economic forces and circumstances driving high fire risk?
- How are these root causes interlinked?
- What are possible responses to these forces and circumstances that could reduce the pressure on biodiversity?

Landscape Fire-Risk Analysis & Modelling

Fire-smart landscape planning requires the identification, the mapping and the prioritization of landscape areas with high wildfire ignition, high fire spread risk, low post-fire recovery capacity, fire-prone LU/LC types and management practices. 4 sub-steps are required.

1 THE NEED

for fuel management within the landscape

Evaluation of hazardous fuel models and the needed changes, in terms of accumulation and distribution of dry biomass in the landscape

2 WHERE

to intervene in the landscape

Selection of strategic "high to very high fire risk areas" where to prioritize fuel management interventions ***(highlighting the interface between LU/LC fuel models with high/very high fire spread risk and high/very high fire ignition risk; estimating fire intensity levels, flame length probability and perimeter of burned area, making use of fire simulations based on landform data, meteorological data, and the LU/LC fuel models)***

3 THE DESIRED SCENARIO

Alternative fuel models for the prioritized high fire risk areas

List of alternative fire-smart fuel models contributing to reduce the risk of occurrence of large-scale fires ***(alternative management or restoration practices aimed at modifying the fuel load of critical areas and elements at risk; alternative LU/LC types in critical areas, such as the recovery of agricultural or pastoral uses in abandoned areas covered by dense woody vegetation)***

4 THE VISION

Fire-smart Landscape Action Plan

Defining a common vision to enable stakeholders to share concerns and needs on forest fires and to visualize different planning scenarios for territorial uses and fire risk modification. The plan should include:

- analysis of the root-causes of large-scale wildfires in the target landscape
- GIS mapping and description of the critical areas for fire-risk reduction and current fuel models
- alternative fuel models, validated by all concerned stakeholders
- detailed management plan of each proposed fuel model
- resources needed (human, animal and material), tasks and responsibilities
- a gender- and youth disaggregated capacity development plan for all concerned public and private stakeholders
- a policy influencing plan analysing strengths, weaknesses, gaps and opportunities of existing policies and governance mechanisms to support the fire-smart landscape plan implementation
- framework describing objectives, outcomes, outputs, activities, timeframe and budget to cover the costs
- cost-benefit analysis and a multiple financing strategy
- participatory and adaptive monitoring plan

FSL PRINCIPLE 2

Prioritization of Locally Adapted Cross-Sectoral and Innovative Intervention Measures

Fire-smart landscape interventions include a set of sustainable biomass management options linked to the protection, management and /or restoration of forests, pastures and farmland, often integrating several intersectoral complementary measures that require the establishment of collaboration frameworks between different actors in the territory ***(e.g. forest owners, pastoralists and farmers)*** and harmonized management plans.

Fuel-Break Areas

What

Fuel-break areas may consist of

- a low-density tree layer of natural or planted forest tree species dispersed over a natural herbaceous cover
- a low-density agroforestry tree plantation ***(e.g. chestnuts, cherries, plums, almonds, figs, carobs, olives, among others)*** over a living mulch cover ***(wild or cover crop interplanted)***
- a plantation of vines over a living mulch cover ***(wild or cover crop interplanted).***
- an herbal cover of farmland or pastureland.

Where

In critical areas of the landscape that allow the fire front to be broken ***(e.g. mountain headlands that separate different valleys)*** and where it is necessary to facilitate the access of extinguishing agents.

Complementary Fire-Smart Interventions

- Initial mechanical clearing and/or prescribed burning of excess woody biomass, possibly coupled controlled grazing
- Tree thinning, in areas with high tree density, often resulting of unmanaged plantations or secondary ecological succession after the abandonment of agro-pastoral land or post-fires
- Tree planting, in case of establishing productive fuel-breaks ***(e.g. agroforestry)***
- Controlled grazing in priority fuel-break areas, including measures to avoid destroying the existing saplings and seedlings ***(e.g. grazing seasonality, suitable breeds, use of protectors)***
- Sustainable management of agriculture biomass residues, avoiding burning

Climate Adaptive Forest Management

What

It is the adoption of multipurpose objectives and diversification of productive and cultural ecosystem services, to bear the costs of forest management objectives ***(e.g. protection of watersheds, extraction of wood)***.

Such objectives may include the exploitation of ***non-timber forest products (NTFPs)***, such as mushrooms, resins, fruits, honey, wild herbs, tree fodder and pastures, complementary to timber production, and the development of forest biomass management plans ***(forest thinning and pruning)***.

Where

Dense forest stands with low to medium conservation value, with high fire spread risk located in landscape areas where they interface with high/very high fire ignition areas ***(e.g. roads, urban land, power lines and stations)***.

Complementary Fire-Smart Interventions

- Tree thinning ***(see "Fuel break areas")***
- Tree planting ***(idem)***
- Controlled grazing ***(idem)***
- NTFP inventory, valuation and management
- Biodiversity monitoring, to evaluate the positive effect of biomass reduction

Sustainable Management of Biomass in Secondary Shrublands

What

The reduction of biomass in secondary shrubby areas that have colonized abandoned pastures and farmlands. It is one of the greatest challenges in terms of fire risk reduction due to high and low economic return.

Where

Dense scrublands with low to medium conservation value, with high fire spread risk located in landscape areas where they interface with high/very high fire ignition areas ***(e.g. roads, urban land, power lines and stations)***.

Complementary Fire-Smart Interventions

- Initial mechanical clearing and/or prescribed burning of excess shrub biomass, possibly coupled with controlled grazing. A mosaic of cleared patches (***pastures with scattered trees)*** and cultivated patches should be sought.

- Tree planting at low densities of re-sprouting species with high resilience to fire and economic potential ***(e.g. oak, chestnut, hazelnut, symbiotic with truffles and other economically valuable mushrooms)*** in cleared scrubland is recommended.

- Biodiversity monitoring, to evaluate the positive effect of the pasture-scrubland mosaic

Active ecological restoration interventions in degraded landscape areas with high fire risk

What

The EU Biodiversity Strategy for 2030 commits to planting at least 3 billion trees with the aim to ***"increase the EU forest area and resilience, enhance biodiversity, and help with climate change mitigation and adaptation"***. Possible actions include:

- selection of native species with a multipurpose value ***(e.g. re-sprouting fruit species that attract seed-dispersal fauna, regrow after fires and have an economic value)***
- development of production techniques for native multipurpose species to produce hardened seedlings resistant to lack of water and soil nutrients.
- realization of diversified planting techniques ***(e.g. locally- and climate-adapted planting densities, water-conservation soil preparation and soil mulching measures etc.)***
- temporary enclosures of degraded pastures to recover plant diversity

Sustainable Management of Pastures

What

Overgrazing causes a loss of palatable species and an increase in unpalatable species that limit pasture productivity. The lack of grazing plans may cause severe wildfires escaping to high fire risk areas ***(e.g. dense forest stands, urban areas)***. Restoration of sustainable uses of pastures requires agreements between users and landowners on temporal and spatial grazing rights and the definition of management plans of the rotation and resting type ***(including enrichment planting)*** with calculation of cattle carrying capacities.

Sustainable Management of Agricultural Biomass

What

Burning pruning residues and stubble are a major cause of fire ignition. Modern farmland practices give value to this biomass, by integrating it into the soil, producing bioenergy and compost ***(e.g. briquettes)***, and using it as fodder for livestock. This leads to a lowered fire risk and to increased ecosystem services, such as soil fertility, water retention in summer, hydration of plants, changes in microclimate and relative humidity.

Biomass Clearing Around Houses, Settlements, and Infrastructures

What

In the last decades, building isolated houses and neighbourhoods nearby forests resulted in an increase of the large-scale interaction between high fire hazard and high ignition risk areas, the so-called ***"wildland-urban interface" (WUI)***, an area where homes, public buildings and commercial structures meet with or are dispersed within wildland vegetation. After identifying and mapping the most critical areas, fuel loadings and stand structure should be modified through fuel treatments in strips surrounding buildings. National legal frameworks spatially defining the buffer distance of WUI for practical fire risk management are established in several EU countries, ranging from 50 to 400 m, depending on whether they apply to urban or to forest areas.

FSL PRINCIPLE 3

Enhance and Restore the Species Diversity, Functionality, Fire Resilience and Ecosystem Services of the Natural and Seminatural Habitats in the Landscape

Wildfires are more a social than an ecosystem issue. In fact, fire is part of the dynamics of Mediterranean ecosystems, although it is difficult to define the natural regime of fire disturbance and its influence on ecological processes. Coastal xerophytic pine forests regenerate after fires ***(e.g. Pinus halepensis, P. brutia, P. pinaster)***, although the increased frequency of anthropic fires can be incompatible with the ecology of these species. The most widely proposed and/adopted fire-smart interventions linked to increasing the resilience of natural ecosystems are the following:

Connectivity Restoration Among Old-Growth Forest Stands

In many Mediterranean landscapes, old-growth forests are usually relic small stands scattered in the landscape, highly vulnerable to fire. Ecological restoration actions should aim to increase connectivity between unconnected patches and to manage surrounding biomass to reduce the risk of fire spread.

Diversification of Species

Managed forests are usually monospecific, dominated by a single species favoured by a selected use ***(e.g. wood, resin, silvo-pastoral, etc.)***. Restoring species diversity and promoting post-fire re-sprouting species foster a quicker recovery of landscapes after wildfires ***(diversification of conifer forests with native Quercus and fruit producing species, e.g. Sorbus spp., Prunus spp., Pyrus spp., Malus spp., Arbutus spp., etc.)***.

Changes in the Vegetation Structure and Species Composition to Speed Up Natural Succession towards Mature Stages

Abandoned farmlands and rangelands are often dominated by dense scrublands and secondary high-flammable pine forests. Selective clearing of scrubs and planting of re-sprouting species can promote a grass-dominated landscape with scattered re-sprouting scrubs, providing fuel discontinuity in just 3 years. Early thinning of dense Aleppo or Brutia pine saplings that colonized abandoned or burned landscape is strongly advised to speed up tree growth.

Habitat Diversification

Breaking fuel continuity in the landscape through mechanical cutting ***(forest thinning, forest gap opening, and shrub clearing in non-forest areas)*** followed by controlled grazing helps create new habitats and favours the diversification of forest species.

Management of Post-Fire Snags and Woody Debris

Post-fire snags and woody debris play a fundamental role in the natural regeneration of burned areas and in preventing erosion by water runoff. Burnt logs and branches left on site improve seedling establishment by reducing water stress and increasing nutrient availability. In the case of pine trees with serotinous cones, harvesting of standing dead trees should be postponed for at least three/four years to allow seed dispersal.

FSL PRINCIPLE 4

Sustainable Return on Fire-Risk Reduction Investments, Ensuring the Provision of Ecological, Social and Economic Benefits

Assessing costs and benefits of land use investments allows decision-makers to demonstrate that fire-smart interventions result in better socio-economic and environmental outcomes. Public and private stakeholders can make use of customized decision-making tools on impacts, cost and environmental, social and economic benefits provided by alternative scenarios with or without fire-smart landscape interventions.

A cost-benefit analysis may include the following 5 steps:

1 SETTING THE SCENE

Stakeholders should agree on the purpose and the parameters of the analysis: which activities are relevant, who should be involved, which fire-prone LU/LC and management practices are targeted and which fire-smart interventions should be applied.

2 DEFINE THE STAKEHOLDERS

...who will be impacted by the shift to the proposed fire-smart fuel model.

3 EVALUATE POSITIVE/NEGATIVE IMPACTS AND DEFINE INDICATORS

Impacts are broadly defined to include the costs of conversion to a fire-smart scenario ***(e.g. implementation, transaction and opportunity costs),*** and the ecosystem services representing the benefits ***(e.g. carbon sequestration, erosion control, wood and NTFP products, recreation etc.)***.

4 MODEL COSTS AND BENEFITS

Generate 1-hectare model scenarios with fire-smart interventions for each proposed climate-smart LU/LC type, defining costs and benefits. Models are then scaled-up across each priority area for fire-risk reduction and/or the entire landscape. Scenarios should elaborate the sustainable return on investment ***(time horizon for costs to generate benefits).***

5 ANALYSIS OF COSTS AND BENEFITS

Calculate different types of indicators, such as the ***net present value (NPV)***, the ***internal rate of return (IRR)***, the benefit/cost ratio, the ***return on investment (ROI)*** and the ***return on equity (ROE).*** A cost-benefit analysis should include also a sensitivity analysis.

FSL PRINCIPLE 5

Enabling Multi-Stakeholders to be Actively Involved in the Implementation of Fire-Smart Landscape Plans Through 360º Capacity Development Interventions and Innovative Governance Mechanisms

Fire-risk reduction requires the participation of stakeholders in planning and management of fire prevention and to build their capacities to apply effectively fire-smart measures in the long term. Here below a potential list of actions to foster the stakeholders' engagement.

Multi-Stakeholder Involvement

Multi-stakeholder participation can address effectively the challenges posed by large-scale wildfire prevention in the landscape, by

- helping to develop a comprehensive understanding of the relationship between the fire risk and land uses
- promoting mutual learning
- tailoring proposed fire-smart interventions and technologies to local sociocultural and environmental conditions
- reducing the marginalization of stakeholders from decision-making

Innovative Governance Arrangements

...such as ***multi-stakeholder platforms (MSP)*** for the FSL planning process and/or for the implementation of the FSL plan ***(e.g. a working group including 2/3 coordinating members and a larger number of multi-stakeholder and multi-disciplinary specialists from public authorities, private sector and civil society, providing advice)*** or formal collaboration frameworks among landscape practitioners for the joint implementation of fire-smart management practices ***(e.g. forest owners' associations, formal contracts between forest owners or public administration and shepherds, public-private partnerships under Payment for Ecosystem Services (PES) schemes, landscape wildfire operation groups, etc.)***

Capacity Building

The implementation of fire-smart landscape plans needs major investments to professionalize practitioners on fire risk management practices ***(e.g. new curricula for farmers, shepherds and forest manager schools)*** and to create attractive business development and employment opportunities linked to fire-smart land uses and management practices, that also help to attract new settlers in depopulated territories.

FSL PRINCIPLE 6

Long-Term Adaptive Monitoring and Financing Mechanisms for Fire-Smart Landscapes

Long-Term Financing

Financing opportunities for the long-term implementation of fire-smart landscape plans differ depending on the landscape's agro-ecological, social, economic, legal and political framework. They include:

- asset investments in physical components of the landscape or activities that contribute to restoring landscape fire-resilience, such as forest thinning, controlled grazing, creation of productive firebreaks etc.
- enabling investments that lay the institutional and policy foundation for asset investments by generating incentives. Some examples are:
  - appropriate legal and regulatory frameworks
  - development of incentive mechanisms such as tax-reduction, certification schemes and payment mechanisms for fire-smart services
  - ***corporate social responsibility (CSR)*** commitments
  - investments from domestic banks willing to offer below-market capital
  - allocations by government budget line items to implement the EU Green Deal policies

If associated with proper market mechanisms, asset investments provide opportunity to generate financial returns for stakeholders, resource managers and investors. To give some possible examples:

- sustainable agro-silvo-pastoral production from combined biomass management interventions – bioenergy, compost, diversified crops and livestock products, wood and NTFPs
- fire-smart commodity value chains linked to productive fuel-breaks with agroforestry plantations
- ecotourism

Enabling Policy Framework

International Level

Several transformative policies of the EU Green Deal are relevant to fire-smart landscapes ***(EU Biodiversity Strategy for 2030, Nature Restoration Law, new EU Forest Strategy, Common Agricultural Policy, Farm to Fork Strategy, Carbon Funding Strategy, new Bio-economy Strategy, 2021 Climate Law)***.

National and Sub-National Level

Fire-smart landscape planning should address and amend cross-sectoral policy barriers to fire-risk reduction to create an enabling legal environment supporting the implementation of the prioritized risk reduction interventions. As a follow up to the planning exercise, the project teams should develop a policy influencing plan, including:

- policy briefs with new/revised crosscompliant policy proposals
- a collection of best practices
- implementation of an advocacy plan to put forward for consultation and acceptance of policy makers the proposed policy briefs

Long-Term Adaptive Monitoring

Given the complexity of social, environmental, and economic factors linked to the fire-smart landscape plans, it is necessary to design monitoring systems to evaluate and qualify the impacts of fire-smart interventions at the landscape level. Fire-smart landscape plans may adapt the ***Sustainability Index for Landscape Restoration (SILR)*** developed by the ***World Resources Institute (WRI)***, a tool for monitoring the biophysical and socioeconomic impacts of landscape restoration and providing information for decision-making processes.

MED ITER RE3

Restoring the Resilience of Mediterranean Landscapes to Reduce GHG Emissions from Wildfires

A project aiming to reduce fire-related GHG emissions in three target landscapes in Greece, Montenegro and France, through the application of Forest Landscape Restoration (FLR) principles for fire-smart restoration of landscapes.

Promoted by:

OIKOS

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

European Climate Initiative EUKI