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**LANDSCAPE FIRE
MANAGEMENT**

IN THE WESTERN BALKANS

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STRATEGY

FOR

ADAPTIVE LANDSCAPE MANAGEMENT

AND

LANDSCAPE FIRE MANAGEMENT

IN THE REPUBLIC OF NORTH MACEDONIA



LIST OF INSTITUTIONS AND ORGANIZATIONS INVOLVED IN THE PROCESS OF DEVELOPING THE STRATEGY:

- ❖ Agency for Real Estate Cadastre
- ❖ Agency for Financial Support of Agriculture and Rural Development
- ❖ Agency for Promotion of Agricultural Development
- ❖ Association of The Units of Local Self-Government of The Republic of North Macedonia
- ❖ Aeronautical Federation of Macedonia
- ❖ Crisis Management Centre
- ❖ Directorate for Protection and Rescue
- ❖ Entuzijast Voluntary Firefighting Association
- ❖ Forest Police
- ❖ Faculty of Forestry, Landscape Architecture and Eco-Engineering "Hans Em."
- ❖ Hydrometeorological service of Macedonia
- ❖ International Institute for Development and Research, Dr. Jugoslav Achkoski
- ❖ Kochani Voluntary Firefighting Association
- ❖ Military Academy General Mihailo Apostolski – Skopje
- ❖ Ministry of Agriculture, Forestry, and Water Economy
- ❖ Ministry of Environment and Physical
- ❖ Macedonian Ecological Society
- ❖ National Park Mavrovo
- ❖ National Park Shar Planina
- ❖ National Park Pelister
- ❖ National Park Galichica
- ❖ National Association of Private Forest Owners
- ❖ National Farmers' Federation
- ❖ Public Enterprise "National Forests."
- ❖ Public Enterprise "Parks and greenery."
- ❖ Public Enterprise "Pastures."
- ❖ Public Enterprise for the Management and Protection of the Multipurpose Area Jasen
- ❖ Rural Development Network of North Macedonia
- ❖ SOZSU "Gjorce Petrov", Kavadarci
- ❖ State Statistical Office
- ❖ State Inspectorate Forestry and Hunting
- ❖ Sveti Nikole Voluntary Firefighting Association
- ❖ Kochani Voluntary Firefighting Association
- ❖ Territorial Firefighting Units of Kochani

LIST OF EXPERTS AND INSTITUTIONS INCLUDED IN THE PREPARATION OF THE STRATEGY:

Preparation and compilation of the report:

Bojan Mihajlovski, LFMWB Country Project staff in Skopje

National supervisor of the process:

Jordan Zdravkovski, LFMWB Country Focal Point, Ministry of Agriculture, Forestry, and Water Economy of North Macedonia

Expert process support:

Prof. Dr. Nikola Nikolov, Regional expert for landscape fire management, Regional Fire Monitoring Centre (RFMC), with the support of the RFMC Staff

Velian Jagev, Regional coordinator for Landscape Fire Management, Regional Fire Monitoring Centre (RFMC), and Jakob Kiprovski, Junior Associate for Landscape Fire Management, Regional Fire Monitoring Centre (RFMC)

Expert on process for preparation of LFM Strategy:

Aleksandar Karaev

Proofreader:

Elena Jankoska

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LIST OF ACRONYMS

ARM	Army of the Republic of North Macedonia
AFSARD	Agency for Financial Support of Agriculture and Rural Development
APAD	Agency for the Promotion of Agricultural Development
BAER	Burned Area Emergency Response
CMS	Crisis Management System
CMC	Crisis Management Centre
DPR	Directorate for protection and rescue
EU	European union
EEA	European Environmental Agency
ESA	European Space Agency
FAO	Food and Agriculture Organization
FP	Forest Police
FFUM	Firefighting Union of Macedonia
GFMC	Global Fire Monitoring Centre
LFM	Landscape Fire Management
LSG	Local-Self Government
MFFIS	Macedonian Forest Fire Information System
Mol	Ministry of Interior
MAFWE	Ministry of agriculture, forestry and water economy
MoEPP	Ministry of Environment and Physical Planning
MoD	Ministry of Defence
MoFA	Ministry of Foreign Affairs
MoLSG	Ministry of Local Self-Government
MoEMM	Ministry of Energy, Mining and Mineral Resources
MoE	Ministry of Education
NAoPFO	National Association of Private Forest Owners
NHMS	National Hydrometeorological Service of the Republic of North Macedonia.
NMK	North Macedonia
NPs	National Parks
NGOs	Non-governmental organizations
OSCE	Organization for Security and Co-operation in Europe
PE	Public enterprise
PENF	Public Enterprise National Forests
PEP	Public Enterprise Pastures
PRS	Protection and rescue system
RDNNMK	Rural Development Network of North Macedonia
SSO	State Statistical Office
SIFH	State Inspectorate for Forestry and Hunting
SIA	State Inspectorate for Agriculture
SIE	State Inspectorate for Environment
TFFUs	Territorial Firefighting Units
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNDRR	Agency for Coordination of Disaster Risk Reduction
UKIM	University of St. Cyril and Methodius
UN	United Nations
UGD	Gotse Delchev University
WMO	World Meteorological Organization
WHO	World Health Organization

INTRODUCTION

Placed in the rugged hilly-mountainous terrain, Republic of North Macedonia has diverse landscapes - from high dense forests, through pastures and meadows, degraded forests and scrublands, to agricultural areas and urban areas of which is more or less susceptible to the unpredictable impact of landscape fires. In this dynamic environment where the boundaries between urban and peri-urban environments are blurring, the need for an effective adaptive landscape management and fire management strategy becomes a critical necessity.

The Republic of North Macedonia faces an increased threat of landscape fires due to climate change, i.e. increased temperatures, prolonged dry periods and extreme weather events increase the risk of fires. Furthermore, demographic changes or depopulation of rural areas and the abandonment of traditional land management practices lead to the accumulation of combustible materials. Intensive urbanization also increases the risk to human life and property through the spread of settlements towards natural areas. Of particular importance is the insufficient prevention, i.e. the current systems predominantly focus on reactive measures rather than proactive prevention and fragmented management or the absence of an integrated approach linking different sectors and levels of management.

Landscape fires spread across natural ecosystems and can affect different types of vegetation and land cover, including forests, scrub, grasslands, meadows, agricultural areas, and areas where natural and peri-urban landscapes overlap. In contrast to the traditional understanding of "forest fires", landscape fires are characterized by a multi-ecosystem character, i.e. they can spread across different ecosystems categories of land use. Furthermore, they affect the ratio of natural and urban landscapes where settlements and infrastructure are directly threatened. These fires are characterized by complex behaviour, i.e., their spread and intensity are influenced by topography, climate, vegetation type and human activities. And finally, these fires have major consequences, primarily affecting biodiversity, water quality, air, the economy, and public health. In the last decade, the concept of landscape-based fire management (LFM) has emerged as a proactive approach to address the increasing threat of fire, while fostering ecological resilience and community well-being. Landscape-based fire management represents a fundamental paradigm shift from traditional fire management practices to a flexible, science-based, and adaptive methodology. Instead of focusing exclusively on fire suppression LFM is a comprehensive approach that integrates ecological principles, social dynamics, economic aspects, and climate variability and change with a focus on preventive activities/measures and actions.

Recognizing the complex interaction between natural processes and human activities, the LFM seeks to reduce the risk of destructive fires at the landscape level, improve the health and resilience of ecosystems, promote sustainable land management practices, protect human lives and property, and preserve the biodiversity and ecosystem services that different landscapes provide. Thus, the diverse landscapes of North Macedonia, ranging from the high-mountain ecosystems of Shar Planina, Pelister, Osogovo, Galicica, and Jakupica to the fertile valleys of the Vardar River basin, and from semiarid landscapes in the east to the hilly-mountainous massifs in the west, provide a complex basis for the application of the LFM principles.

Managing fires at the landscape level in this context requires a deep understanding of local ecosystems and their natural susceptibility to fire, the socio-economic characteristics of different regions, traditional land management practices, and contemporary challenges related to climate change and urbanization. Each region of the country – from the high forests of the Mavrovo National Park to the semiarid landscapes of Ovche Pole, from the hilly-mountainous landscapes of the Osogovo Mountains to the mixed forest-agricultural landscapes of the central parts – presents its own unique set of challenges and opportunities for the implementation of the landscape fire management strategies.

The geographical location of the Republic of North Macedonia at the crossroads of continental and Mediterranean climates makes it particularly vulnerable to the impacts of climate change, including prolonged droughts, extreme temperatures, and irregular rainfall regimes. Regional projections show that further increases in fire risk can be expected in the coming decades, making this strategy not only necessary but also urgent. In this context, the Landscape fire management approach offers an advanced, science-based approach that helps mitigate the effects of climate change while fostering greater resilience in natural ecosystems and human communities. The strategy is based on a voluntary, participatory approach of the competent institutions, governmental bodies, public enterprises, and others (members of the National Landscape Fire Management Network), adapted to the specificities and needs of the North Macedonian landscape fire management system.

1. OVERVIEW OF THE STATUS OF THE LANDSCAPE FIRE MANAGEMENT IN THE REPUBLIC OF NORTH MACEDONIA

Landscape fire management is at the forefront of global efforts to mitigate the impacts of fires, protect communities, and preserve ecosystems. This complex endeavour operates within a complex legal framework, engaging diverse stakeholders (key actors), and requires collaborative efforts in public awareness, education, research efforts, and the crucial role of cross-sectoral and international collaboration in landscape fire management in the Republic of North Macedonia.

LEGAL FRAMEWORK RELATED TO LANDSCAPE FIRE MANAGEMENT

The legal framework governing landscape fire management in North Macedonia is distributed across different jurisdictions, but typically encompasses a combination of national legislation, policies and international agreements. These legal instruments establish guidelines for prevention, suppression and land management practices, defining responsibilities between government agencies, landowners and other stakeholders involved in the landscape fire management.

The legal and strategic framework for landscape fire management in North Macedonia also consists of several key laws and strategic documents. The legal regulations include:

- Local Self-Government Law
- Protection and Rescue Law
- Nature Protection Law
- Firefighting Law
- Crisis Management Law
- Environment Law,
- Agricultural Land Law,
- Hunting and Game Law,
- Forests Law
- Urban Greenery Law
- Criminal Code Law
- Pasture Law

- Law on Energy
- Law on Water
- Protection of Cultural Heritage Law
- Public Road and Railway Traffic Law

These laws interact with landscape fire management in distinct but complementary ways. The Forests Law and Nature Protection Law establish the foundation for ecosystem management and define protective measures for fire-prone areas, including mandatory preventive management zones and restrictions on activities during high-risk periods. The Crisis Management Law and Protection and Rescue Law delineate operational frameworks for emergency response, coordination between agencies, and resource mobilization during fire events. The Agricultural Land Law and Pasture Law regulate land use practices that directly influence fire risk, such as burning for agricultural purposes and grazing management that affects fuel loads. Meanwhile, the Local Self-Government Law assigns critical prevention and preparedness responsibilities to municipal authorities.

Finally, these laws comprehensively regulate the various aspects of landscape fire management, from local competencies to nature and forest protection. Strategic documents, on the other hand, include:

- Strategy for Sustainable Development of Forestry,
- National Strategy for Agriculture and Rural Development 2021-2027
- National Strategy for Protection and Rescue,
- National Platform for Disaster Risk Reduction,
- National Strategy for Nature Protection,
- Strategy for Adaptation of the Health Sector to Climate Change in the Republic of Macedonia with an Action Plan 2011 – 2015
- Strategy for Environment and Climate Change, and
- Strategy for Climate Action and Action Plan

These strategic documents set long-term goals and priorities for sustainable forest management, disaster risk reduction, nature protection and climate change management. Together, these laws and strategic documents form a comprehensive framework that encompasses all aspects of landscape fire management, including prevention, preparedness, response, and recovery, providing an integrated approach to environmental protection and citizen safety in North Macedonia.

Despite this comprehensive legal architecture, significant inconsistencies exist between laws that complicate effective landscape fire management. Overlapping jurisdictions between the Forest Law and Agricultural Land Law create ambiguity regarding responsibility for fire prevention on forest-agriculture interface zones. The Crisis Management Law, Firefighting Law, and the Protection and Rescue Law contain conflicting provisions, and create uncertainty regarding institutional responsibilities in of the key authorities during major fire events. Additionally, gaps exist in enforcement mechanisms across different laws, with inadequate penalties for negligent burning practices in some legislation, while others impose strict sanctions. These legal inconsistencies result in fragmented implementation, unclear accountability, and reduced coordination among competent institutions, undermining the overall effectiveness of the landscape fire management system.

INSTITUTIONAL FRAMEWORK OF THE LANDSCAPE FIRE MANAGEMENT

Effective landscape fire management relies on cooperation and coordination of various stakeholders at local, regional, national, and international levels. Government agencies, institutions, ministries, science community, enterprises, including fire services, play a central role in landscape fire management.

The Parliament and the Government have a central role in adopting the main legislative procedures as well as adopting strategic documents directly related to landscape fire management, while the Ministry of Agriculture, Forestry and Water Economy is a state administration body responsible for implementing the work related to the management and protection of forests, management of agricultural land and water resources through water management. The State Inspectorate for Forestry and Hunting is a competent institution/body that carries out inspection supervision over the implementation of legal regulations, by-laws from the Law on Forests, the Law on Hunting, the Law on Reproductive Material of Forest Tree Species, the Law on Protection of Plants from Diseases and Pests, and other legal regulations that are closely related to this issue. The National Hydrometeorological Service (NHMS) of the Republic of North Macedonia as state administrative office within the Ministry of Agriculture, Forestry, and Water Economy, plays a crucial role in landscape fire management by providing meteorological data and forecasts. The service monitors critical parameters such as temperature, air humidity, wind speed, and precipitation, which are vital for assessing fire risk. UHMR issues warnings and weather forecasts that help fire services prepare and respond in a timely manner, while also providing long-term climate analyses for planning preventive measures to protect nature. Among other things, the Ministry of Environment and Physical Planning is closely related to environmental management through monitoring and protection of the environment, preservation of biodiversity, making decisions related to National Parks such as Pelister National Park, Mavrovo National Park, Galichica National Park, and all other protected areas on the territory of the State. Within the framework of the Ministry of Environment and Physical Planning, the competent authority for the control of all legal entities in the field of environmental protection is the State Inspectorate for Environmental Protection.

Regarding the Spatial planning, the Agency for Spatial Planning implements the spatial planning and development policy of the Republic of North Macedonia in accordance with the Law on Urban Planning. Among other things, the Agency develops and implements the Spatial Plan of the Republic of North Macedonia, as well as regional planning, areas of special interest and spatial plans of local governments and develops general urban plans and their revision on a large scale.

The Directorate for Protection and Rescue (DPR) carries out activities such as planning, assessing the risk of natural disasters and other accidents, organizing, preparing and equipping the protection and rescue system, operating the system for prevention and detection of occurrence and elimination of consequences, providing material reserves, controlling and assessing the readiness of the protection and rescue forces and their training. On the other hand, the Crisis Management Centre is also responsible for continuous interdepartmental and international cooperation, preparation and updating of the Risk and Threat Assessment of the Security of North Macedonia, proposes measures and activities for crisis resolution, and is mandated to provide overall support (professional, organizational, administrative and other) of the Steering Committee and the Assessment Group. In addition, the Directorate for Protection and Rescue and the Crisis Management Centre provide operational coordination, supported by a network of 34 territorial and 14 regional firefighting units that operate at the local and national level and are vital in the event of a fire and its complete extinguishing.

Landscape fire management in North Macedonia is further strengthened by the contribution of scientific institutions, including the Macedonian Academy of Sciences and Arts (MASA), Faculty of Forestry, Land-

scape Architecture and Eco-Engineering “Hans Em” whose scientific and applied activities support monitoring, management and prevention of fires in forest ecosystems; Faculty of Agricultural Sciences and Food - Skopje, Institute of Agriculture - Skopje, Faculty of Natural Sciences and Mathematics - Skopje, Faculty of Natural and Technical Sciences, University “Goce Delchev” – Shtip. This network also extends to secondary schools such as S.O. Agricultural Forestry School Gjorche Petrov - Kavadarci and S.O.U. Krste Petkov Misirkov - Demir Hisar, as well as to the Agency for the Promotion of Agricultural Development and the Agency for Financial Support of the Agriculture and Rural Development (AFSARD), which provides education and training of young people on landscape fire management. On the other hand, the non-governmental sector (NGOs) actively participates in education and raising public awareness, organizing volunteer actions, monitoring, and reporting on the state of the environment, as well as advocating good environmental management policies.

PUBLIC AWARENESS AND EDUCATION

Public awareness and education programmes in North Macedonia must be strategically designed for specific target groups with tailored outcomes. Primary target groups include rural communities and farmers (focus on safe agricultural burning practices and alternative land management techniques), students at all educational levels (building foundational fire ecology knowledge and responsible behaviour in nature), mountaineers and outdoor recreationists (emphasizing fire prevention during wilderness activities), forest-adjacent residential populations (defensible space creation, and volunteer firefighting organizations (technical training and community leadership roles).

Desired behavioural outcomes for these programmes include measurable reduction in banned burning practices, particularly agricultural stubble burning during high-risk periods; increased reporting of deliberate fires and arsons, improved compliance with fire restrictions during critical weather conditions, and active participation in local fire prevention initiatives, such as fuel reduction projects.

Current institutional efforts, while present in annual operational plans, lack coordination and systematic evaluation of effectiveness. A functional education system requires standardized curricula adapted to each target group, regular assessment of behavioural change indicators, integration of landscape fire management into formal education systems, and sustained public campaigns using diverse media channels. These educational priorities directly inform the action plan’s capacity-building measures, which detail specific training programmes, resource development, and implementation timelines.

RESEARCH RELATED TO LANDSCAPE FIRE MANAGEMENT

Research serves as a foundation for advancing the science, technology, and practices of landscape fire management. Interdisciplinary research initiatives explore diverse aspects of fire behaviour, ecological impacts, and socio-economic dynamics, informing evidence-based approaches to prevention, preparedness, suppression, and land management. After defining the factual situation, a lack of collaboration between scientists, practitioners, and policymakers that facilitates the implementation of research findings into action plans for improving community resilience, ecological restoration, and adaptive management of fire-vulnerable landscapes has been identified in the Republic of North Macedonia.

Priority research fields must be strategically defined to address North Macedonia’s most pressing landscape fire management challenges. First, fire behaviour and risk modelling research should focus on developing predictive models that incorporate local topography, fuel types, and weather patterns in the early

warning system. Second, post-fire ecosystem recovery studies are essential to understand regeneration patterns in forests, grasslands, and agricultural mosaics, and restoration plans and adaptive land management practices. Third, socio-economic research must investigate the drivers of human-caused ignitions, economic impacts of fires on rural livelihoods, and cost-benefit analyses of prevention investments versus suppression expenditures. Additionally, interdisciplinary research on landscape fuel management should evaluate the effectiveness of prescribed burning, mechanical treatments, and integrated grazing strategies within North Macedonia's mosaic landscapes. Research on climate change impacts must project future fire regimes under various scenarios, enabling proactive adaptation of management strategies and infrastructure planning.

These research priorities directly align with action plan initiatives for establishing monitoring networks, developing decision-support tools, and implementing pilot projects that translate scientific findings into operational practice. Success requires institutional mechanisms for science-policy interface, including regular research-practitioner forums, dedicated funding streams for applied fire research, and formal protocols for integrating new evidence into management guidelines and training programmes.

CROSS-SECTORAL AND INSTITUTIONAL COLLABORATION

Cross-sectoral and institutional collaboration forms the operational backbone of effective landscape fire management in North Macedonia, requiring formalized mechanisms beyond general coordination principles. Currently, the system lacks the structural integration necessary for seamless cooperation among diverse stakeholders.

The Crisis Management Centre (CMC) serves as the primary coordinating body during crisis (in this case landscape fires), operating through its National Operational Centre which facilitates real-time information exchange between the Directorate for Protection and Rescue (DPR), Ministry of Agriculture, Forestry and Water Economy (MAFWE), Public Enterprise National Forests (PENF), Management Authorities of National Parks and all other stakeholders part of the Landscape Fire Management system. During the fire season (March – October), coordination meetings convene representatives from these institutions to review fire danger ratings, resource deployment and allocation status, and incident reports. Inter-ministerial working groups have been established for specific landscape fire management components and the Technical Working Group on Fire Prevention (within MAFWE) meets quarterly to harmonize forest and other land management activities across forest and agricultural lands, the Macedonian Forest Fire Information System (hosted by CMC) updates the fire weather index and reporting protocols, and the Post-Fire Assessment Team (comprising forestry experts in PENF) evaluates damages and restoration priorities following significant fire events.

Data sharing is facilitated through the Macedonian Forest Fire Information System (MKFFIS), which integrates meteorological data from the Hydrometeorological Service; forest inventory data from PENF; land use information from the Agency for Real Estate Cadastre; and incident reports from municipal fire brigades. However, significant gaps remain in standardized data formats and real-time accessibility across institutions. Municipal-to-central coordination operates through Regional Fire Coordination Centres in all municipalities, which serve as intermediaries between local governments and national authorities. Municipalities are involved through local prevention campaigns, and maintenance of firebreaks, but capacity varies, dramatically from well-equipped urban municipalities to under-resourced rural areas with limited firefighting personnel and equipment. Joint exercises and training programmes are conducted annually, including the CMC, DPR, PENF, Army units, Forest police, and others which test cross-sectoral and institutional response protocols. National-level table-top exercises simulate multi-jurisdictional fire scenarios requiring coordination among forestry, agriculture, environment, health (for smoke exposure), and tourism sectors.

Despite these mechanisms, persistent challenges include failure to comply with standard operating procedures during major incidents involving multiple jurisdictions; inadequate budget allocation at the municipal level for prevention activities; limited technical capacity in smaller municipalities and forest management units for implementing fuel management; and insufficient formalization of cooperation protocols with non-governmental stakeholders, particularly rural communities and private landowners who manage significant fire-prone areas.

Strengthening the collaborative framework through LFM approach requires legally mandating inter-institutional coordination structures with defined decision-making authority, establishing dedicated budget lines for municipal fire prevention programmes with performance-based allocation, creating regional landscape fire management councils that include local government, community representatives, and land management agencies, implementing standardized training curricula across all stakeholder institutions, and finally formalizing partnerships with research institutions to ensure science-policy integration in management decisions.

2. LANDSCAPE FIRE MANAGEMENT AND THE ENVIRONMENT

a. PROTECTIVE ROLE OF THE LANDSCAPE

The protective role of landscapes is very important, primarily due to the maintenance of ecological balance and environmental sustainability. Landscapes have an important protective role through their ability to provide stable ecosystems and natural habitats for diverse species. Landscapes are an integral part of nature and play a key role in the protection of biodiversity. Through the rich biodiversity in North Macedonia, landscapes offer protection through their various physical and biological characteristics. Forest ecosystems are not only home to a large number of animals and plants, and microorganisms, but also function and have a role as natural air purifiers and climate regulation. Also, the hilly and mountainous landscapes that are found in most of the country play an important role in water retention and quality, as well as preventing soil erosion and the consequences that occur.

b. PRESERVATION OF BIODIVERSITY

Biodiversity is the foundation of healthy ecosystems, providing resilience to environmental disturbances and supporting essential ecosystem functions. Landscape fire management plays a key role in conserving biodiversity by maintaining habitat diversity, species richness and genetic variability. By incorporating biodiversity conservation objectives into fire management strategies, we aim to minimize the negative impacts of fire on vulnerable species and ecosystems. Conserving biodiversity not only supports ecosystem resilience, but also provides numerous benefits to society, including enhanced ecosystem services, recreational opportunities and cultural values associated with biodiversity-rich landscapes.

North Macedonia's protected areas exemplify the critical intersection between landscape fire management and biodiversity conservation, with fire regimes directly threatening species and ecosystems of national and international significance.

National Park Pelister harbours the endemic Macedonian Pine (*Pinus peuce*, (Macedonian -molika), a relic tertiary species found in only five Balkan mountain ranges. This slow-growing, fire-sensitive species requires specific landscape fire management strategies as intense fires can eliminate centuries-old stands that serve as genetic reservoirs. Fire management in Pelister must balance the removal of accumulated fuel loads through controlled interventions while preventing catastrophic fires that would destroy irreplaceable pine forests. The park's management plan integrates fuel reduction in mixed forests surrounding pure pine stands, creating protective buffers that reduce fire intensity if ignition occurs.

National Park Galichica, positioned between Lakes Ohrid and Prespa, contains over 30 endemic plant species, including several *Centaurea*, *Alchemilla*, and *Campanula* taxa restricted to specific rock outcrops and alpine meadows. Fire management here addresses the dual challenge of preventing fires in drought-stressed Mediterranean vegetation at lower elevations while maintaining traditional grazing patterns that historically limited fuel accumulation in alpine zones. Uncontrolled fires threaten not only endemic flora but also communities essential for these plants' reproduction.

Shar Planina National Park provides critical habitat for the Balkan Lynx (*Lynx lynx balcanicus*), one of Europe's most endangered large carnivores with an estimated population of fewer than 50 individuals. Landscape fires affect lynx populations indirectly by destroying prey habitat (particularly areas supporting roe deer and chamois), fragmenting movement corridors, and forcing displacement during fire events. Fire management strategies must maintain the mosaic of forest cover, shrubland, and meadows that support diverse prey communities while ensuring connectivity between habitat patches across the transboundary landscape shared with Kosovo and Albania.

The Prespa wetlands, including the wet meadows and riparian zones surrounding Lake Prespa, support internationally important populations of the Dalmatian Pelican (*Pelecanus crispus*) and numerous wetland-dependent species. While wetlands themselves resist fire, surrounding agricultural lands and reed beds are highly vulnerable to late-summer fires that destroy nesting habitat, reduce food availability, and degrade water quality through ash and sediment runoff. Integrated landscape fire management in Prespa requires coordination between wetland conservation authorities, agricultural communities practicing traditional land use, and cross-border cooperation with Albania and Greece, given the transboundary nature of the ecosystem.

These examples demonstrate that effective landscape fire management in North Macedonia must be tailored to specific conservation targets, incorporating ecological fire thresholds, species life-history traits, and habitat requirements into prevention, suppression, and post-fire restoration strategies. This necessitates close collaboration between the national parks' management authorities, the Ministry of Environment and Physical Planning, research institutions monitoring threatened species, and international conservation organizations supporting Balkan biodiversity conservation.

c. LANDSCAPE FIRE MANAGEMENT AND CLIMATE CHANGE

Climate change is fundamentally altering fire dynamics in North Macedonia, posing significant challenges that require adaptive landscape fire management aligned with international climate frameworks and national commitments.

The North Macedonia's landscape fire management strategy must align with its obligations under key international climate agreements and mechanisms. The country is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, committing to limit global temperature rise and enhance adaptive capacity. North Macedonia's Nationally Determined Contributions (NDCs), most recently updated in 2021, include commitments to reduce greenhouse gas emissions by 51% by 2030 compared to 1990 levels, with specific attention to the forestry sector both as a carbon sink and source of emissions through fires and degradation.

The Intergovernmental Panel on Climate Change (IPCC) assessments project significant changes for the Mediterranean and Balkan regions, including increased temperatures (2-3°C by 2050 under moderate scenarios), reduced summer precipitation (15-25% reduction), and extended drought periods—all conditions that dramatically increase fire risk. North Macedonia's participation in UNFCCC Conferences of the Parties (COP) has reinforced the need to integrate climate adaptation into sector-specific strategies, with landscape fire management recognized as both a climate mitigation tool (through preserving carbon stocks in forests and soils) and an adaptation priority (reducing vulnerability to climate-driven fire regimes).

The country has developed a National Adaptation Plan (NAP) process, which identifies forestry and natural ecosystems as priority sectors vulnerable to climate change impacts. The draft NAP includes spe-

cific measures related to fire risk reduction, ecosystem-based adaptation approaches, and early warning system enhancements. Additionally, North Macedonia submitted a National Adaptation Programme of Action (NAPA) framework that recognizes landscape fires as a growing climate-related hazard requiring urgent attention and investment.

Observed climate trends already demonstrate measurable impacts on fire regimes. Between 2000 and 2023, the fire season extended by approximately 30-45 days, with fire danger periods now beginning in early May rather than mid-June and extending into late October. The Fire Weather Index (FWI), calculated by the MKFFIS based on the data from the Hydrometeorological Service, shows that “extreme” fire danger days have increased from an average of 8-12 days per season (1990-2010) to 18-25 days per season (2010-2023). The 2024 fire season exemplified climate-driven fire intensity, with over 96,000 hectares burned during extreme heat and drought conditions—approximately nine times more than the decadal average of 9,870 ha.

Climate models project further intensification: by 2050, “very high” to “extreme” fire danger conditions are expected to occur 40-60 days per season under RCP4.5 scenarios, with overnight humidity recovery periods shortening, reducing opportunities for fire suppression. Rising temperatures combined with altered precipitation patterns are shifting vegetation distributions, with thermophilic species expanding into higher elevations and increasing fuel connectivity across previously fragmented landscapes.

3. LANDSCAPE FIRE MANAGEMENT AND SOCIO-ECONOMIC ASPECTS

a. CONTRIBUTION OF LANDSCAPE FIRE MANAGEMENT TO RURAL DEVELOPMENT, POVERTY REDUCTION, LOCAL COMMUNITIES' WELL-BEING AND LIVELIHOODS

Since the last census in 2021, there has been an estimated population of 1,836,713 people, which is a slight decrease compared to the 2002 census where population was 2,022,547 people. However, the rate of population growth has been decreasing in recent years due to factors such as emigration and aging population, especially in the rural areas. However, a significant issue is the concentration of the population or distribution disparity in a few large cities, with approximately 30% of the country's population living in Skopje. This is one of the major demographic challenges (LFM Country report of Macedonia, 2024). Villages in fire-prone areas and mountainous municipalities have lost the capacity to maintain traditional landscape fire management practices, firebreak maintenance, and vigilant fire monitoring during critical periods. Overall, the historical review suggests a gradual decrease in the rural population and a significant increase in the urban population of North Macedonia over the past decades. This trend reflects the global pattern of urbanization, as populations shift from rural areas to urban centres in pursuit of economic opportunity, education, and healthcare, and it significantly fuels the landscape fire crisis. In accordance with the "Strategy for Balanced Development 2020-2030 Report for North Macedonia, approximately 180,000-220,000 hectares of agricultural land have been abandoned since 1990, primarily in hilly regions. This abandoned land undergoes succession to dense shrubland dominated by highly flammable species (*Paliurus spina-christi*, *Juniperus oxycedrus*, *Carpinus orientalis*), creating continuous fuel where cultivated fields once provided natural firebreaks. The Mariovo region exemplifies this transformation: once intensively cultivated, vast areas now consist of dense, fire-prone shrubland. Additionally, sheep populations have declined by 50-60% since 2000 (from over 1.2 million to fewer than 600,000 animals), eliminating a critical landscape fire management tool (Landscape Fire Management Report for North Macedonia, 2024). Science-based approaches show that reduced grazing results in grassland fuel accumulation in high-elevation pastures, shrub encroachment into former grazing lands, and loss of low-fuel buffers around villages that once protected settlements from fires. Areas maintaining traditional grazing show significantly lower fire occurrence and severity.

While rural areas depopulate, peri-urban zones around Skopje, Kumanovo, Bitola, Ohrid, and Strumica expand into fire-prone landscapes (Landscape Fire Management Report for North Macedonia, 2024). This includes weekend cottages in forested mountains, suburban development in oak forests and shrublands, and tourism facilities around lakes. WUI expansion creates acute challenges: structures require protection during fires, access roads complicate firefighting operations, and many residents lack fire risk awareness. Rural livelihoods depend on fire-vulnerable resources: forestry and wood products (fuelwood is still used by 60% of rural households), high-value fruit production in Prespa, Resen, and Strumica regions,

beekeeping supporting 8,000-10,000 households with colonies in fire-prone interfaces, and tourism in national parks and rural areas generating income through accommodation and traditional products.

These connections demonstrate that landscape fire management in North Macedonia must be integrated with rural development strategies addressing depopulation, land abandonment, and livelihood sustainability. The Action Plan in this Strategy contains the community engagement measures and integrated landscape management approaches that operationalize this integrated perspective through employment in fuel management programmes providing seasonal income, fire protection enhancing agricultural viability in high-value crop areas, community-based initiatives building local organizational capacity, payment for ecosystem services compensating landowners for maintaining fire-resistant landscapes, and integration with Agri-environment programmes creating financial incentives for fire risk reduction measures.

4. LINKING NATIONAL LANDSCAPE FIRE MANAGEMENT WITH THE REGIONAL AND INTERNATIONAL CONTEXT

Landscape fire management in North Macedonia is embedded within a multi-layered system of regional and international cooperation that provides critical operational support, technical capacity, and resource mobilization capabilities beyond national capacities.

a. REGIONAL COLLABORATION

Regional cooperation in landscape fire management is vital to address the common challenges posed by fires. Given the transboundary nature of these fires and their significant impacts on ecosystems, human health and economies, cooperation between countries in the region is essential. By working together, countries in the neighbourhood and the region can improve their collective capacity to prevent, manage and mitigate landscape fires. Only through jointly coordinated measures and policies can countries in the region build resilient landscapes, improve firefighting capacities and foster a sense of shared responsibility and cooperation. Key regional entities, initiatives and cooperation mechanisms include:

- REGIONAL FIRE MONITORING CENTRE (RFMC) / Regional Southeast Europe/Caucasus Wildland Network (RSECWFN)

In 2010, the Global Fire Monitoring Centre and the Council of Europe supported the establishment of the Regional Fire Monitoring Centre for the South-Eastern Europe and Caucasus region. The centre was established with a mission of capacity building and regional cooperation. The regional centre encompasses cooperation between Albania, Azerbaijan, Armenia, Bosnia and Herzegovina, Bulgaria, Croatia, Georgia, Greece, North Macedonia, Moldova, Montenegro, Romania, Serbia, Slovenia, Turkey and Ukraine.

The Regional Southeast Europe/Caucasus Wildland Fire Network (RSECWFN) has provided a longstanding framework for cooperation since 2010, facilitating knowledge exchange and capacity building across 16 countries spanning from the Balkans through the Caucasus region. This network operates in close coordination with the Regional Fire Monitoring Centre (RFMC) and the Global Fire Monitoring Centre (GFMC), which serve as technical hubs connecting North Macedonia to the broader Global Wildfire Management approach coordinated by FAO's Global Fire Management Hub. These interconnected systems enable daily fire weather data sharing, transboundary fire situation monitoring, and access to scientific expertise and global fire management resources at North Macedonia's disposal.

- LANDSCAPE FIRE MANAGEMENT IN THE WESTERN BALKAN PROGRAMME

This programme represents a collaborative effort to increase the resilience of forests and landscapes to fires in the region of Western Balkans, supporting community-based projects, capacity building, and re-

gional cooperation. The programme encompasses cooperation between Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia.

- EU MECHANISM FOR CIVIL PROTECTION

Between 2007 and 2024, almost 20% of all requests for assistance through the EU Civil Protection Mechanism were in response to landscape fires in the region. The Western Balkan countries work closely with this mechanism when it comes to emergency responses to landscape fires.

b. INTERNATIONAL COLABORATION

Landscape fires are a global challenge that transcends borders and affects ecosystems, people and communities around the world. As the frequency and intensity of fires continue to increase due to climate change and other factors, international cooperation in landscape fire management becomes increasingly urgent and necessary.

International organizations play a key role in coordinating global landscape fire management efforts. These organizations include:

- European Environment Agency (EEA) – monitors and reports on the fire situation in Europe
- European Centre for Disease Prevention and Control (ECDC) – deals with the health consequences of fires
- FAO (Food and Agriculture Organization of the United Nations) – develops global strategies for forest fire management and capacity-building programmes
- GFMC (Global Fire Monitoring Centre) – provides scientific support and coordination
- JRC – Joint Research Centre
- OECD (Organization for Economic Co-operation and Development) – develops policies and guidelines for risk management
- OSCE (Organization for Security and Cooperation in Europe) – promotes regional cooperation in natural disaster management
- UNDP (United Nations Development Programme) – supports projects for disaster risk reduction and climate adaptation
- UNDRR (United Nations Office for Disaster Risk Reduction) – coordinates global efforts to reduce the risk of natural disasters
- UNEP (United Nations Environment Programme) – focuses on the environmental aspects of fire management
- WMO (World Meteorological Organization) – provides meteorological data and early warning systems
- WHO (World Health Organization) – addresses health implications of fires and smoke

These organizations provide platforms for knowledge exchange, resource coordination, technical assistance, financial support, and implementation of strategies for prevention, mitigation, and response to landscape fires.

International cooperation involves collective efforts of countries and organizations from different regions to address the complex challenges posed by landscape fires, share knowledge and resources, and implement coordinated strategies.

5. TRANSFORMING THE STRATEGY FOR ADAPTIVE LANDSCAPE AND LANDSCAPE FIRE MANAGEMENT INTO ACTION

a. STRATEGIC PLANNING

Through this strategic document and the fulfilment of the strategic principles listed below, the Government of the Republic of North Macedonia will ensure the development and harmonization of the overall legal framework necessary for the implementation of the Strategy for Adaptive Landscape and Landscape Fire Management in North Macedonia.

STRATEGIC PRINCIPLES:

- The Strategy should be aligned with national, state and regional landscape fire management plans, environmental policies, climate adaptation plans and community protection strategies;
- The main principles for transforming goals into action are ensuring accountability, influence, and support in the implementation process by each member of the National Landscape Fire Management Network;
- Activities, responsibilities and deadlines should be clearly defined, which will enable monitoring of the implementation of the strategic plan and precise determination of responsibility;
- Provision of indicators for monitoring and assessing performance and progress towards meeting the objectives of the Strategy, i.e. the implementation of the Action Plan should be continuous monitored. The Action Plan should be based on appropriate data and realistically reflected goals, resources and expected results, considering the human potential, overall fiscal frameworks and budget changes that ensure the implementation of the plan.
- The Action Plan should be transparent, so as to provide comprehensive information on the implementation of the Government's priorities.

STEPS:

- I. A precisely defined mechanism for adopting and implementing measures from the strategy and fulfilling actions and measures from the Action Plan of the Strategy for Adaptive Landscape and Landscape Fire Management in North Macedonia;
- II. Defining a mandated institution to oversee the entire process of fulfilling the defined objectives of the Strategy;
- V. Formation of inter-ministerial working groups whose task will be to harmonize the objectives, measures and activities of the Strategy for Adaptive Landscape and Landscape Fire Management,

as well as defining monitoring procedures to ensure regular monitoring and review of the achievement of the results of the strategy;

- VI. Defining the objectives and desired results of the Strategy in order to examine all possibilities (actions) for resolution. Analysis of the actions – namely, the consequences if no intervention is made, as well as the positive and negative impacts of the intervention – forms the basis for choosing the most favourable solution (action).
- X. In order to analyse and calculate the fiscal impacts of the implementation of the Strategy, in accordance with the definition of the necessary financial resources for its implementation, Human Resources, spatial accommodation, technology, materials, etc. should be considered.
- XII. After defining the infrastructure, proceed to prepare a Plan for the implementation of the goals set by the Strategy with clearly defined activities, responsibilities, deadlines and indicators of success.
- XIII. The defined responsibilities and deadlines of all stakeholders established in the Strategy Implementation Plan – covering programmes, sub-programmes and projects – require ministries and state administration bodies to foresee and allocate financial resources, by sources of financing and dynamics for their provision, as well as the human resources needed for implementing the goals of the Strategy.
- XXII. Determining indicators and a method of collecting data for those indicators, which clearly show whether the expected results and the implementation dynamics of the Strategy are being achieved.

b. COORDINATION AND COLLABORATION (LIST OF DOCUMENTS THAT SHOULD CONTAIN THE LANDSCAPE FIRE MANAGEMENT PRINCIPLES)

The harmonization of the Strategy for Adaptive Landscape and Landscape Fire Management requires integration with various strategic documents related to environmental management, protection and rescue, land management, and sectoral development. The following strategic documents need to be harmonized with landscape fire management principles in North Macedonia:

LIST OF DOCUMENTS:

- **Spatial Plan of the Republic of Macedonia (2002-2020):** Establishes land use zoning and development restrictions that directly influence fire risk patterns; harmonization ensures fire-prone areas are identified in spatial planning and appropriate land use restrictions are applied in high-risk zones.
- **Strategy for Sustainable Development of Forestry (2006-2026):** Defines forest management practices including silvicultural treatments, harvesting methods, and reforestation approaches that determine fuel loads and forest flammability; integration ensures fire risk reduction becomes a core objective in forest management planning.
- **National Strategy for Nature Protection (2017-2027):** Governs protected area management where fire suppression must balance ecological integrity with biodiversity conservation; harmonization enables development of fire management approaches tailored to conservation objectives in national parks and nature reserves.
- **National Strategy for Protection and Rescue (2014-2018):** Establishes the overall civil protection framework including emergency response structures, resource allocation, and inter-agency coordi-

nation; integration ensures landscape fire management aligns with broader disaster risk reduction priorities and operational protocols.

- **Threat Assessment of Natural Disasters and Other Accidents:** Provides risk assessment methodology and hazard mapping that should incorporate landscape fire vulnerability analysis, ensuring fire risk is appropriately weighted in national risk profiling and resource allocation decisions.
- **National Plan for Protection and Rescue from Natural Disasters and Other Accidents:** Operationalizes emergency response procedures, mutual assistance mechanisms, and resource deployment protocols that directly govern firefighting operations and inter-institutional coordination during fire events.
- **Strategic Plan of the Crisis Management Centre (2024-2026):** Defines operational priorities, capacity development, and system upgrades for the national emergency coordination body; integration ensures landscape fire management receives appropriate priority in CMC's planning and resource allocation.
- **National Strategy for Biodiversity with Action Plan (2018-2023):** Identifies threatened species and habitats requiring protection from fire impacts; harmonization enables targeted fire management in areas supporting priority biodiversity, balancing suppression with ecological fire regimes where appropriate.
- **Strategy for Environment and Climate Change (2014-2020):** Establishes climate adaptation priorities and greenhouse gas reduction targets; integration positions landscape fire management as both a climate adaptation measure (reducing vulnerability) and mitigation tool (preventing carbon emissions from fires).
- **National Action Plan for Combating Deforestation (2017-2023):** Addresses forest degradation drivers including fire; harmonization ensures fire prevention measures align with anti-deforestation efforts, and post-fire restoration supports reforestation objectives.
- **National Water Strategy (2012-2022):** Manages water resources essential for firefighting operations and addresses watershed protection from fire-induced erosion and water quality degradation; integration ensures water infrastructure planning considers firefighting water supply requirements.
- **Waste Management Strategy (2008-2020):** Regulates waste disposal including agricultural residues that, when burned improperly, cause numerous landscape fires; harmonization restricts open burning practices and promotes alternative waste management reducing ignition sources.
- **National Programme for Development of Agriculture and Rural Development (2013-2017):** Shapes agricultural practices including stubble burning, grazing management, and land abandonment patterns that fundamentally influence fuel loads; integration embeds fire risk reduction in agricultural support programmes and rural development initiatives.
- **Plan for Management of Waste from Electrical and Electronic Equipment (2013-2020):** Addresses hazardous waste that can ignite fires when improperly disposed of in rural areas; harmonization reduces ignition risks from illegal dumping in fire-prone landscapes.
- **National Strategy for Sustainable Development (2009-2030):** Provides an overarching sustainability framework within which landscape fire management must operate; integration ensures fire management contributes to broader sustainability goals including ecosystem resilience and community well-being.
- **Third National Communication/Climate Change Plan (2014):** Reports climate change impacts and adaptation needs under UNFCCC commitments; harmonization ensures landscape fire management is recognized in national climate reporting and attracts climate finance.

- **Communication Strategy and Action Plan on Climate Change (2013):** Governs climate-related public communication; integration enables coordinated messaging linking fire risk to climate change and promoting climate-adaptive behaviours.
- **Programme for Gradual Reduction of Emissions of Certain Pollutants (2012):** Addresses air quality including smoke pollution from fires; harmonization supports fire prevention as an air quality improvement measure and informs smoke management protocols during fire events.
- **National Action Plan for Strategic Management of Chemicals (2010):** Regulates hazardous materials that can increase fire intensity or create toxic smoke; integration ensures chemical storage facilities in fire-prone areas meet fire safety standards.
- **Strategy for Development of Energy (2008-2020, being updated):** Governs energy infrastructure including power lines that frequently ignite fires, and biomass energy that can utilize fuel reduction residues; harmonization addresses infrastructure fire risks and creates markets for fuel management by-products.
- **Strategy for Use of Renewable Energy Sources (until 2020):** Promotes biomass energy that can utilize fuel reduction materials; integration creates economic incentives for landscape fuel management by establishing markets for removed vegetation.
- **Strategy for Improvement of Energy Efficiency (until 2020):** Encourages energy-efficient heating reducing fuelwood demand that drives some forest fires; harmonization supports transition away from fire-prone energy sources.
- **National Transport Strategy (2007-2017):** Plans road and rail infrastructure that can ignite fires (vehicle sparks, discarded cigarettes) but also provides firefighting access; integration ensures transport planning considers both fire risk mitigation and emergency access requirements.
- **National Strategy for Development of Tourism (2016-2021):** Promotes tourism in fire-prone natural areas; harmonization requires fire safety standards for tourism facilities, visitor education programmes, and tourism planning that avoids high-risk zones during critical fire weather.
- **National Strategy for Rural Tourism (2012-2017):** Develops rural tourism that depends on landscape aesthetics vulnerable to fire; integration protects tourism assets through fire prevention while engaging tourism operators in fire management efforts.
- **Strategy for Regional Development (2009-2019):** Allocates regional development resources that can support fire management capacity building; harmonization directs development investments toward fire-vulnerable regions and embeds fire risk reduction in regional planning.
- **Strategy and Action Plan for Protection of Biological Diversity:** Protects biodiversity threatened by fire; harmonization ensures fire management approaches preserve habitat quality for threatened species while managing fire as an ecological process where appropriate.
- **Strategy for Development of Greenery in City of Skopje (2024-2034):** Manages urban and peri-urban vegetation including fire-prone wildland-urban interface areas; integration requires fire-resistant species selection, fuel management in urban forests, and coordination between urban planning and fire management authorities.

This comprehensive harmonization ensures landscape fire management principles permeate all relevant policy domains, creating an integrated governance framework where fire risk reduction, ecosystem protection, rural development, and climate adaptation objectives mutually reinforce rather than conflict with each other.

6. STRATEGY VISION, GOALS, AND OBJECTIVES

a. VISION

Based on the principles of adaptability, collaboration and sustainability, this Strategy aims to transform the way landscape fires are managed in the Republic of North Macedonia, emphasizing preventive measures as the foundation of effective landscape fire management. Prevention is a key pillar of landscape fire management, including proactive strategies for risk reduction, improving ecosystem resilience, and community preparedness. This strategic document seeks to reduce the destructive impacts of fires through a combination of integrated science-based management practices, active community engagement, and informed decision-making at key moments.

**CREATING A SUSTAINABLE AND RESILIENT ENVIRONMENT
IN WHICH THE RISK OF FIRE IS MINIMIZED, ECOSYSTEMS ARE
STRENGTHENED, AND THE WELL-BEING OF COMMUNITIES IS
ENSURED THROUGH ADAPTIVE AND INTEGRATED MANAGEMENT.**

b. GENERAL OBJECTIVES OF THE STRATEGY FOR ADAPTIVE LANDSCAPE AND LANDSCAPE FIRES MANAGEMENT IN NORTH MACEDONIA

General objectives of the landscape fire management are:

- I. Improvement and harmonization of the legal and institutional framework for landscape fire management
- II. Increasing public awareness, science-based principles, education, and community participation
- III. Encouragement of measures through adaptive landscape management
- V. Strengthening institutional capacities and establishing an efficient landscape fire management system
- VI. Adaptive management and climate resilient landscapes
- VII. Strengthening regional/international cooperation and knowledge exchange
- VIII. Post-fire landscape management, rehabilitation, and restoration

7. ACTION PLAN

The Strategy and Action Plan for Adaptive Landscape and Landscape Fire Management in North Macedonia are based on the results of several documents obtained as a result of the work of the National Network for Landscape Fire Management in North Macedonia, established through the Landscape Fire Management Programme in the Western Balkans. The key documents on which this Strategy is based are the following documents:

- National Report on Landscape Fire Management in North Macedonia, together with recommendations for improvement, and
- Gap Analysis of Landscape Fire Management in North Macedonia.

In order to prepare this strategic document with an action plan for implementation, a series of workshops, group and individual meetings were held with all relevant institutions, non-governmental organizations and individuals.

The Action Plan for Adaptive Landscape and Landscape Fire Management includes defined actions that should be implemented in order to fulfil the goals set with the Strategy. The actions are defined in several measures and activities that arise from previously defined goals (specific and general) based on which the State should be guided in implementing landscape protection from fires through adaptive landscape management and fire management.

This Action Plan defines the following basic determinations:

1. Public awareness and education
2. Institutional strengthening
3. Research and monitoring
4. Land management
5. Legislation
6. Financial sources for the implementation of the Strategy
7. Coordination and implementation of the Strategy

Each of the determinations has its own measures and activities for implementation, which describe the detailed activities for its implementation and achievement of the desired goal. The section intended for activities sets out the dynamics of the implementation process by year, responsibilities for each measure depending on the competent institutions, as well as indicators/indicators of the implemented measures and activities. In addition to the defined commitments with detailed measures, this Action Plan also contains the necessary financial resources for the implementation of the Strategy.

ACTION PLAN

Table: Action plan for adaptive landscape management and landscape fire management in North Macedonia

No.	ACTIVITIES	PERIOD (YEAR)	RESPONSIBLE INSTITUTIONS	INCLUDED PARTNERS	BUDGET
1.	GG 1 Improvement and harmonization of the legal and institutional framework for landscape fire management				
1.1.	Review and harmonization of existing legislation (forests, agricultural land, environment, civil protection, crisis management law, etc.) on landscape fire management	1 – 3 years	Assembly of NMK and MAFWE	DPR, CMC, MoEPP, PEP	250,000 EUR
1.2.	Development of a mechanism for advanced inter-institutional and inter-sectoral cooperation and communication based on existing laws and by-laws	1 – 3 years	MAFWE	MoEPP, NPs, DPR, CMC, MoD, Mol, PENF, PEP, UHMR.	40,000 EUR
1.3.	Increasing the technical capacity and legal authority (competence) of the guard services and forest police to conduct field inspections and interventions	1 – 3 years	Assembly of NMK and MAFWE	MAFWE, MoEPP, NPs, PENF, and FP	500,000 EUR
1.4.	Development of legal regulations regarding the use of fire, including clear regulations on mechanisms for permitting controlled burning	1 – 3 years	Assembly of NMK and MAFWE	MAFWE, MoEPP, NPs, PENF, and FP	40,000 EUR
1.5.	Create a comprehensive national policy for landscape fire management	1 – 3 years	Assembly of NMK	Academic Community	30,000 EUR
2.	GG 2 Increasing public awareness, science-based principles, education, and community participation				
2.1.	Creating LFM-focused modules for primary and secondary schools	Continuity	MoE	MoLSG, MAFWE, MoEPP, NPs, PENF, FACULTIES	150,000 EUR
2.2.	Education and raising public awareness of the local population on landscape fire management	1 – 3 years	MAFWE	MoLSG, Mol, PENF, PEP, MoEPP, NPs, Rural Development Network of NMK, AFSARD, and APAD	90,000 EUR
2.3.	Target campaigns informing all population groups about the risks of fire use	1 – 3 years	MAFWE in close collaboration with AFSARD	MoLSG, Mol, PENF, MoEPP, NPs, Rural Development Network of NMK and APAD	250,000 EUR
2.4.	Development of a structured mechanism for ongoing knowledge sharing, study exchanges, and the dissemination of innovative practices and methodologies related to LFM between all members of the LFM Network	3 – 5 years	Government of the NMK	MAFWE, MoEPP, NPs, PENF, PEP, and FP	75,000 EUR
2.5.	Holding continuous scientific Regional/Planning region workshops at the municipal level with all LFM responsible and relevant stakeholders	1 – 3 years	MoE	Supported by the faculties and all educational & research institutions, bodies, and members of the LFM Network in North Macedonia	60,000 EUR/Year
2.6.	Establishment of a National Platform as a central digital repository for lessons learned, case studies, and fire behaviour data to support evidence-based management	1 – 3 years	Government of the NMK	DPR, MAFWE, PENF, PEP, NPs, LSG, FP, APAD, UHMR and CMC	80,000 EUR

2.7.	Introduction of financial and technical support and development programmes for the promotion of scientific journals, books, and scientifically based reports on fire management.	3 – 5 years	Government in close collaboration with MoE	MoE, MAFWE, faculties, AFSARD, APAD and MoEPP	55,000 EUR/Year
2.8.	Risk Perception Assessment: Survey various socio-economic groups to understand how communities perceive risk and accept fire impacts	1 – 2 years	Agency for the financial support of agriculture and rural development (AFSARD)	Scientific community, NGOs, Rural Development Network of NMK (RDNNMK) and APAD	80,000 EUR
3. GG 3 Encouragement of measures through adaptive landscape management					
3.1.	Implementation of silvicultural, agricultural land, shrublands, and meadows management measures to reduce the risk of fires	3 – 5 years	MAFWE	PENF, PEP, NPs, MoEPP	1,000,000 EUR/Year
3.2.	Mapping landscape fire vulnerable areas (Fire Susceptibility Map of North Macedonia)	1 – 3 years	MoD in close collaboration with UHMR	DPR, LSG, MAFWE, CMC, MoEPP, PEP, PENF, UHMR, and NPs	145,000 EUR
3.3.	Establishment of a local, regional, and national network of water facilities, small dams, and water accumulation basins in remote areas to decrease response times and reduce reliance on aviation	3 – 5 years	MoD together with MoLSG	LSG, DPR, MAFWE, NPs, MoEPP, PEP, and PENF	5,000,000 EUR
3.4.	Improvement of forest, pasture, and agricultural road infrastructure, permanent maintenance, and management	3 – 5 years	MAFWE	PENF, PEP, DPR, LSG, NP, AFSARD MoD, and Mol	2,500,000 EUR
3.5.	Support and promotion of the establishment of Local Action Groups (LAGs) for improved regional cooperation between municipalities	1 – 3 years	Rural development network in close collaboration with MAFWE	MoLSG, LSG, PENF, NPs, and AFSARD	50,000 EUR
3.6.	Silvo-pastoral grazing Schemes: Establish result-based payment schemes for livestock owners to maintain fuel-free buffers in high-risk zones.	2 – 5 years	MAFWE in close collaboration with PEP	Farmers' associations, AFSARD, and Agricultural national networks	400,000 EUR
3.7.	Plant native, fire-resistant broadleaf species near key infrastructure	3 – 5 years	MoEPP	MAFWE, PENF, PEP, MoLSG, NGOs.	600,000 EUR
4. GG 4 Strengthening institutional capacities and establishing an efficient fire management system					
4.1.	Establishing a centralized National training centre for the professional training of fire units, VFSs, and land managers in advanced LFM tactics	3 – 5 years	Government of the NMK	PENF, DPR, LSG, TFFUs, and MAFWE	1,500,000 EUR
4.2.	Building the capacities of fire services and strengthening voluntary firefighting societies (VFS).	3 – 5 years	Government in collaboration with the MoD	DPR, LSG, CMC, TFFUs, and VFSs	600,000 EUR
4.3.	Integration of AI-driven early detection and a new information module into the existing MKFFIS platform	1 – 3 years	MoD	CMC, DPR, MAFWE, and Mol	450,000 EUR

4.4.	Assessment of current needs for improved aviation and advancement of the development of the fire protection air force	3 – 5 years	Government in collaboration with the MoD	DPR	500,000 EUR/Year
4.5.	Coordinate joint inspections across environment, forestry, agriculture, and water management for required LFM preventive and preparatory actions by all institutions in the system	1 – 3 years	MAFWE in collaboration with MoEPP	SIFH, SIA and, SIE	65,000 EUR/Year
4.6.	Development of a comprehensive National Early Warning and Alert System designed to effectively notify all at-risk communities	1 – 3 years	Government in collaboration with the MoD	DPR, CMC, TELE-COMMUNICATIONS	800,000 EUR
4.7.	Flexible Operational Readiness: Shift readiness protocols from a set calendar to a foreseeable necessity model based on fire-danger projections	Continuity	CMC	DPR, Mol, MoD	40,000 EUR/Yearly
4.8.	Establishment of a long-term LFM education programme for all stakeholder institutions in the LFM in North Macedonia	Continuity	Government of NMK	All members of the LFM National network and stakeholders involved into the LFM	120,000 EUR/year
5. GG 5 Fuel management mechanisms, stubble burning alternatives, and agricultural modernization					
5.1.	Development of a National Management Plan for Combustible Materials	2 – 3 years	MAFWE in collaboration with MoEPP	PENF, NPs, PEP, FACULTIES	90,000 EUR
5.2.	Planning and execution of fire & fuelbreaks, and their continuous, permanent maintenance	3 – 5 years	MAFWE	PENF, PEP, NPs, LSG, DPR	800,000 EUR/Year
5.3.	Implementation of fuel management activities around agricultural lands, pastures, abandoned rural and natural lands, shrublands, meadows, etc	3 – 5 years	MAFWE	PENF, PEP, NPs, MoEPP	750,000 EUR/Year
5.4.	Establishing certification programmes for prescribed burning	3 – 5 years	DPR	FFUM and MAFWE	150,000 EUR/Year
5.5.	Implementation of multi-method fuel management projects that integrate mechanical clearing with controlled grazing and prescribed burning	5 – 10 years	MAFWE	MoEPP, PENF, NPs, PEP, DPR, and SIFH	2,000,000 EUR/Year
5.6.	Promotion of sustainable agricultural practices as an alternative to burning agricultural land	2 – 3 years	MAFWE	PENF, NPs, PEP, faculties, and research institutions	300,000 EUR
5.7.	Development of vegetation management guidelines that reduce the vulnerability of structures, settlements, and encourage or require the use of defensible buffer space	1 – 3 years	SCIENTIFIC INSTITUTIONS	MAFWE, MoEPP, PENF, and PEP	80,000 EUR
5.8.	Biomass Collection Incentives: Endorse the provision of subsidies for agricultural equipment dedicated to biomass processing as a sustainable alternative to burning	1 – 5 years	MAFWE in close collaboration with AFSARD	IPARD Agency, farmers	1.2 M EUR

5.9.	Creation of regional composting centres for circular bioeconomy hubs by converting crop residues into organic soil fertilisers and bioenergy	3 – 5 years	MoEPP	LAGs, Chambers of Econ. AFSARD	800,000 EUR
5.10.	Establish an initiative for farmers/agricultural operations that adopt defensible space practices	2 – 4 years	MAFWE	SIFH, Rural Development Network	150,000 EUR
6. GG 6 Adaptive management and climate resilience					
6.1.	Integration of seasonal and long-term fire danger projections into national planning frameworks by developing climate change scenarios that assess threat intensity and community exposure through current data and probability models	2 – 4 years	Hydrometeorological service of NMK	MAFWE, MoEPP, NPs, DPR, and CMC	180,000 EUR
6.3.	Implementation of Nature-Based Programmes as a tool to shape resilient landscapes across the country	2 – 3 years	MoEPP in close collaboration with MAFWE	PENF, PEP, and NGOs	500,000 EUR/Year
6.4.	Development of a comprehensive system for monitoring and reporting greenhouse gas emissions resulting from landscape fires, thereby contributing to the achievement of national climate objectives	2 – 3 years	MoEPP in close collaboration with MoEMM	MAFWE, MoD, UHMR, and Mol	200,000 EUR
7. GG 7 Strengthening international cooperation and knowledge exchange					
7.1.	Strengthening cross-border cooperation through existing regional and EU Civil Protection Mechanism structures	1 – 2 years	MoFA	Mol, MAFWE, DPR, CMC, MoEPP, PENF, PEP, and NPs	45,000 EUR
7.2.	Participation in international networks for landscape fire management	Continuity	MoFA	All stakeholders included	60,000 EUR/Year
7.3.	Exchange of experts and best practices for landscape fire management with neighbouring countries	Continuity	Government of the NMK	Scientific institutions supported by DPR, MoFA, CMC, MAFWE, PENF, PEP, and MoEPP	90,000 EUR/Year
8. GG 8 Post-fire landscape management, rehabilitation, and restoration					
8.1.	Emergency response programmes regarding erosion, invasive species, and consequences through the establishment of Burned Area Emergency Response (BAER) teams	2 – 3 years	MAFWE	MoEPP, PENF, PEP, NPs, MoLSG, and LSG	350,000 EUR
8.2.	Active implementation of programmes for environmental rehabilitation and restoration of burned landscapes	2 – 3 years	MoEPP in close collaboration with MAFWE	PENF, PEP, NPs, and PEP	1,000,000 EUR/Year
8.3.	Training specialized personnel within the Mol and Forest Police to perform forensic analysis of burned sites	1 – 3 years	Mol	Public Safety Bureau, MoD, Mol, and FP	330,000 EUR
8.4.	Species Habitat Availability index: Biodiversity monitoring in burned vs unburned sites	1 – 5 years	MoEPP	PENF, PEP, NPs, and PEP	250,000 EUR
8.5.	Assisted Natural Regeneration: Emphasize natural regeneration processes rather than monoculture replanting in restoration practices	2 – 5 years	PENF	MoEPP, National Parks	500,000 EUR

MONITORING PLAN

No.	MEASUREMENT / ACTIVITY (From Action Plan)	GENERAL AND SPECIFIC OBJECTIVES, AND INDICATORS	SOURCE OF DATA COLLECTION	DATA COLLECTION DYNAMICS	INSTITUTION RESPONSIBLE FOR DATA COLLECTION	STARTING VALUE (2025)	ULTIMATE VALUE (2030)
1.0 GG 1: Improvement and Harmonization of the Legal and Institutional Framework							
1.1	Review and harmonization of existing legislation (Forests, agricultural land, environment, crisis management law, etc.) on landscape fire management	Obj: Legal coherence. Indicator: Number of legislative acts successfully harmonized with LFM principles.	Official Gazette; MAFWE Legislative Dept	Annual (Q4)	Assembly and MAFWE	0	5 key laws
1.2	Development of a mechanism for advanced inter-institutional cooperation and communication.	Obj: Seamless coordination. Indicator: Formal adoption of the Plan and "Information Delta" speed during crises.	CMC incident logs; Inter-agency audits	Annual (Q4)	MAFWE	1 meeting annually	3-5 meetings annually
1.3	Increasing the technical capacity and legal authority (competence) of the guard services and forest police to conduct field inspections and interventions	Obj: Enforcement. Indicator: % increase in field inspections and processed citations in high-risk zones.	SIFH field reports; Forest police logs	Semi-annual	MAFWE (SIFH)	Baseline (2024)	+150%
1.4	Development of legal regulations regarding the use of fire, including prescribed burning activities	Obj: Regulated fire use. Indicator: Existence of a functional permitting and practitioner certification system.	Official Gazette; MAFWE by-laws	Annual (Q4)	Assembly and MAFWE	0	1 system
1.5	Create a comprehensive national policy for landscape fire management	Obj: Policy stability. Indicator: Formal endorsement of the National Landscape Fire Policy.	Parliamentary Records; Strategic docs	Once (Year 2)	Assembly of NMK	0	1 LFM policy document
2. GG 2: Increasing Public Awareness, Education, and Community Participation							
2.1	Creating LFM-focused modules for primary and secondary schools	Obj: Fire literacy. Indicator: % of national schools integrating LFM modules into official curricula.	Ministry of Education (MoE) Reports	Annual (Q4)	MoE	0%	100%
2.2	Education and raising public awareness of the local population on landscape fire management	Obj: Behavioural change. Indicator: % reduction in human-caused ignitions (due to negligence/farming).	SSO/CMC Statistics; Post-fire analysis	Annual (Q4)	MAFWE and SSO	~90%	<50%
2.3	Establishment of Target campaigns informing all population groups about the risks of fire use	Obj: Balanced perception. Indicator: Reach and impact score of nationwide awareness campaigns.	Media monitoring; Sociological surveys	Every 2 years	MAFWE and AFSARD	N/A	High

2.4	Development of a structured mechanism for ongoing knowledge sharing, study exchanges, and the dissemination of innovative practices and methodologies related to LFM between all members of the LFM Network	Obj: Knowledge transfer. Indicator: Number of joint cross-sectoral projects or exchange missions successfully completed.	Government project reports	Annual (Q4)	Government	0	5 Projects/ Missions/ yr
2.5	Holding continuous scientific Regional/ Planning region workshops at the municipal level with all LFM stakeholders	Obj: Science-Practice interface. Indicator: Number of cross-sectoral/ cross-municipality workshops held and stakeholder attendance rate.	Workshop registries	Annual (Q4)	MAFWE/MoE	2 / yr	10 / yr
2.6	Establishment of a National Platform as a central digital repository for lessons learned, case studies, and fire behaviour data to support evidence-based management	Obj: Evidence-based mgmt. Indicator: Number of active institutional users and LFM case studies uploaded.	Platform Analytics (Web-GIS logs)	Monthly	Government/ DPR	0	>2,000 users
2.7	Introduction of financial and technical support and development programmes for the promotion of scientific journals, books, and science-based reports on landscape fire management	Obj: Academic growth. Indicator: Number of LFM-focused publications receiving national support.	MoE	Annual (Q4)	MoE	0	5 Pubs/yr
2.8	Risk Perception Assessment: Survey various socio-economic groups to understand how communities perceive risk and accept fire impacts	Obj: Targeted outreach. Indicator: "National Risk Perception Index" score (Baseline vs. Year 5 results).	SSO field surveys	Every 2 years	AFSARD and SSO	0	+40% score
3. GG 3: Encouragement of Measures through Integrated Landscape Management							
3.1	Implementation of silvicultural, agricultural land, shrublands, and meadows management measures to reduce the risk of fires	Obj: Fuel reduction. Indicator: Hectares of treated landscape.	PENF Registry; GIS audit	Annual (Q4)	MAFWE	<1,000 ha	>10,000 ha/yr
3.2	Mapping landscape fire vulnerable areas (Fire Susceptibility Map of North Macedonia).	Obj: Precision planning. Indicator: % of national territory mapped.	MKFFIS database; Technical audit	Every 2 years	MoD and UHMR	~15%	100%
3.3	Establishment of a local, regional, and national network of water facilities, small dams, and water accumulation basins in remote areas to decrease response times and reduce reliance on aviation	Obj: Decreased response time. Indicator: Number of functional water points within 5 km of high-risk forest zones.	Field inventory; MoD Logistics	Annual (Q2)	MoD and LSGs	~12 units	60 units

3.4	Improvement and maintenance of forest, pasture, and agricultural road infrastructure	Obj: Accessibility. Indicator: Kilometres of roads upgraded to heavy fire-truck standard (\$3.5 m\$ width).	MAFWE/PENF project logs	Annual (Q4)	MAFWE	Baseline (2024)	+2,000 km
3.5	Support and promotion of Local Action Groups (LAGs) for improved regional cross-municipal cooperation and coordination	Obj: Community leadership. Indicator: Number of LAGs with an active "Fire Resilience" section in their development strategy.	Rural Development Network reports	Annual (Q4)	Rural Dev Net / MAFWE	4 LAGs	12 LAGs
3.6	Silvo-pastoral grazing Schemes: Result-based payments for livestock owners for fuel-managed buffers	Obj: NbS fuel mgmt. Indicator: Hectares of strategic landscape maintained through "prescribed grazing" contracts.	PE Pastures Registry; GIS verify	Semi-annual	MAFWE and PE Pastures	0 ha	15,000ha/annually
3.7	Plant native, fire-resistant broadleaf species near key infrastructure	Obj: Resilience. Indicator: Survival rate of planted fire-resistant native species.	Field surveys; PENF monitoring	Annual (Spring)	MoEPP	0%	>85%
4. GG 4: Strengthening Institutional Capacities and Efficient Fire Management							
4.1	Establishing a centralized National training centre for the professional training of fire units, VFSs, and land managers in advanced LFM tactics	Obj: Professionalization. Indicator: Operational status of the centre and number of LFM certified personnel.	Centre training registry	Annual (Q4)	Government/ DPR	0	1 centre / 500 certified
4.2	Building fire service capacities and strengthening the Voluntary Firefighting Service (VFS).	Obj: Local resilience. Indicator: Number of functional VFS and % of call volume handled by volunteers.	LSG municipal reports; DPR	Annual (Q4)	Government / MoD	24 VFS	40 VFS
4.3	Integration of early detection and new information modules into the existing Macedonian Fire Information System platform.	Obj: Latency reduction. Indicator: Reduction in "Detection-to-Initial Attack" time in rural areas (minutes).	MKFFIS system logs; CMC audit	Quarterly	MoD	>45 min	<15 min
4.4	Assessment and advancement of the development of the fire protection air force	Obj: Aviation efficiency. Indicator: Availability rate of aviation assets during high-risk days.	DPR flight logs; Maintenance reports	Monthly (Season)	Government / MoD	60% availability	>95% availability
4.5	Coordinate joint inspections across environment, forestry, agriculture, and water management for required LFM preventive and preparatory actions by all institutions in the system	Obj: Compliance. Indicator: Number of joint inspection missions and compliance rate for fire-safety regulations.	SIFH/SIE Inspection Bulletins	Quarterly	MAFWE and MoEPP	2/quarter	10 / quarter

4.6	Development of a comprehensive National Early Warning and Alert System designed to effectively notify all at-risk communities	Obj: Public safety. Indicator: Time delta between fire-danger rating and community SMS/App alert (lead time).	CMC alert system logs	Annual (Q4)	Government / MoD	N/A	<30 min
4.7	Flexible Operational Readiness: Shift readiness protocols from a set calendar to a foreseeable necessity model based on fire-danger projections	Obj: Resource efficiency. Indicator: Correlation between fire-danger ratings and pre-positioned forces.	Seasonal performance reviews	Monthly (Season)	CMC/DPR	Low	High (>0.85)
4.8	Establishment of a long-term LFM education programme for all stakeholder institutions in the LFM in North Macedonia	Obj: Institutional memory. Indicator: % of stakeholder institutions with designated LFM focal points trained in the new programme.	Training registry; Govt reports	Annual (Q4)	Government	10%	100%
5. GG 5: Fuel Management, Stubble Burning Alternatives, and Agri Modernization							
5.1	Development of a National Management Plan of Combustible Materials	Obj: Holistic fuel mgmt. Indicator: Completion and adoption of the National Plan.	Official Gazette; MAFWE reports	Once (Year 2)	MAFWE / MoEPP	0	1 Plan
5.2	Implementation of silvicultural, agricultural land, shrublands, and meadows management measures to reduce the risk of fires	Obj: Fire containment. Indicator: Kilometres of new and maintained fuelbreaks (verified via satellite).	PENF/NPs GIS database	Annual (Q2)	MAFWE	~200 km	1,500 km
5.3	Implementation of fuel management activities around agricultural lands, pastures, abandoned rural and natural lands, shrublands, meadows, etc.	Obj: Interface protection. Indicator: Hectares of interface zones treated with mechanical or grazing methods.	MAFWE field surveys	Annual (Q4)	MAFWE	<500 ha	>5,000 ha/yr
5.4	Establishing certification programmes for prescribed burning	Obj: Technical excellence. Indicator: Number of certified prescribed burn practitioners.	DPR Certificate Register	Annual (Q4)	DPR	0	100 certified
5.5	Implementing multi-method fuel management projects that integrate mechanical clearing with controlled grazing and prescribed burning	Obj: Mosaic integration. Indicator: % of landscape area categorized as "Fire-Smart Mosaic" (Low connectivity).	Satellite imagery (Sentinel)	Every 2 years	MAFWE	~5%	25%
5.6	Promotion of sustainable agricultural practices as an alternative to stubble burning	Obj: Waste circularity. Indicator: % reduction in stubble burning alerts in pilot areas.	MKFFIS hotspot analysis	Monthly (Season)	MAFWE	Baseline (2024)	50% reduction

5.7	Development of vegetation management guidelines that reduce the vulnerability of structures, settlements, and encourage or require the use of defensible buffer space	Obj: Defensible space. Indicator: Number of municipalities adopting MoLSG registry "Defensible Space" by-laws.	MoLSG registry	Annual (Q4)	Scientific Inst.	0	30 municipalities
5.8	Biomass Collection Incentives: Endorse the provision of subsidies for agricultural equipment dedicated to biomass processing as a sustainable alternative to burning	Obj: Bioeconomy. Indicator: Value of IPARD funds disbursed for biomass-to-energy/compost equipment.	AFSARD (IPARD) reports	Quarterly	MAFWE / AFSARD	0 EUR	1.2M EUR
5.9	Creation of regional composting centres for circular bioeconomy hubs by converting crop residues into organic soil fertilisers and bioenergy	Obj: Resource valuation. Indicator: Tons of agricultural biomass diverted from burning to composting/bioenergy.	LSG waste reports	Annual (Q4)	MoEPP	0 tons	180k tons/yr
5.10	Establish an initiative for farmers/agricultural operations that adopt defensible space practices.	Obj: Private land mgmt. Indicator: Number of farms permanently holding defensible space.	MAFWE Rural Dev. Registry	Annual (Q4)	MAFWE	~	500 farms/private land-owners
6. GG 6: Adaptive Management and Climate Resilience							
6.1	Integration of seasonal and long-term fire danger projections into national planning frameworks by developing climate change scenarios that assess threat intensity and community exposure through current data and probability models	Obj: Future-proofing and risk forecasting. Indicator: Number of climate scenarios integrated into Regional Spatial Plans and Publication of the "National Fire-Climate Scenarios 2050" report.	Agency for Spatial Planning audit and UHMR/ Scientific reports	Every 3 Years	UHMR	0	8 planning regions and 1 report related to fire risk scenarios.
6.3	Implementation of Nature-Based Programmes as a tool to shape resilient landscapes across the country	Obj: Ecological integrity. Indicator: Total area (ha) managed under the fire resilient landscape programme	PENF/NPs management logs	Annual (Q4)	MoEPP / MAFWE	<2%	>15% area
6.4	Development of a comprehensive system for monitoring and reporting greenhouse gas emissions resulting from landscape fires, thereby contributing to the achievement of national climate objectives.	Obj: Climate accountability. Indicator: Accuracy and completeness of the "Greenhouse Gas Inventory from Fires."	MoEPP Climate Unit reports.	Biennial	MoEPP	Fragmented	100% compliant
7. GG 7: Strengthening International Cooperation and Knowledge Exchange							
7.1	Strengthening cross-border cooperation through existing regional and EU Civil Protection Mechanism structures	Obj: Regional security. Indicator: Number of joint cross-border training exercises or mutual aid activations.	MoFA / Mol Bulletins	Annual (Q4)	MoFA	1 / yr	4 / yr

7.2	Participation in international networks for landscape fire management	Obj: Knowledge share. Indicator: Macedonian participation rate in GFMC, RFMC, and EFFIS networks.	Institutional reports	Continuity	MoFA	Active	Enhanced
7.3	Exchange of experts and best practices with neighbouring countries	Obj: Peer learning. Indicator: Number of realized expert exchanges (in/out) per year.	Exchange reports; MoFA	Continuity	Government	~20 / yr	50 / yr
8. GG 8: Post-fire Landscape Management, Rehabilitation, and Restoration							
8.1	Emergency response programmes regarding erosion, invasive species, and consequences through the establishment of Burned Area Emergency Response (BAER) teams.	Obj: Damage mitigation. Indicator: % of burned area covered by emergency post-fire stabilization within 3 months.	MAFWE/ MoEPP GIS records	Semi-annual	MAFWE	15% coverage	>80% coverage
8.2	Active implementation of programmes for environmental rehabilitation and restoration of burned landscapes	Obj: Ecosystem recovery. Indicator: Number of successfully completed large-scale restoration projects.	MoEPP Archives	Quarterly	MoEPP	2 projects	12 projects
8.3	Training specialized personnel within the Mol and Forest Police to perform forensic analysis of burned sites	Obj: Accountability. Indicator: Conviction rate for fire-related arson or gross negligence cases.	Mol Bulletins: Prosecution	Annual (Q4)	Mol	<2%	>20%
8.4	Species Habitat Availability index: Biodiversity monitoring in burned vs unburned sites	Obj: Biodiversity tracking. Indicator: Species richness trend (Passive Acoustic Monitoring - PAM).	MoE; MAFWE; MoEPP; Hans Em Faculty of Forest Sciences, Landscape Architecture, and Ecoengineering	Annual (Spring)	MoEPP	Baseline (Yr 1)	Stable/ Increasing
8.5	Assisted Natural Regeneration: Emphasize natural regeneration processes rather than monoculture replanting in restoration practices	Obj: Ecological restoration. Indicator: % of burned area showing successful natural recruitment vs plantation.	PENF field surveys	Every 2 years	PENF	Baseline (2024)	+30% natural area

