STRATEGIC GUIDELINES FOR WILDLAND FIRE MANAGEMENT IN SPAIN

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1. WHY IS A STRATEGY FOR MANAGING WILDLAND FIRES NECESSARY?

Spain has a longstanding wildland fire management system[1] that has been explicitly implemented by the forestry administration through the enactment of various regulations since the mid-19th century (1833 General Wildland Ordinances, 1847 Royal Order, 1848 Royal Order, 1858 Royal Order and so forth). In organizational terms, the system goes back to 1955, year in which the first specific government unit was established to protect willdlands from fires[i]. Subsequently, the 1957 Wildland Act (*Ley de Montes*) was the first systematic organizational step towards preventive, combative and reparative wildland fire measures. But the increasing severity of the phenomenon gave way to the approval of the Wildland Fire Act 81/1968, specifically regulating prevention, suppression and the protection of goods and persons, and sanctioning violations and restoring the affected forest wealth. Since then, the legislative, organizational and structural developments have been enhanced, particularly in current times since jurisdiction was transferred to the Autonomous Communities as set forth in the Spanish Constitution[2].

In this new constitutional framework, in 1994, the functions of the National Nature Protection Commission, a consultative body for cooperation between the central government and the Autonomous Communities, established by Act 4/1989, were laid down. The National Wildland Firefighting Committee (*Comité de Lucha contra los Incendios Forestales* - CLIF), in charge of nationally coordinating wildland fire management, was ascribed among other technical committees to this Commission. Since then, its work has been ongoing. The Spanish Forestry Strategy (1999) and the Spanish Forestry Plan (2002) emerged shortly thereafter to define common forestry policy to be coordinated by the central government and shared by the Autonomous Communities whose forestry plans were added to enhance the strategy. All considered wildland fires as one of their main objectives. The enactment of the 43/2003 Basic Wildland Act led to the repeal of Act 81/1968, and a specific chapter was set forth on wildland fires. In addition, several Acts, regulations, and general and specific plans have come at either Autonomous Community or Municipal level to tackle wildland fires from a forestry approach.

Legal instruments have also been developed in the sphere of civil protection and have recently been consolidated with the National Civil Protection System Act 17/2015 (*Sistema Nacional de Protección Civil*), to plan action in the face of wildland fire emergencies. The Basic Civil Protection legislation (Royal Decree 407/1992) established the need to act through special plans whose elaboration must meet the requirements of the Basic Guideline for emergency civil protection e in the event of wildland fires (This was renewed by Royal Decree 893/2013). This guideline, in turn, set forth a general planning structure (approved via the 15th December 2020 Council of Ministers Decision), special plans for the Autonomous Communities, and local action plans stemming from the former. Indeed, by virtue of Act 7/1985 regulating local regimes, local entities also exercise competences of their own in wildland fire prevention and suppression.

The implementation of these plans has meant that, over recent decades, the central government, Autonomous Communities and municipalities have developed an extensive and operative suppression undertaking made up of special air and land units whose capabilities to respond in the event of a risk of wildland fires has been tried and tested.

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[1] Wildland fire is understood to be a fire spreading out of control on forest fuel located on wildland.

[2] Competencies in wildland fires matters correspond to the Autonomous Communities, excepting Navarra, Basque Country and Canary Islands, where they correspond to the Foral Community of Navarra, the Basque Foral Provincial Councils and the *Cabildos*, respectively. The competencies corresponding to the General Administration of the State are regulated in the Spanish Forest Law (43/2003).

Judicially speaking, wildland fires have been codified as a crime in successive amendments to the Criminal Code, which, as of 1983, expressly included the environment. In 1994 the crimes and applicable sentences for wildland fires were revised, and the most recent amendments were made in 2015. Legislative amendments have gradually adjusted sentences to facilitate enforcement, serve as examples and dissuade those causing these fires. This legislative framework, coupled with a greater endowment of human and material resources to tackle criminal investigations, reflects a reinforcement of the preventive approach.

Insofar as investigation, Spain currently has more than 40 groups working regularly on wildland fires from a broad variety of disciplines[ii], and this work has been stepped up over the years to delve into further knowledge on the phenomenon both in terms of its severe negative impact across the geography (mortality, desertification, etc.), and of the positive effects of controlled burns (improving habitats and grazing land, regeneration, and so forth) as well as action to tackle, control, prevent and manage them.

This entire regulatory, organizational and structural framework has contributed to the gradual reduction of the impact of wildland fires in terms of both their numbers and surface area. Yet wildland fires continue to be not only one of the most severe factors degrading our forest heritage, but also a threat to material goods and even human lives. They continue to pose a complex, cyclical recurring threat. Furthermore, climate change, coupled with social, economic and ecological change in rural areas, whose most visible effect is the accumulation of biomass due to changes in traditional land use, points towards the emergence of even more complex emergency situations entailing even more negative consequences.

Although the National Wildland Firefighting Committee collegiately performs a key role in coordinating the main levels of government with jurisdiction in this area, the strategic management of wildland fires continues to be tackled piecemeal, meaning that there is a need for a common framework for action nationwide, able to integrate all public and private actors with varying degrees of responsibility on this issue.

Therefore, and given the increasing complexity of the issue, a set of strategic guidelines are needed to set objectives, jointly define shared major lines of work, and identify the main stakeholders in society with a degree of responsibility to work with them. While this is the main justification for the need to establish Strategic Guidelines, there are other objective reasons, as listed below:

- Wildland fires are a cross-cutting problem requiring a multi-sector approach. Various public policies directly or indirectly impacting the risk of fires must be coordinated, and co-responsible public and private stakeholders sharing the same geography must be included.
- Wildland fires have historically been present naturally in many of our ecosystems, but are also generated by anthropic action owing to their secular use as a tool for land management. This has a recurring impact on both natural and cultural landscapes. It is not realistic to conceive of eliminating wildfires, but is rather opportune to consider them as a land management tool to be planned by consensus, determining where, when and how these fires should be present and for what purpose. We need to live with fire and society must be imbued with a culture of wildland fire risk.
- The loss of forestry ecosystems and natural, culture and economic values due to recurring, intense wildland fires runs against the interests of their social role as a source of resources, environmental services and livelihoods. These functions are considered very important in major international strategic policies including Bioeconomy[iii], Climate Change[iv] and Forestry[v]. Conserving and protecting these values requires a coordinated vision of wildland fires because, particularly owing to their recurrence and their extension, they are one of the main factors degrading ecosystems.

- The new Global Change[vi] related perspectives will lead to increasing risks and greater intensity of wildland fires and will induce the occurrence of multi-emergencies affecting citizens' safety as these disasters are increasingly complex, dangerous and difficult to manage.
- Depopulation, closely linked to the abandonment of traditional land use, and the lack of harnessing forestry resources, gives rise to a transformation of the landscape which often triggers forest structures that are more likely to propagate fire and that diminish opportunities for suppression.
- Anticipation is necessary to manage wildland fires. Not only climate change scenarios must be considered, but also the fact that our forests are continuously transforming both ecologically and socially. Wildland fire management must be suited to these changes and future scenarios must be considered new knowledge and technology.
- Reducing wildland fires' threat to civil society is crucial, both for persons and for goods and infrastructure, and risks to the population must be curbed. Both increasing urban and industrial development near wooded areas (urban-forestry interface), and increasing affluence of the public for recreational purposes makes it more likely for forest fires to pose great risks, and this requires developing measures to enhance the residents' and users' safety, preventing wildland fires from occurring and mitigating their effects.
- Public administrations have gained a great deal of experience in managing wildland fires, making it opportune to capitalize on the knowledge gained. Future actions should be coordinated to better meet objectives more efficiently, in collaboration with research groups. This has a positive effect on the ongoing improvement of the system.
- Public investment publicly allocated to manage wildland fires is high, yet imbalances between prevention and suppression remain and this severely limits their efficacy. Work must be done towards obtaining the best return in terms of efficacy and efficiency, and an approach with silos of prevention and suppression must be replaced by one of comprehensive land management while maintaining investment in rural areas. Furthermore, wildland fire restoration efforts must seek more resistance and resilience to wildland fires.
- Spain has highly experienced and specialized means to deal with wildland fires. Their capacity and safety can be optimized on both an individual and collective basis, as can their mutual cooperation. This should be done on a Europe-wide and even internationally.

2. GOVERNING PRINCIPLES OF THE STRATEGIC GUIDELINES

More than half a century's experience in the organized management of wildland fires has allowed for establishing a series of principles, understood as steering strategic guidelines. These principles are as follows:

- **Comprehensive management principle** Fire is a natural and cultural actor that has historically been present in Spain's ecosystems and cannot be eliminated. Wildland fires must be prevented, and their propagation must be effectively managed and/or avoided. This must be done by reducing undesirable consequences according to pre-established objectives suited to each geography and guided by technical and scientific criteria. In order to do so, comprehensive forestry and rural landscape management is key to achieving resistant and resilient systems in a context of climate and social and economic change. Exclusive suppression policies must be complemented by other proactive policies focused on wildland fire management in rural areas, and integrating prevention and suppression capabilities.

- **Social interest in wildland fire management principle.** Priorities established in decision-making for wildland fire management must be, in this order, the safety of people and equipment, control of emergencies and the protection of goods and the natural surroundings. The common good, understood as that which benefits society as a whole, must prevail in wildland fire management decisions.
- **Land sustainability principle.** Wilderness has economic, environmental and strategic value that is fundamental for society overall and for the rural population in particular. Planned management of wildland fires is imperative to ensure land conservation, protect biodiversity, foster ecosystemic services in natural spaces and preserve the quality of the landscape, and also to contribute to ambitious bioeconomy and rural development objectives set forth in national and international strategies.
- **Co-responsibility principle.** Wildland fires are complex problems whose effective management requires coordinated action agreed upon by several public and private actors with co-responsibility for the land management. This includes the participation of society and citizens, involved in their own safety. Furthermore, there are different sectoral policies that operate in the geographies that must join forces to contribute to effective wildland fire management, therefore tending towards good governance.
- **Adaptation and mitigation principle** Wildland fires are a widespread, recurring phenomenon involving alternating cycles. Against a backdrop of evident climate change and ongoing transformation of the social system and landscape, we must stay a step ahead and seek preparedness for the future to find ways to reduce the vulnerability given new scenarios. And we must diminish the factors involved in wildland fire outbreaks and propagation.
- **Operative safety principle.** Organizations in charge of wildland fire management must ensure that the suppression forces have the capacity to respond, and must anticipate opportunities and efficiently employ resources to sustain their reaction potential and prevent the risk of collapsing. Their operative functionality must be ensured, considering that their social and environmental surroundings are increasingly demanding given the intensity and extension of major wildland fires and their consequences.

3. OBJECTIVES

General Objective: reduce the impacts generated by wildland fires' social, economic and environmental effects.

Specific Objectives:

1. Manage the rural geography to achieve sustainability in the face of wildfires.
2. Reduce the risk of wildland fires, adapting ecosystems and preparing society for their occurrence.
3. Involve other strategic sectoral policies in wildland fire risk management
4. Adapt wildland firefighting organizations to the new scenarios and reinforce cooperation
5. Further knowledge about wildland fires and their impact on ecosystems
6. Foster society's participation and wildland fire management awareness raising
7. Incorporate technological improvements in prevention and suppression of wildland fires.

4. PRIORITY LINES OF ACTION

Objective 1: Manage the rural geography to achieve sustainability in the face of wildland fire

The lines of action under this objective are based on the multi-functional value of forest ecosystems ensured through rural land management to increase resistance and resilience to wildland fires by integrating prevention, suppression and rural development.

1. Foster **sustainable forest management** as a tool to promote the appreciation of forest ecosystems by properly stewarding their resources. This line of action falls in line with strategic initiatives promoting the appreciation of forest systems, including the European Forest Strategy, the Bioeconomy Strategy, and the 2030 Strategy for Europe[vii]. To achieve this, investment and incentives should be enhanced, such as tax breaks accounting for this activity's benefits for society.

2. Support the preservation of **traditional agriculture, extensive livestock raising and forestry** as they contribute to generating land with natural, social and economic value that is less vulnerable to wildland fires, and cooperate in reducing the depopulation of rural and mountain areas. Promoting the figure of active foresters is also advisable.

3. Support the **appreciation of agricultural and forestry products**, including the services and externalities that wildland affords society (support services, provisioning, regulation and cultural services). Stimulate payment for environmental services as a way to impact owners and producers. Support the use of surplus forestry biomass as a source of renewable energy, as well as the use of timber and non-timber products as a means of impacting owners and producers. Foster the use of local and kilometre zero products and develop lines of support for production, promotion, and communication to society.

4. Enhance the **competitiveness and profitability** of forest holdings, providing incentives for business and supporting the host of direct and indirect products to bring about sustained use. Foster or create identity marks for forest products.

5. Strengthen or support the **co-responsibility of individuals** in the forestry management of their wildland through participative management, balancing of interests, and governance. Work on land stewardship and other ways of involving owners in management, particularly in the private sphere.

6. Integrate wildland fires in **land planning** on different levels:
   o Develop forest resource and wildland firefighting plans; reach consensus on criteria to identify **high wildland fire risk areas** as a basis for land planning.
   o Include forest fires as a management factor in **protected natural area plans** (natural resource plans, use and management plans, Natura 2000 network plans, self-protection plans of National Parks, etc.), while foreseeing alternatives for intervention to cover conservation needs and risks to people and goods.
   o Consider **wildland fires in urban planning** (general urban planning, subsidiary municipal ordinances or partial and special plans as well as building codes) in order to curb or impose conditions on urban development in high risk areas.

Objective 2: Reduce the risk of wildland fires, adapting ecosystems and preparing society for their occurrence

This objective includes lines of action contributing to preventing wildland fires or reducing their effects, enhancing the ability of ecosystems and society to confront risk in favourable conditions, minimizing negative consequences, and, when applicable, seizing opportunities generated from their positive effects.

1. Integrate fire in **forest planning** and prevention in order to minimize the potential effects of major wildland fires. Action contributing to diminishing wildland fires' potential and enhancing conditions for safety in suppression is suggested. This is to be based on concepts such as defining and identifying standard types of wildland fires, factors leading

to wildland fire propagation and their hubs, critical points and strategic management points[viii]. Prediction indices and associated mapping need to be developed.

2. **Land management on a meso and macro scale** to reduce the load and continuity of fuel, incentivizing mosaic type landscapes where the likelihood of wildland fires beyond suppression capacity is diminished

3. Strengthen prevention based on **civil protection** by developing local plans of action in accordance with the special plans of the Autonomous Communities, which in turn should be endowed with the necessary technical and financial means.

4. Generate **risk awareness** so that the population living where there is a likelihood of wildland fires, and particularly private owners, become aware of these risks. Support the empowerment of local communities, users and residents to act in self-defence and adopt measures to protect themselves and their goods. This approach pursues the necessary subsidiarity in prevention.

5. Foster the adoption of **self-protection** measures, particularly in urban-forest and industry-forest interface areas where direct responsibility must be required of real property owners or condominium owners in adopting and preserving preventive measures to face wildland fire risks. Regulation on inhabitability or ceasing of business is also advisable given a lack of legally established protective measures.

6. In the context of local forestry management, foster the **resistance and resilience of forest cover to wildland fire**, through various actions ranging beyond conventional preventive forestry (thinning, clearing, firebreaks lines and areas, hydrants, etc.) and including the use of prescribed burning when advisable as a tool to diversity the landscape. This will consist of stimulating alternatives such as forest area maturity enhancement, species replacement with more adequate ones, more resistant mixed ecosystem development, heterogeneous landscape development through the recovery of agricultural areas, extensive livestock raising promotion, and so forth. In order to do so, financial resources should be sought in existing tools including the Common Agricultural Policy, other structural funds, national and international funding programmes, and private schemes. Participative management and private ownership support are essential.

7. Reinforce **preventive and dissuasive monitoring** and early detection of wildland fires, be they natural or triggered by humans, with support in human and technological means. This will prevent wildland fires from starting and limit their spreading through early intervention.

8. Prosecution as a means of **sanction and persuasion** is essential given the high degree of human intervention in outbreaks. This requires an effort in investigating the causes of wildland fires and in criminal investigations. Action must be taken to complementarily ascertain the profiles of those causing the fires in order to implement measures to modify their behaviour.

9. Agreements should be sought to **conciliate interests** and balance out the needs of those living in rural areas (farmers, hunters, rural property owners, etc.) and those demanding environmental services. This will help reduce or eliminate the use of unnecessary or improper fire and provide real alternatives for sustainable land management. This action should be supported by participative management and a true commitment to systematically implement actions demanded by inhabitants of rural areas.

Objective 3: Involve other strategic sectoral policies in wildland fire risk management

Wildland fires are a cross-cutting problem requiring responses from different spheres and particularly the involvement of public policies directly or indirectly affecting the same geographical area. The alignment of certain sectoral policies considered strategic is proposed under this objective.

1. **Territorial policy.** Rural depopulation triggers a serious problem in terms of social and geographic imbalances and leads to underutilization of endogenous resources. This contributes to generating landscapes that are more vulnerable to wildland fires given their structure, their composition and their lack of value. In order to turn this around and contribute to more sustainable landscapes and more cohesive rural areas, government measures promoting demographic incentives, employment and the development of public services, infrastructure and communications are necessary, as is the enhancement of cultural identity in those areas. Structural funds allocated for this purpose should be put to actions and/or investment directly impacting wildland fire risk reduction and the reduction of society's vulnerability to wildland fires.

2. **Agricultural policy.** Agriculture, livestock raising and forestry sectors are essential for maintaining a stable social and economic fabric in rural areas. When they are based on productive models with a high natural value, contribute to generating positive externalities, social benefits and dynamic landscapes that limit or reduce the spread of wildland fires. However, certain agricultural and livestock raising practices are behind 43% of the fires and 40% of the surface area burnt annually, and mechanisms must be established to reduce this impact.

   The Common Agricultural Policy, through its two pillars, promotes agricultural and forestry unevenly, and among the first one, it also promotes intensive and extensive practices unevenly. This has led to inadequate integration of the issue of wildland fires among the mechanisms for allocating aid. Therefore it seems necessary to strengthen conditionality, encouraging best practice for forestry while also enhancing monitoring and sanctions with a view to withdrawing aid to surface areas affected by intentional fires.

   Direct aid and eligible surface areas must be redesigned when they penalize, through the grazing eligibility ratio, to extensive livestock raising that takes advantage of surface areas with woody coverage. Eco-schemes for livestock raising should be also fostered, attaching priority to areas at a high risk of wildland fires. Attaching great importance to small livestock for managing forest fuel warrants encouragement through specific payment enhancement. Furthermore, rural development aid should include the enhancement of the forestry package and encourage payments framed in the figure of territorial farm contracts.

3. **Industrial and energy policy.** Commitments to reduce greenhouse gases causing global warming make it imperative to stimulate the rural bioeconomy by promoting competitive renewable energy, among other initiatives. Wood biomass and forest biomass are sources of renewable energy and have thermal, electric, and solid and liquid biofuel applications as well as industrial applications (fibres, essential oils, biopolymers, organic molecules, etc.). They are extracted in rural areas, thus generating income and jobs that contribute to fixing the population. Incentives must be provided for this harvesting and diverse and sustained supply must be ensured through resource management that preserves productive capacity as well as the natural ecosystem values. In order to attain maximum efficiency in their industrial use, physical-mechanical or chemical processing is required to obtain various products, and this too should be incentivized. Having a national biomass use strategy to support this sector, strategic for its economic, social and environmental function, seems necessary.

   Moreover, with the aim of maximizing funding for adaptation of forest and other lands in the climate change context, it should be promoted the offset of CO_2 emissions in the private sector, both in voluntary and regulated markets, by means of a national system and equivalent instruments that link sustainable forest management with the avoidance of big forest fires risk.

4. **Environmental policy.** Spain's vast protected Surface area (more than 27%) and its major contribution to the Europa Natura 2000 network entail both a requirement and an

opportunity in wildland fire management through this policy. Management tools should include aspects related to wildland fire management (burn plans and use of fire in accordance with protection requirements of each habitat type) and the development of prevention and early action strategies agreed by those in charge of conservation and suppression. Procedures should be simplified to achieve their implementation, and conservation objectives should be harmonized with the need to intervene in the event of a wildland fire. Control and planning are needed, as is adequate prevention and conservation investment and the management of investments made. Furthermore, exchange of knowledge is needed as is the joint work of professionals involved in protection and in firefighting. It seems advisable for coordination bodies to be established to facilitate the work of these different professionals.

5. **Education policy.** Forest ecosystems' qualitative and quantitative importance for society owing to the goods and services they generate make it imperative for all school curricula to include these aspects in order to recover society's ties with nature. Basic knowledge in this field would enable us to overcome the dichotomy of views that rural and urban society have of wildland areas. It would convey the importance of these areas due to the value of their resources, their extraction and sustainable management and conservation. Furthermore, wildland fires, despite their recurrence, are not very well understood by the public at large, particularly urban population. People must be taught to live with fire and a sense of risk must be imbued in societies living in contact with nature given that this threat is very difficult to eliminate, particularly in Mediterranean areas.

6. **Judicial policy.** The high proportion of wildland fires caused by human action make criminal investigation an essential tool to identify those responsible and establish mechanisms to dissuade further action of this type and reduce the number of outbreaks. Investigative work must be reinforced to achieve greater rates of ascertaining the causes of wildland fires in order to combat impunity in the event of arson and also to further knowledge of the psychological and social profile of the arsons. This will help identify them and therefore **improve social prevention policies**. It is needed to apply sociology to understand the origin of intentional wildland fires. It is advisable to strengthen cooperation of those in charge of both criminal and administrative investigations into wildland fires with a view to exchanging information, developing prevention and monitoring, and stimulating judicial action, among other measures. Furthermore, the use of **prescribed fire as a management tool** requires enhancing the **legal certainty** involved.

7. **Urban planning policy.** The increase of urban-forest interface zones is linked to an increase in the risk of wildland fires in many areas. This has implications for both individuals and their property (population risk), and increases the likelihood of scenarios that surpass first respondents' suppression capacity. Urban planning authorities must integrate wildland fire risk into their planning, establish appropriate land use, limit or place conditions on new settlements, and require prevention and self-protection measures, among them, the provision of fire hydrants in those plots located in critical points. Basic building standards should include specifications of the appropriate conditions and materials for building in order to protect homes and facilities while serving to establish adequate self-protection measures. Thus urban-forest interface areas will cease to pose a threat or potentially overwhelm suppression operations and become fire management opportunities. Mapping inhabiting of forests is a necessary tool to identify the most vulnerable areas.

8. **Emergency management policy.** In organising emergency responses to wildland fires, the standardized, coordinated intervention of all of the operatives involved (suppression forces, local, regional and national security corps and forces, the Military Emergency Unit (UME), health personnel, civil protection, etc.) must be ensured through measures including

standardized training, organized communication and proper treatment and dissemination of information.

Objective 4: Adapt wildland firefighting organizations to the new scenarios and strengthen cooperation

New climate change scenarios can give rise to wildland fires that surpass the capacity of suppression. This is understood not merely in terms of diminishing the effectiveness of tactical operations, but also in terms of the possibility of strategic planning of action, decision-making, managing and governing suppression resources, and establishing proactive strategies.

While Spain has longstanding experience in managing wildland fires and a broadly human and material resources for doing so, it is imperative to improve the various organisations' synergies and integration in order to gain in operability. This is addressed in the following strategic action tracks:

1. Strengthen the work of and cooperation with the National Wildland Firefighting Committee, made up of the General Central Administration and the Autonomous Communities, providing it with the ability to generate technical documentation, and to made decisions and issue recommendations.
2. Establish **National Support Teams for Incident Commanders**, made up of technical experts in the regional organizations that can plan, run strategic analysis and perform advanced technical fire operations to support Autonomous Communities in proactively managing complex wildland fires.
3. Facilitate the exchange of knowledge and experiences among wildland fire management professionals through the development of **technological information and communication platforms enabling knowledge to be shared**.
4. Adjust availability of suppression resources in number, type and annual period of activity, combining containment in its growth with dynamic adaptation to changing needs.
5. Spain has a large number of aerial resources, with a high suppression potential, broadly distributed across its geography. Efficient allocation of suppression investment should envisage distribution according to the needs of each geography. Risk, efficiency, efficacy, economic and operational criteria should be applied to optimize work and minimize costs. Also, in the medium to long term, the renewal of the fleet of aerial resources will need to be addressed either due to the obsolescence of current aircraft or to new technological developments.
6. Establish national framework agreements for contracting suppression services and supplies (materials, goods and equipment) for various administrations in order to more efficiently allocate public investment.
7. Considering the large amount of land resources currently available, they are relatively heterogeneous suppression units whose operative capacities are not defined, making inter-regional or international cooperation extremely difficult. To facilitate this interaction, the suppression units must be qualified uniformly according to their operative capacity[ix].
8. Bearing in mind the high number of aerial resources operating in Spain and their high confluence in certain fires, a common **aerial coordination protocol** is required, as recommended by the Research Committee on Civil Aviation Accidents and Incidents (CIAIAC). This protocol should mainly pursue the harmonization of functions, responsibilities and requirements for training experience for the person in charge of coordinating aerial resources. The protocol should be tailored to the gradual roll-out of the emergency management system and the standardization of aerial coordination procedures enhancing safety, efficacy and efficiency of suppression operations, given their complexity. With a view to aerial operation safety, **unequivocal radio indicators** for participating aerial

resources are particularly important. Proper regulation on areas surrounding air bases as of the use of drones for suppression and around air bases is also important.

9. Improving the **exchange of information** between administrations on wildland fires, allocation of suppression resources, and monitoring of their positions is advisable as a way to enhance the operational safety and the efficiency of interventions. This improvement should be underpinned by swifter, transparent flows of information and the convergence of the currently used emergency management systems. Here it is important to support the role of the Spanish Government's **National Information Coordination Centre on Wildland Fires** as an interlocutor for Spain and other countries for information about active wildland fires in real time, weather conditions and resources deployed both across Spain and abroad.

10. Increasing the efficacy, efficiency and safety of wildland firefighting requires the convergence of **emergency management systems** (Incident Command System as it is known in English) that various Autonomous Community currently use. In this regard, it is essential for the National Wildland Firefighting Committee to reach a consensus, with the support of the responsible authorities, on the **mutual recognition of the training, skills and qualifications** of the main suppression positions. Shared procedures and protocols must also be developed to facilitate the management of each wildland fire based on its location, intensity, impact on the affected habitats, and social and environmental context.

11. Historical information on wildland fires is key in order to analyse this phenomenon, prevent it from occurring, and take decisions during an emergency. This requires ongoing improvement in the gathering and accuracy of data for wildfire statistical records and particularly the **General Wildland Fire Statistics.** It is advisable to improve data gathering including automatic capturing of data from other sources (mapping, meteorology, etc.) as well as the compatibility and convergence of the different Autonomous Communities management information systems and to enhance analysis and processing capabilities.

12. Effective interpretation of the behaviour of wildland fires and forecasting their development is key to working safely and planning and adapting suppression and fire control tactics. **Shared protocols for the analysis units** should be established for this purpose. This includes the development of operative maps whose shared legends must first be agreed. The use of **new technology** must be continuously incorporated, including wildland firefighting as a way to simulate the propagation of the fire. Weather forecasts, remote detection or RPAS, and systems for analysing large volumes of data should also be incorporated.

13. The complexity of the problems and their related uncertainties require staying one step ahead of complex scenarios by preparing the crews through **emergency simulations** and organizing coordinated responses involving various actors in each geography (national government, autonomous communities, owners, civil society). As a measure to prepare the crews, it is recommended that mechanisms be established to facilitate **expert exchanges** between administrations in order to share knowledge and experience. Convergence of the crews should be fostered and National Support Teams established to benefit the operations.

14. The suppression units (fire brigades, engine crews, etc.), have experienced a process of increasing urbanization of their members, as their ties with rural areas and the rural population have been diminished. This comes in detriment to their efficacy as they are essential actors in their geographies due to their knowledge of and familiarity with the community. Policies are needed to prevent rural exodus. These policies should foster and prioritise units made up of workers based in rural areas.

15. **Ongoing training** of the suppression units is key for improving their performance and safety. Among the various areas of training needed, progress should be made on the

human factor, with special attention paid to developing mechanisms to take care of the emotional needs of those who experience adverse, traumatic situations with a view to facilitating their recovery. Furthermore, others should be trained, including professionals in wildfire fighting management working locally, such as security forces, managers of protected natural areas and farmers.

As a member of the European Union with broad experience internationally, Spain must work on cooperation, mutual effort, and the ongoing preparation of crews in different countries, and particularly along the following lines.

16. Support and contribute to **shared international protocols** for operating in wildland fires where the surpassing of the country's own means requires resources from different countries to be used.
17. Support and enhance **wildland firefighting modules, equipment and experts within the European Civil Protection Mechanism.** The wildland Firefighting Assessment and Advisory Team (FAST) stands as a significant example of how national knowledge and experience can be put to the service of other countries facing complex situations and also as an expression of our country's solidarity.
18. Related to the previous point, strengthen the commitment of Spain's public administrations to generate a **national database of experts** in wildland firefighting, coordinated by the central government. These experts would be available to participate in international missions both as responders and as advisors.
19. Perform ongoing preparation and coordination work through the implementation of **simulations and exercises** to bring about greater effectiveness, efficiency and safety. The participation of Spain's regional administrations, under the leadership of the central government, is imperative in order to enhance capacity and integrate into other international crews.
20. Spain's experience and the potential for learning from other countries with similar problems makes it imperative to **expand international exchange and training** both with European and Mediterranean countries, and with the Americas and the rest of the world.

Objective 5: Further knowledge about wildland fires and their impact on ecosystems

Wildfires are complex phenomena due to the host of factors involved and to uncertainties tied to processes of change. This makes research, innovation and development, in addition to the dissemination of knowledge, key to improving our understanding of wildland fires and finding new tools to manage them. At least the following strategic lines are put forward for doing so.

1. Given wildland fires' social, economic and environmental repercussions, **increased financial investment** must be made in related research as a way of improving our capabilities to tackle the phenomenon and of maintaining our international leadership.
2. **Strategic research goals** must be defined for wildland fires, and must be aligned with the main needs identified by the administrations with jurisdiction. This applied research must be undertaken with wildland fire and land managers to generate synergies enabling true knowledge transfer and the effective applicability of the outcomes.
3. In line with this, and given that Spain's wildland is basically burned due to social, cultural, economic and political factors giving rise to a phenomenon known as the sociology of fire, **social and economic research** should be a priority. Also, **basic, uniform mapping** of Spain's entire geography is needed on aspects that are key to wildland fires, such as

airbases, defence infrastructure and management areas, in addition to areas at a high risk of wildland fires, ecological or socio-economic vulnerability, or fuel models, and so forth.

4. Given the numerous researchers and experts in this field, mechanisms to **share information and knowledge** must be generated for effective exchange between the public and private sectors, making it advisable to establish periodic national specialised fora.

5. Given the high figures reflecting lack of knowledge or inaccurate knowledge of the causes of wildland fires, particularly in certain geographies, **research on their causes and motivation** must be stepped up as a key to understanding wildland fires and adapting the appropriate management mechanisms. Enhanced endowment of human and other resources is required as well as interaction and exchange of information between teams of investigators, particularly security forces and judicial instances. Causes incorporated into forestry statistics must be harmonised with those in the criminal field and the various psychosocial profiles of arsons must be defined and standardized in order to be able to find predictive relationships to help those in charge to identify those responsible for the wildland fires, thereby increasing the likelihood that the facts can be established judicially.

6. In the **field of technology,** improvement efforts must continue to be made, specifically in fleet monitoring and remote satellite detection or detection by air-carried elements. This improvement also applies to the processing of spectral images, fire behaviour simulation, risk indexes linked to different forestry, phenological and atmospheric variables, fuel model generation, indexes for vulnerability, danger and inhabitability linked to the urban-forest interface, analysis of major series of historical data (Big Data), improvement of the technical prescriptions of the use of fire both in suppression and prevention, etc.

Objective 6: Foster society's participation and awareness raising in wildland fire management

Wildland fires affect ecosystems but also have a social nature because at their origin is a confluence of social circumstances and their repercussions directly or indirectly affect society. Their proper management thus requires the involvement of citizens at large who must become aware of the phenomenon, its causes and its consequences, and participate co-responsibly in wildfire management.

Participation and collaboration mechanisms must therefore be established with other **groups** indirectly involved in wildland fire management, for instance:

- Owners and those making use of rural areas, represented by different associations.
- Various land managers including those responsible of protected natural areas, land planning or farming, forestry and grazing.
- Those in charge of urban planning and infrastructure design in addition to actors that establish, regulate or supervise action impacting self-protection (architects, environmental impact evaluators, urban planners, city councillors, etc.)

Mechanisms for participation, collaboration, training and awareness raising:

1. Establish **fire boards** for active, direct participation of the groups and managers involved.
2. Foster basic **forest education** for society as a whole given forest ecosystems' quantitative and qualitative importance. The integration of basic knowledge on the economic, social and environmental importance of forest ecosystems should be included in school curricula from an early age to permeate society with awareness as to the importance of forests.
3. Target the population at large for forest awareness through adequate, ongoing dissemination and communication to dispel myths. The figure of wildland fire management

informants must absolutely be made more salient so that media can objectively inform the public about emergencies underway and preventive action.

4. Foster a **risk mindset** on the occurrence of wildland fires both generally but also particularly in towns and villages in contact with forests. This must take hold as a way of raising awareness about a recurring problem and take co-responsibility in reducing their vulnerability.

5. It is fundamental for public administrations to run ongoing cyclical **awareness raising campaigns** aimed at the population at large and also at specific groups as a reminder of the occurrence of wildland fires and as a way of pressing their consequences and modifying or dissuading risk-inducing behaviour. This generates an understanding of the preventive usefulness of forestry extraction and prescribed burns, enhances the protection of the population, and, in short, contributes to reducing the impacts of wildland fires. It is also advisable to involve other influential public and private actors (the media, major companies in other sectors, and so forth), but only after they have been basically trained so that objective and truthful language is used. Furthermore, it would be advisable for the comprehensive cost of wildfires (including the loss of natural goods and materials as well as the cost of suppression), to be properly appreciated and disseminated to the public in order to make it aware of the wildland fires' economic consequences.

6. Support organized **volunteering** in prevention and suppression, integrating it in regional or local civil protection systems or other organized structures. The volunteers should have standardized, ongoing training, particularly in self-protection.

Objective 7: Incorporate technological improvements in prevention and suppression of wildland fires

It is a mandatory objective for the future to progressively incorporate technological improvements arising in prevention, detection, organization and coordination of equipment and suppression resources, communications, investigation of causes, etc.

The incorporation of these improvements should be considered in funding provision.

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