



FIRE-RES

Innovative technologies & socio-ecological-economic solutions for fire resilient territories in Europe

D3.1 POLICY BRIEF “Can economic incentives help reducing wildfire risk? Reviewing tools to motivate more fire-resilient land management”

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Abstract: This deliverable takes stock of examples using incentive mechanisms (e.g. subsidies, value-chain labels) to motivate behavioural changes that boost the resilience of landscapes and communities to wildfires. We analyze 76 cases from our M3.1 database, which has inventoried best-practice examples of resilience-enhancing approaches. We categorize economic tools based on the markets they link to and derive policy recommendations on lessons learned.

Keywords: economic incentives, subsidies, forest fires, Payment for Environmental Services, labelling, liability fee, impact investment, bonds, Corporate Social Responsibility,

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0. Acronyms

AGADER: Axencia Galega de Desenvolvemento Rural (Spain)

CTFC: Forest Science and Technology Centre of Catalonia (Spain)

CSR: Corporate Social Responsibility

DFCI: Defence Against Forest Fires in Aquitaine (France)

ESG: Environmental, Social and corporate Governance

EU: European Union

GPS: Global Positioning System

PES: Payments for Environmental Services

RAPCA: Network of Grazed Firebreaks of Andalusia (Spain)

RDP: Rural Development Programme (EU)

USA: United States of America

WUI: Wildland-Urban Interface

Can economic incentives help reducing wildfire risk?

Reviewing tools to motivate more fire-resilient land management

1. Introduction

Wildfires can be considered a public bad, or disservice from forests, bushlands, and other biomass-accumulating land-cover types. Fire impacts can affect not only landowners' own property, but also extensive surrounding society within a defined 'firescape', creating a **spatial externality problem**: landowners and managers may come to underinvest in wildfire risk reduction, due to their insufficient organisation, know-how, capacity, and/or motivation¹. If so, this would justify policy intervention, aimed at reducing wildfire risk more than land managers themselves would have done. To the extent that land managers' own motivation is insufficient, incentivizing and compensating them for incremental risk reduction costs can be one recommendable pathway ('carrots'). Using disincentives (e.g., taxes, fines, liability fees) can be a complementary strategy ('sticks').

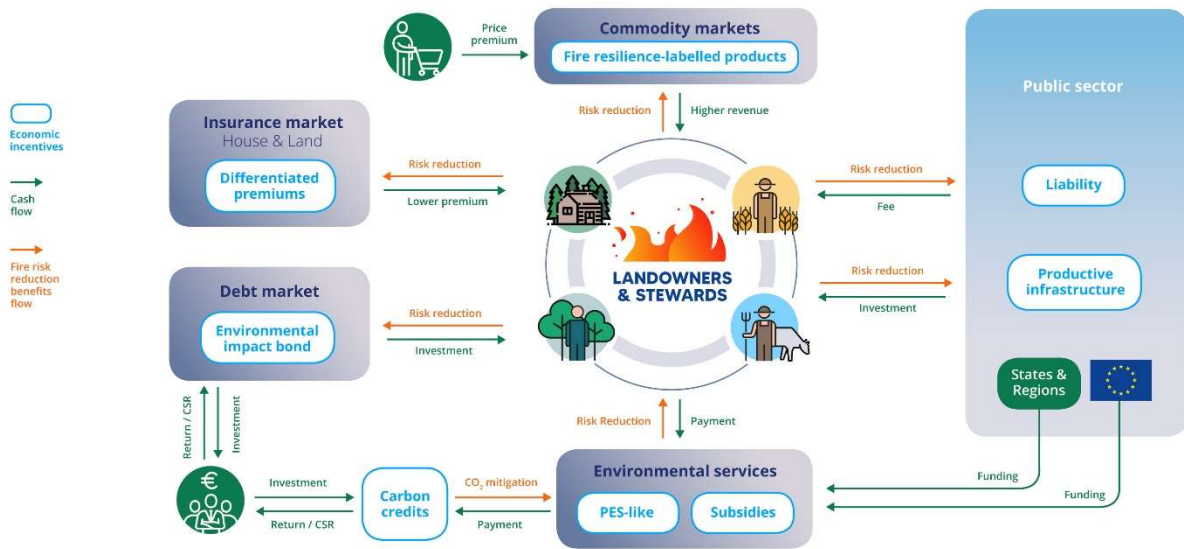
Conceptually, wildfire **prevention** activities reduce the probability of wildfires breaking out (ignition risk), while **mitigation** activities reduce the potential impact of wildfires (spread, intensity) when they occur. Jointly, prevention and mitigation constitute **wildfire risk reduction**, which tends to provide long-term cost-effective solutions, compared (and complementary) to the traditional suppression-focused public-spending. It can involve multi-stakeholder actions towards fire-resilient landscapes, requiring a shift from top-down mitigation to the active engagement of local actors. This policy brief will review what economic incentives have been applied in Europe (where the bulk of action has occurred) and beyond, for wildfire risk reduction by landowners, managers, and their communities, and what we at this stage can learn from these experiences.

2. Incentives at a glance

In principle, policy- and decision-makers have a wide array of economic incentives at their disposal to influence the behaviour of land managers – functionally mostly acting as farmers, foresters, livestock rangers, and property owners. Figure 1 illustrates how **incentives are linked to different markets**: for environmental services (subsidies and payments for environmental services—PES), commodities (fire-resilience product labels), credit (landscape-targeted bonds), insurance (differentiated premiums) and taxes and liability fees for fire damages – the latter partially also working as disincentives.

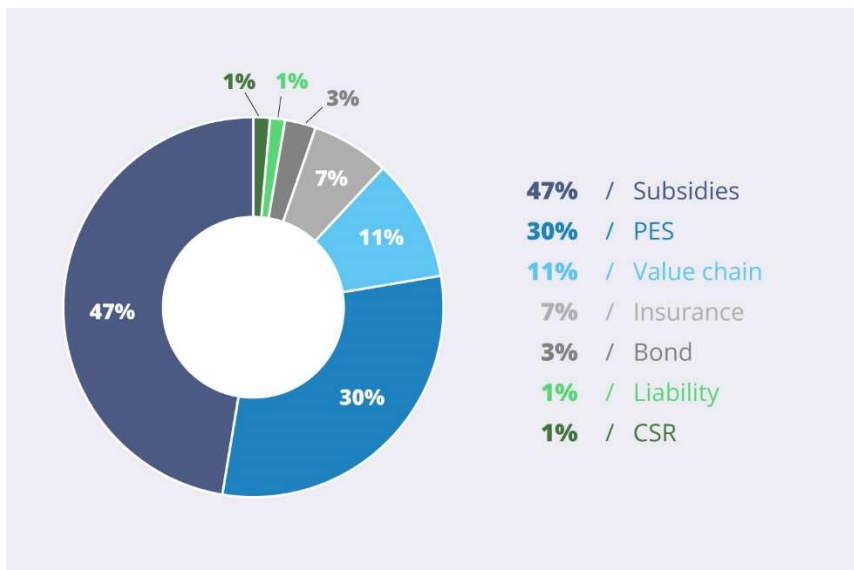
¹ Wunder, S. et al. (2021) <https://doi.org/10.1016/j.forpol.2021.102458>

Figure 1. Portfolio of economic incentives.



We gathered evidence of 76 case studies from both grey and peer-reviewed sources in an open-access database², reporting what is known about their design, outcomes, and fire-risk reducing impacts. Two thirds of cases (64%) spread across Europe, half of which in Spain. Nineteen (25%) are from the USA, and eight (11%) from the rest of the world.

Figure 2. Wildfire risk reduction: case distribution of incentives (%).



While thus multiple incentive tools indeed exist, in practice these are far from equally used. Clearly **dominating is the use of subsidies** (the traditional way of supporting land managers in Europe) and **PES** (conditioned and more targeted support), both linked to

² Fraccaroli, C. et al. (2023) <https://doi.org/10.5281/zenodo.7708751>

environmental service provision. All other implementation instruments are *de facto* much scarcer and only incipiently used (Figure 2). Here is an overview of these tools:

I. SUBSIDIES

How can subsidies make a difference for reducing wildfire risk? Three complementary pathways stand out. First, they can co-finance direct ‘landscape-engineered’, spatially targeted mitigation, such as strategic fuel discontinuities. Second, they can provide ‘bioeconomy’ type of general rural production support, helping to reverse rural land abandonment, and thus mitigating fire risks by keeping open mosaics of working landscapes that avoid excess biomass accumulation. Third, preventing ignition risks could in principle also be subsidized (e.g. adopting no-burn agriculture). Tangibly, subsidies provide public financial assistance to individuals, communities, or organizations for wildfire mitigation measures – the three relevant channels being: (i) cost reimbursements/ sharing, (ii) collective grants, and (iii) productive investments.

As for (i) **cost reimbursements/ sharing**, under the European Union’s (EU) Rural Development Programme (RDP) some Member States have co-funded measures to reduce wildfire risk using competitive grants³. Other subsidy programmes provide funding to directly or indirectly reduce risk through communities or landowner groups. **Collective grants** (ii) aim to foster shared responsibility for collective wildfire risk management (e.g. the Defence Against Forest Fires (DFCI) in Aquitaine (France), the Colorado Wildfire Risk Reduction Grant Programme, and the Joint Chiefs’ Partnership, both in the USA), while (iii) **productive investments** comprise publicly financed investments in infrastructure to promote farming and/or active forest management, containing vegetation encroachment and promoting fire-resilient landscapes – e.g. removal of shrubs for pasture preparation, creating livestock fences or forest management plans – and hence facilitating primary rural production to counteract the negative externalities originating from inactive landowners (cf. Box 1).

BOX 1. Productive subsidies to reduce wildfire risk: Galicia’s Model Villages (Spain)

The Model Villages Programme, backed by *the Law for Recovery of Galicia’s Agricultural Land*, subsidizes local processes aiming to prevent wildfires in pre-identified high-risk villages. Essentially, a Land Bank, created in 2007, consolidates Galicia’s highly fragmented rural land tenure, enabling larger-scale subsidized investments in productive land uses that are to hinder land abandonment and keep strategic fuelbreaks open. Galicia’s Office for Rural Development (AGADER) acts as matching mediators between (groups of) inactive landowners and local farmers willing to engage in crops, livestock, and/or horticultural production. Typically, buffer rings of low biomass are established and maintained around the Model Villages by land- and business-enabled farmers, as is the

³ Colónico, M. et al. (2022) <https://doi.org/10.1016/j.landusepol.2022.106079>

case of Parada dos Montes (targeted cattle grazing – cf. figure 4) and neighbouring Moreda (pig grazing in holm oak forest), and Trelle (mixed extensive grazing). In Parada dos Montes, 10 animals are grazing 15.5 hectares surrounding the village (see map borders) on a five-year contract, but these belong to no less than 75 landowners! AGADER invested 105,000€ in prior land clearing, and improved village roads, sanitation, and communication infrastructure. This buffer zone demonstrated **an impressive effectiveness** during an extreme wildfire in July 2022, giving opportunities for fire control in the grazed area, whereas the outer wooded areas were all burnt (cf. figure 3). Hence, the model seems to work in terms of land aggregation and fire protection. Yet, on a per-hectare basis it can present **a significant one-time investment**. In Parada dos Montes, the low number of (mostly retired) inhabitants may cast doubt upon the current sustainability of this bioeconomy-based model: it would eventually require younger people to be attracted back to reside in the village. Currently 21 Model Village nuclei have been approved, covering in total 575 hectares belonging to 2,360 landowners.



Figure 3. Forest burnt seen from Parada dos Montes in 2022 (Cecilia Fraccaroli).

Figure 4. Map of Parada dos Montes (AGADER)

II. PAYMENTS FOR ENVIRONMENTAL SERVICES

PES are voluntary transactions between service users (e.g. municipalities concerned over escalating fire risk) and service providers (e.g. landowners with little resources to engage in risk-reducing actions). Compared to subsidies, PES incentives are more directly conditional upon *de facto* delivery of targeted actions or services. Notably, wildfire prevention practices could also synergistically provide other services, such as reduced CO₂ emissions rewarded through carbon markets (e.g. Australia’s Savanna Burning Project), safeguarding watersheds (e.g. Denver and Santa Fé Water programmes, USA) and biodiversity (e.g. Hen Harrier Project, Ireland), or be part of multi-objective agri-environmental PES schemes (e.g. maintenance of extensive farming in Central Portugal).

Beyond landowners, PES-like schemes can also compensate non-owner land stewards, such as pastoralists performing targeted grazing services (cf. Box 2).

BOX 2. Pastoral PES: three decades of paying for grazing to keep Mediterranean lands open

The PES tool has been used to pay shepherds for reducing biomass accumulation through targeted livestock grazing: between France and especially Spain, various replicate schemes have been implemented, and learning over the years has enabled improvement in design. Shepherds are remunerated for keeping open fuelbreak areas by reducing biomass fuel accumulation through targeted grazing of livestock (sheep, goat, cattle) in designated fire risk areas.

The first effort was an agri-environmental scheme funded by the EU Common Agricultural Policy in 1992 in France’s Languedoc region within the local forest-fire defence action plan. Between 1996 and 2009, the Valencian region was a pioneer in Spain, establishing compensations for herders who assist fuel control for wildfire reduction⁴⁵. *Plan 42* in Castilla-y-Leon (2002-2011), combined payments to shepherds with a fire ban to motivate a shift from traditional burning practices to mechanical clearing for increasing grazed areas. Since 2007, the Network of Grazed Firebreaks of Andalusia (*Red de Áreas Pasto-Cortafuegos de Andalucía—RAPCA*) further developed the contract features, introducing a result-based scheme where compliance is estimated based on levels of vegetation consumed, and requiring pastoral experience as an eligibility criterion. In 2016, participation reached 223 shepherds working a surface area of 6,000 ha. In 2016, the *Catalan RDP* supported targeted grazing covering 649 ha, but adapting the scheme based on the RAPCA example, and raising the budget as well as initial payments from 48€/ha (2016) to 300€/ha (2022). A 140€/ha bonus applies if the area is considered "strategic" for wildfire risk management; 70€/ha when it is "complementary". The most recent replication is on the Canary Islands: *Gran Canarias Pastorea*. Contracts were signed with 35 shepherds in 2022 for grazing about 2,000 ha, thus also giving social recognition to the gradually disappearing pastoral practices. The scheme features some design innovations, such as sophisticated spatial analyses identifying high-risk areas in firescapes, and activity monitoring through herd-installed GPS, enabling a clearer mode of establishing payment conditionality.

Pastoral PES schemes **have proved both good potential and ability to adapt their design** over time and space. Evidence documents they can maintain traditional activities,

⁴ Dopazo, C. et al. (2012) <https://academica-e.unavarra.es/xmlui/bitstream/handle/2454/27814/DopazoComparaci%C3%B3n.pdf?sequence=1&isAllowed=y>

⁵ Lovreglio, R. et al. (2014) <https://doi.org/10.3832/ifer1112-007>

although their wildfire-reducing impact has not yet been scientifically evaluated⁶⁷. Yet, the **long-term commitment** of public administrations is key for pastoral PES functioning. Andalusian RAPCA is the longest-lasting scheme; the Valencian counterpart was affected by some funding discontinuities. Payments in Languedoc were at some point scaled up, but seemed then to lose some of their targeted focus⁸. Overall, PES payments can effectively assign shepherds with the role of risk-reduction service providers, reinforcing positively and spatially directing their traditional fire-preventive behaviour. Beyond the monetary transfer, pastoral values are also socially being recognized in the Mediterranean Basin – as an allegedly backward economic activity under progressive region-wide decline.



Controlled grazing in Gran Canaria. Photo credits: Dídac Díaz Fababú.

III. VALUE CHAIN LABELS

These incentives work through commodity markets, by certifying agricultural or forest products that demonstrably are produced in ways contributing to wildfire risk mitigation – typically by keeping mosaic landscapes open that without this production would likely have been abandoned, growing into biomass-thick and wildfire-prone vegetation. To the extent consumers are conscious of escalating wildfire risk, and supportive of this certified effort to counteract this risk, these products would fetch their willingness to pay for a targeted price premium. The generated extra income would in turn reward certified producers, and thus also allow them to continuously finance their future risk mitigation efforts. Beyond of economics, labels could also give some social recognition to producers implicitly or explicitly acting as local fuelbreak providers.

How do value-chain labels work in practice? Examples include the Mosaico project (Extremadura, Spain), Ramats de Foc (Catalonia, Spain), and Landa Carsica (Friuli, Italy).

⁶ Lecina-Diaz, J. et al. (2023) <https://doi.org/10.1016/j.JENVMAN.2023.117707>

⁷ Pulido, F. et al. (2023). <https://doi.org/10.1007/S10980-023-01618-W/FIGURES/7>.

⁸ Charmetant, R. Duperron, C. (2019). Medidas de soporte a la ganadería extensiva para la gestión del riesgo de incendios. ALBERAPASTURE conference presentation.

Many labels originated from EU research and innovation projects. At this stage, very little is empirically known about their outcomes. There is no evidence from these schemes showing any significant consumer willingness to pay price premiums; perhaps some have seen rising sales revenues. Consumers may perceive wildfire prevention as an intrinsic aspect of forest grazing; a targeted grazing label may thus not add much willingness to pay⁹. Certification standards are heterogeneous, and sometimes unclear: are producers paid exclusively for the status quo, or also for actively reinforcing new fire-wise strategic efforts? Overall, most **value-chain labels have so far remained at a proof-of-concept stage**, with limited impact on local markets. Their demand has not generated enough traction to confirm their future potential as standalone strategies towards wildfire resilience.

IV. INSURANCES PRICING IN RISK

Notably, the sheer existence of a risk-pooling insurance mechanism *per se* rather discourages individual or community efforts of risk reduction, compared to a scenario where every home and landowner had to self-assume the full costs of wildfire damages. Yet, in California (USA) recently some homeowner insurers have in high-wildfire risk areas adopted differentiated premiums: those insured who have implemented fuelbreaks and other risk reductions (applying to the full risk spectrum of hazard, exposure, and vulnerability) would be offered a discounted premium, compared to those who have not (who could even be denied home insurance). In principle, insurance screening could thus serve as a (dis)incentive tool for promoting more active risk reduction among to-be-insured home and landowners.

In practice, **differentiated premiums have been little applied, especially in Europe** – apparently because the transaction costs of differentiating and monitoring mitigation compliance are too high, compared to the insurers’ current perceptions of aggregate risk levels. In addition, the public sector has often stepped in to cover disastrous damages in Europe, thus arguably also undermining such insurance innovations.

V. LIABILITY FEES

Not everywhere in the world are landowners and users rewarded for reducing wildfire risk; conversely, they may also be punished if they disrespect their legal responsibilities, be it for causing ignitions or for incompliance with prescribed mandates for reducing the risk of fire spread. Accordingly, governments may thus also use disincentives: fees, fines, compensations for attributable damage from ‘owning the fire’. Often the borderline between incentives and disincentives comes to be blurred. **Liability fees have been**

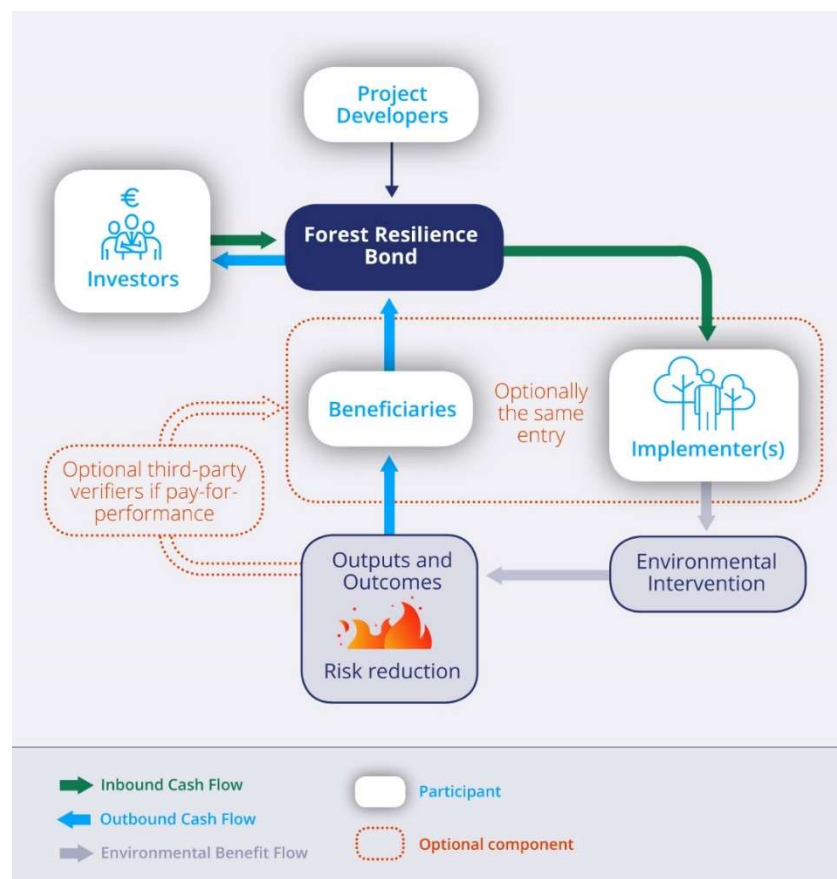
⁹ Lecegui, A. et al. (submitted). Assessing consumers’ preferences for beef and lamb meat linked to wildfire prevention services.

extensively used, e.g., in the USA or South Africa. It is politically easier to enforce them vis-à-vis wealthy landowners, rather than smallholders.

VI. BONDS

Environmental Impact Bonds are earmarked to an environmental action, and a form of environmental, social and corporate governance (ESG) investment. The tool has some similarities with PES, but instead **land managers receive funds upfront** as debt finance, in advance of the action – whereas PES typically are paid ex post. The land manager provides wildfire risk reduction and related environmental services; if the environmental target is achieved, investors receive their initial investment back with a return (Figure 3). The Forest Resilience Bond has been used specifically in the USA to finance some large-scale, biomass-reducing forestry operations by the public US Forest Service. It hinges much on the ability of service beneficiaries to solidly commit to future payments.

Figure 3. Structure of the Environmental Impact Bond. Based on Brand et al (2021)¹⁰.



¹⁰ Brand et al., 2021. Environmental Impact Bonds: a common framework and looking ahead. Environ. Res. Infrastruct. Sustain. 1, 023001. <https://doi.org/10.1088/2634-4505/ac0b2c>

VII. CORPORATE SOCIAL RESPONSIBILITY (CSR)

Private companies may invest in CSR projects as part of a strategy contributing to fire resilience. Funding can come from donations to local organisations to conduct activities on the ground, as when flight carrier Ryanair made environmental commitments to reduce CO₂ emissions in Portugal funding post-fire restoration. **Involving private companies can bring new funding opportunities** to fire risk reduction, on condition that the focus is on making nature-positive impacts beyond a carbon-offsetting logic.

3. Key messages

I. What fire-related economic incentives are currently out there?

- a. **Wildfire mitigation incentives remain globally incipient tools.** The world still relies mostly on command-and-control suppression instead. Navigating a change in emphasis from a hierarchical culture of suppression to one of participatory prevention and mitigation requires institutions and citizens to shift attitudes – which takes time, unless windows of opportunity emerge (e.g. larger political and social sensibility after a wildfire catastrophe triggering substantial change). Yet, fuel management seems the only controllable variable for diminishing the probabilities of future extreme wildfires.
- b. **Among those economic incentives, most are public subsidies.** About two thirds of our 76 cases rely on public funds. The 'market' and private finance play little role – which is little surprising, for addressing a classical public-damage externality problem.
- c. **Most wildfire risk-reducing incentives are being used for mitigation** (especially curbing excess biomass accumulation), rather than **prevention** (e.g. avoiding ignition). The latter are more being addressed through command-and-control policies and education; the former represent often higher private opportunity costs to compensate.
- d. **Direct incentives are more frequent than indirect ones.** Much more are incentives applied for 'landscape engineering' (e.g., fuelbreaks) than for 'bioeconomy' (e.g., productive subsidies in Galicia's Model Villages). Among the incentivized solutions, targeted agricultural action dominates over forestry interventions. If successful, indirect incentives could have longer-term impacts (i.e., reviving rural economies), but they also tend to be less focused, more expensive, and less certain in their impacts.
- e. **Payments for Environmental Services are leading – and continue to evolve.** PES or PES-like conditional, outcome-oriented subsidies for avoided forest biomass disservices have been the favoured incentive channel. Good design progress has been made over 30+ years of implementation.

- f. **Glaring inefficiencies in traditional rural subsidies**, including due to weak strategic zoning. For instance, wildfire mitigation funding under the EU-RDP seem to go mostly to regions and lands with low wildfire risks.
- g. **Wildfire externalities will grow; expect incentives to address them to do the same.** Climate change and the forest transition will predictably exacerbate wildfire problems in Europe and elsewhere. There will thus be more future scope to use economic incentives as one element in mitigation-focused strategies to manage fire risk.

II. How to adequately contextualize incentives?

- a. **Country/ regional contexts differ substantially.** In Europe, PES and subsidies are used as public-agency-to-landowner tools. In the USA, more bonds, insurances, liability fees, and community tools respond to their less state-focused rationale.
- b. **Fragmented landownership puts incentives in the driver’s seat.** Southern Europe's rural smallholders politically demand incentives to change – conversely, large private owners in South Africa and the USA (incl. state forests), and more US wildland-urban interface (WUI) spread-out settlement are all scenarios calling less for incentives.
- c. **Risk culture matters for beneficiaries’ willingness to pay:** European citizens (and taxpayers) tend to expect wildfire risk management duties to be one of a welfare state's traditional functions – not a service that needs to be privately paid for.
- d. **Current heavy burns in Western USA may foretell some of Europe's future – and possibly some solutions:** more economic carrots and sticks creatively combined may also be an adequate cocktail for Europe’s challenges ahead.
- e. **Local behavioural customizations are needed.** Risk perceptions, informal rules, social norms, and landowner opportunity costs for risk-preventive actions are all factors that may change primary motivations, and that adaptively need to be considered.

III. How to increase impacts through improved incentive design?

- a. **Spatial targeting of high-risk areas is often weak, including in various subsidy schemes** (e.g., EU-RDP). It is fundamental to identify the most vulnerable and strategic areas in the firescape, and make sure they become highest priority for action.
- b. **Consider opportunity costs of landowners.** We should research what is the right payment type and level to land managers, and/or the use of trial and error to find out – as happened in the successive grazing PES schemes.

- c. **Are individual or collective incentives needed, or both?** Motivations and relevant risk-reducing actions, social capital, fragmentation of ownership and need for spatial coordination will all vary locally – and so should the recipients of incentives.
- d. **Guide local agencies on motivation strategies.** Capacity building may be needed for local implementers to discover the factors motivating landowners to join an incentive scheme, to reach adequate participation levels.
- e. **Involve forest owners in design and financing of preventive actions.** Where forestry is sufficiently profitable (e.g. in South-Western France), obligatory landowner fees paid to municipal associations can help co-finance costly wildfire risk-reducing actions, as part of a locally sustained model featuring cost-sharing and collective action.

IV. How to better implement impact-oriented incentive-based strategies?

- a. **Experiments with incentives need time.** Stakeholders from public administrations to communities and landowners need to adapt; continuous political commitment is required. Grazing PES schemes and their long-term progress show that patient adaptation can pay off.
- b. **Secure long-term funding streams.** A precondition for continuity is that the economic basis for the incentives is clear and solid: who will pay, for how long?
- c. **Impact evaluation needed to know better what works.** The empirical basis for choosing rationally between risk-reduction strategies currently remains thin. Recurrent monitoring and frequent formal impact evaluations would help implementers in moving towards adaptive management of wildfire risk.
- d. **Mixed strategies can increase flexibility.** Using simultaneously both public and private funding, and both incentives and disincentives/ liability rules may increase implementers’ degrees of freedom and make it easier to be adaptive.
- e. **Good intermediaries can be essential.** Mediators, including local intercessors, can often more effectively communicate and coordinate among landowners, and/or vis-à-vis the external public entities. They can help smoothing administrative burdens.
- f. **Scaling-up incentives beyond the firescape might not work well.** There is eventually a danger for upscaled incentives to lose focus – just as there arguably has been for hydrological protection schemes, upscaled beyond watersheds¹¹. Rather, *scaling-out* – replicating initiatives at a similarly customized scale – will often be more promising.

¹¹ Asquith, N. & Wunder, S. (2008).

https://www.researchgate.net/publication/236027847_Payments_for_Watershed_Services_The_Bellagio_Conversations#fullTextFileContent

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