Cultivated land is resistant to fire due to the presence of moisture and a lack of dry fuel, and can act as a fuelbreak. Photo: Harifidy Ratsimba

Agricultural fuelbreaks in sustainable fire-resilient landscapes in Madagascar

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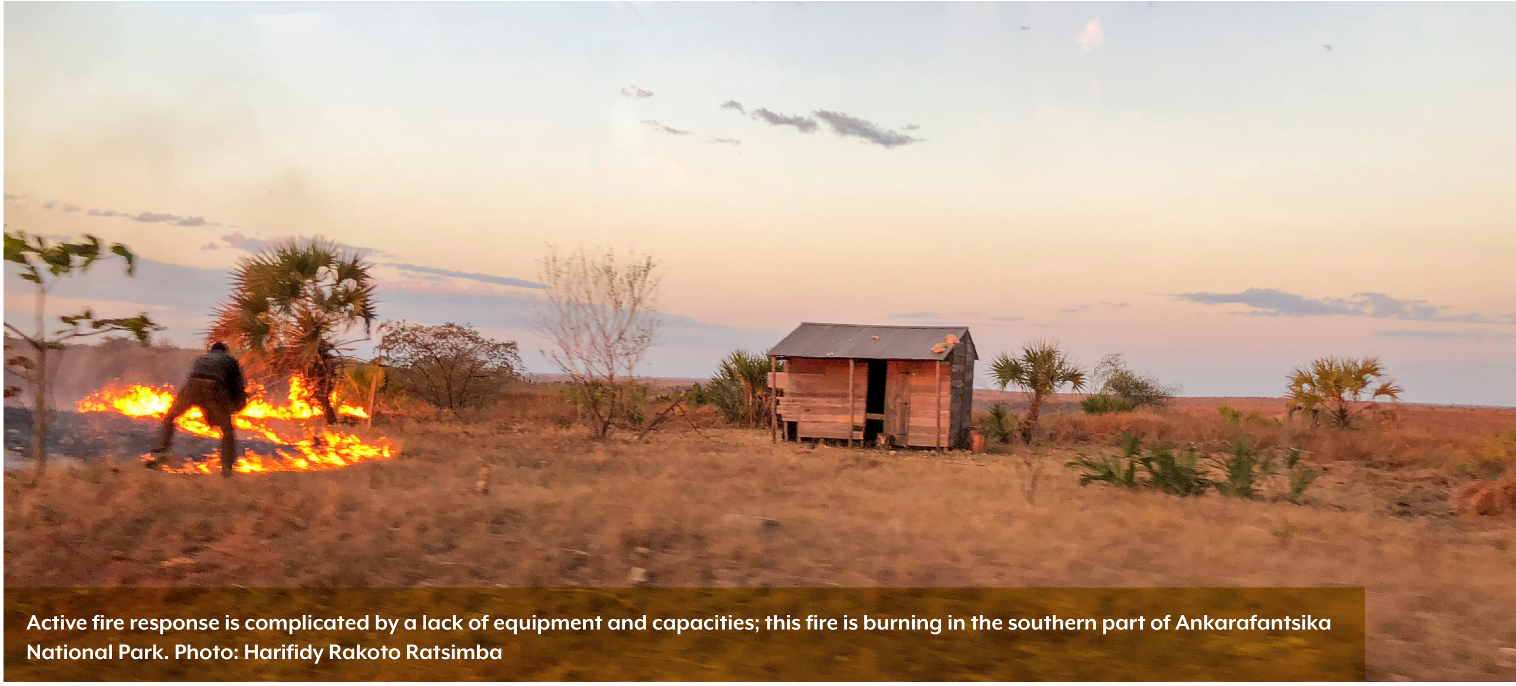
"Establishing agricultural fuelbreaks helps to create fire-resistant mosaic landscapes, including new farmland, while reducing forest degradation and deforestation."

Introduction

The use of fire has been part of agricultural and forestry practices for millennia and is still practised today throughout the tropics, including Madagascar. However, uncontrolled fire is also one of the main threats to natural habitats, ecosystems and species in Madagascar, being especially damaging in with rich biodiversity, such as protected areas. Fire has affected much of the country's unique biodiversity, characterized by substantial endemism of more than 80% in plants, 90% in reptiles and mammals, and 99% in amphibians. The high frequency of fire in Madagascar has also increasingly shaped landscapes, gradually degrading closed forest into savanna and grassland. Landscapes are affected by the cumulative effects of fire and other human activities, particularly logging, charcoal making and the planting of exotic trees in reforestation projects.



Active fire response is complicated by a lack of equipment and capacities; this fire is burning in the southern part of Ankarafantsika National Park. Photo: Harifidy Rakoto Ratsimba

The main cause of uncontrolled fires in forested areas is the clearing of land for slash-and-burn farming, often carried out by poor farmers with extremely limited resources. To a lesser extent, wildfires spread from agricultural fields and pastures to wetlands, where fire is used for conversion into rice fields.

Context

The impacts of uncontrolled fires have long been known. In 1881, Queen Ranavalona II published the 305 Articles code, which included a formal framework for forest management and specified sanctions for offenders (Julien 1932). Article 101, for example, stated that "Forests must not be burnt; those who burn them will be put in irons for 10 years." Before independence in 1960, more than 40 laws or degrees were enacted that prohibited fires for forest clearing, and regulated crop and pasture fires, with penalties of five to ten years' imprisonment, and obligations to fight fires at the local level (Rasamoelina 2003). At that time, at least 2,500,000 hectares of fires per year were reported (Gendarme 1960).

Large areas continued to burn each year: 1-3 million hectares (ha) annually between 1970 and 1984. A drastic improvement began in the 1980s, with the development of initiatives by the national government, financial instruments, and through the awareness and empowerment of actors and citizens. This reduced the annual burned areas to 0.1–1.0 million ha between 1985 and 2000 (Rasamoelina 2003). However, this work was hampered by a lack of local interest in fighting fires, and by the absence of suitable equipment and capacities and of dedicated fire services.

In recent years, the extent of burned areas has risen sharply, with more than 5 million ha burned annually on average between 2017 and 2021, as reported by the Regional Eastern Africa Fire Monitoring Resource Center. This increase, however, may be due in part to improved technologies that allow for very accurate evaluation of burned areas through high-resolution satellite images.

The development context

In Madagascar, agricultural extensification continues to be promoted by agricultural policy, which allocates fertile land — often in lowland wetlands and natural forests — for conversion into farmland. This is accompanied by the use of fire for clearing and shifting cultivation and for renewing pastures, largely by smallholders with limited access to agricultural inputs, labour and equipment, and decreasing plot sizes with very small family farm holdings averaging 0.87 ha per household (MAEP 2007).

To address this, the government, with the support of technical and financial partners, has implemented various approaches that focus on specific sectors, such as water management, biodiversity conservation, land restoration and agricultural development. These approaches have increasingly been combined to promote multifunctional landscapes that are adapted to the needs of a range of stakeholders.

An evolution in approaches

Landscape approaches go back decades, but tended in the past to focus on environmental objectives through conservation of large forest holdings or watersheds, and through reforestation, often using exotic species. In 1946, soil scientists first undertook an analysis of Malagasy soil types. This involved an assessment of different types of erosion and possible means of control, noting the importance of soil organic matter and the role of trees (Segalen 1948). Since then, the dominant discourses in both scientific approaches and operational responses have been geared to reforestation, especially on steeply sloping land.

Agricultural development efforts concentrated on mechanized ploughing practices on flat farmland and in large irrigated areas. Schemes in the 1950s focused on reforesting watersheds upstream of reservoirs and rice fields. This approach was later replaced by agroforestry, including coffee and other trees, and in the 1990s by the promotion of agrosilvopastoral systems (Chabalier 2005). However, these approaches, like previous ones, were based on the premise that technical solutions should replace traditional land-use systems, and this tended to lead to confrontations with smallholder farmers.

In the late 1980s, experts criticized the frequent failure of previous management approaches, especially those efforts that focused on erosion control. They proposed more participatory strategies that attempted to improve smallholder livelihoods while also enhancing soil fertility, water infiltration and cropping systems, fusing local and technical knowledge, and adapting to evolving ecological and economic conditions. However, promoting and adopting such practices was limited by the context of three- to five-year projects; successful adoption requires much more time. For example, it took 10 to 20 years for the positive impacts of the practice of off-season crops and rotations — introduced in the 1990s — to become apparent.

Forest landscape restoration

Early sustainable land management efforts were limited to practices that reduced runoff and erosion and increased soil fertility. Broader approaches emerged over time that included the management of water, biomass and soil fertility being extended from plot level to cover whole watersheds. However, improving agricultural production or farmer income was rarely a goal, and many programmes even sought to limit farming. Forest landscape restoration (FLR) is the latest incarnation of these broader approaches. It is more a process than a set of management actions, and it explicitly includes social and economic development at its core, aiming to improve agricultural production, biodiversity (of both crops and wild species), ecosystem conservation, and local livelihoods. Inclusive multi-stakeholder dialogue is also a crucial component.

Using the FLR approach, regional and communal land-use plans have been initiated in some areas of Madagascar, first appearing in the late 2000s for

Fire control seems to be impossible on forested land (left), while some fire management is carried out in agricultural areas (right). Photo: Harifidy Rakoto Ratsimba

Developed agricultural areas in valleys are rarely affected by large savanna fires. Photo: Harifidy Rakoto Ratsimba

implementation over a 15-year period. In theory, they included landscape dimensions, but in practice, they were constrained by a lack of effective decentralization of capacities and decision-making. In addition, the key actor of change in FLR is the farmer or landowner — a fact that was often neglected, if not ignored entirely. Also, concepts of land-use planning and land tenure have tended to be considered in different ways, whereas in FLR they should are addressed together to ensure a transition to more sustainable land use.

Lessons for developing fire-resilient landscapes

The evolution of approaches to land use in Madagascar includes examples of cumulative analysis and expanding expertise over more than 80 years to address the complex issues surrounding sustainable land management, especially in the face of fire. Several key findings have emerged.

- Cultivated farmland rarely burns, except when plots are cleared by fire (which creates a risk of the fire spreading if it is not controlled).
- Forest land has long been protected by firebreaks (see Box 1); these are usually 3–10 metres (m) wide, depending on resource availability (mainly labour). However, firebreaks are costly to maintain, due to the regrowth of vegetation, which has to be removed at least every three years.
- Savanna and grassland areas are considered wasteland by farmers (Carver 2020), who see value only in cultivable areas, and think that forest land is useful only for harvesting tree products, or to be cleared for farmland (Goldammer 1988). These areas, now considered as degraded land, today represent almost two-thirds of the country.
- Restoration efforts, which are necessarily long term, have been hindered by issues regarding unclear land ownership.
- The need to improve smallholder livelihoods has received inadequate attention, even though farming is the main source of sustenance and income for more than 80% of the country's population.
- Natural ecosystems have their own inherent capability to regenerate, but human activities weaken this ability, which means that a deeper understanding is needed of appropriate nature-based solutions.

Agricultural fuelbreaks – a response to multiple issues

'Classical' firebreaks are usually 3–10 m wide. They limit the impact of fires, but require clearing every three years (see Box 1). They also have little influence on fires that are started within forests for slash-and-burn cultivation; this is a survival strategy for the poorest rural people, who need land to produce food.

From these observations was born the idea to create broader agricultural fuelbreaks, 25–100 m wide (see Box 1). They can be created by farmers and can generate additional livelihood options while also limiting the build-up of biomass or fuel load through regular cultivation.

Box 1. Definitions

Firebreaks – "Any natural or constructed discontinuity in a fuelbed utilized to segregate, stop, and control the spread of fire or to provide a control line from which to suppress a fire; characterized by complete lack of combustibles down to mineral soil (as distinguished from fuelbreak)."

Fuelbreaks – "Generally wide (20–300 meters) strips of land on which either less flammable native vegetation is maintained and integrated into fire management planning, or vegetation has been permanently modified so that fires burning into them can be more readily controlled (as distinguished from firebreak). In some countries fuelbreaks are integrated elements of agro-silvopastoral systems in which the vegetative cover is intensively treated by crop cultivation or grazing."

Source: FAO 2013

Agricultural fuelbreaks have multiple aims, which include integrating systems that limit the frequency and spread of uncontrolled wildfires, reversing the conversion of forest to farmland or to otherwise becoming degraded, increasing the ability of ecosystems to regenerate, and balancing the needs of communities to produce their own food and protect ecosystem services. See Figure 1.

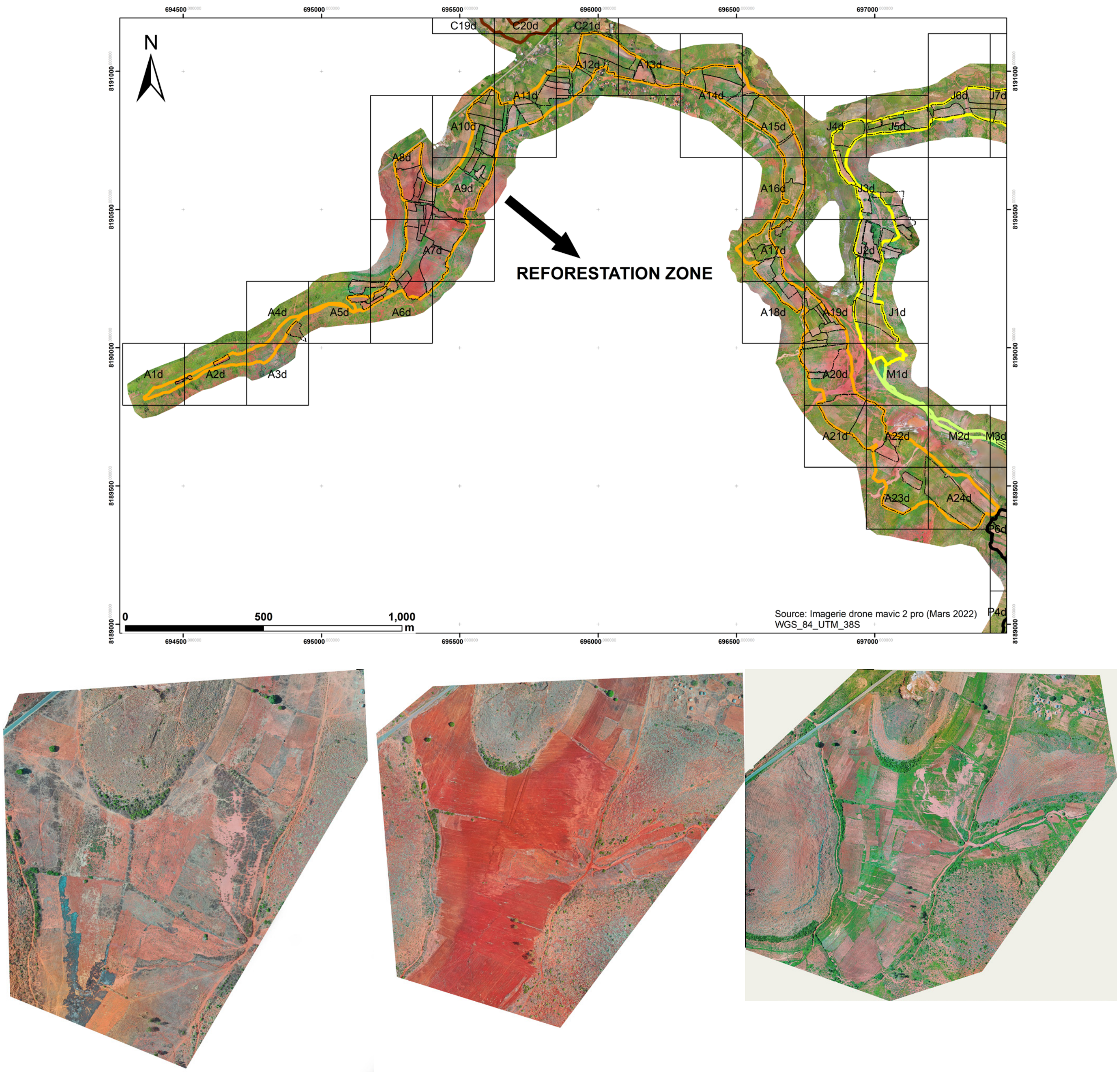
Establishing agricultural fuelbreaks requires substantial investments in the first year, but they do not then require any follow-up costs for clearance. The land must be ploughed to break up compacted soils, and amendments must be added to ensure enough fertility to grow crops, which happens during the rainy season. Biomass is eliminated before the dry season.

Most importantly, land-use rights need to be secure to ensure that farmers are willing to invest their own resources over the long term in the plots allocated to them, while also respecting local, sub-national and national rules. This security gives value to the degraded land within fuelbreaks. Plots have to be large enough to attract farmers, however; soil fertility is generally very low, and farmers require some production from the first year to support household food security. Thus, agricultural practices must respond to the technical issues of fertility (use of inputs, crop associations, etc.), economic issues related to subsistence, and social issues related to land ownership.

Successful implementation

The first 65 km of agricultural fuelbreaks in the country were established in Boeny Region (mainly around Ankarafantsika National Park) in northwestern

Territorial organization remains a major issue in landscape management, with underlying social and technical challenges. Photo: Harifidy Rakoto Ratsimba



November 2021 December 2021 March 2022

Figure 1: Visualization of the results of setting up fuelbreaks around a reforestation area. Source: Harifidy Rakoto Ratsimba

Madagascar between 2021 and 2022. This effort was supported by the GIZ PAGE2 project (*Programme de Protection et Exploitation Durable des Ressources Naturelles à Madagascar*), the Land, Landscape and Development Research Lab, and the Regional Eastern Africa Fire Monitoring Resource Center.

Established in generally open landscapes dominated by grassy savanna, these fuelbreaks limit the spread of fires, which occur with varying frequency. They also create an additional 615 ha of farmland for crop production; this should help to limit further slash-and-burn activities in the national park and so further reduce the potential for future fire ignitions.

Due to the benefits seen by local smallholders and decision makers, the use of such fuelbreaks has now spread to more locations far from the national park, creating more new farmland and further reducing the risk of uncontrolled wildfires spreading. In 2022, an additional 400 ha of agricultural fuelbreaks are planned; and are envisaged around other protected areas in the coming years.

The keys to success are territorial land-use plans that make it possible to create fire-resistant mosaic landscapes that combine forest and agricultural land. A priority of territorial planning is to reduce the impact of fires for multiple reasons, such as the protection of wooded areas and biodiversity zones and the protection of nearby residential areas. The goal is to find sustainable solutions to the problem of fire, while in parallel, creating agricultural, economic and social opportunities.

The next stage is to plant wide spaced trees in the fuelbreaks to reduce erosion and improve nutrient cycling and availability, while diversifying production (for example, a lemon and moringa plantation has already been established in the sloped area of Boeny Region). Agricultural fuelbreaks should eventually resemble agroforestry plots, and their elongated structure should gradually give way to an integrated landscape with multiple functions (Figure 2).

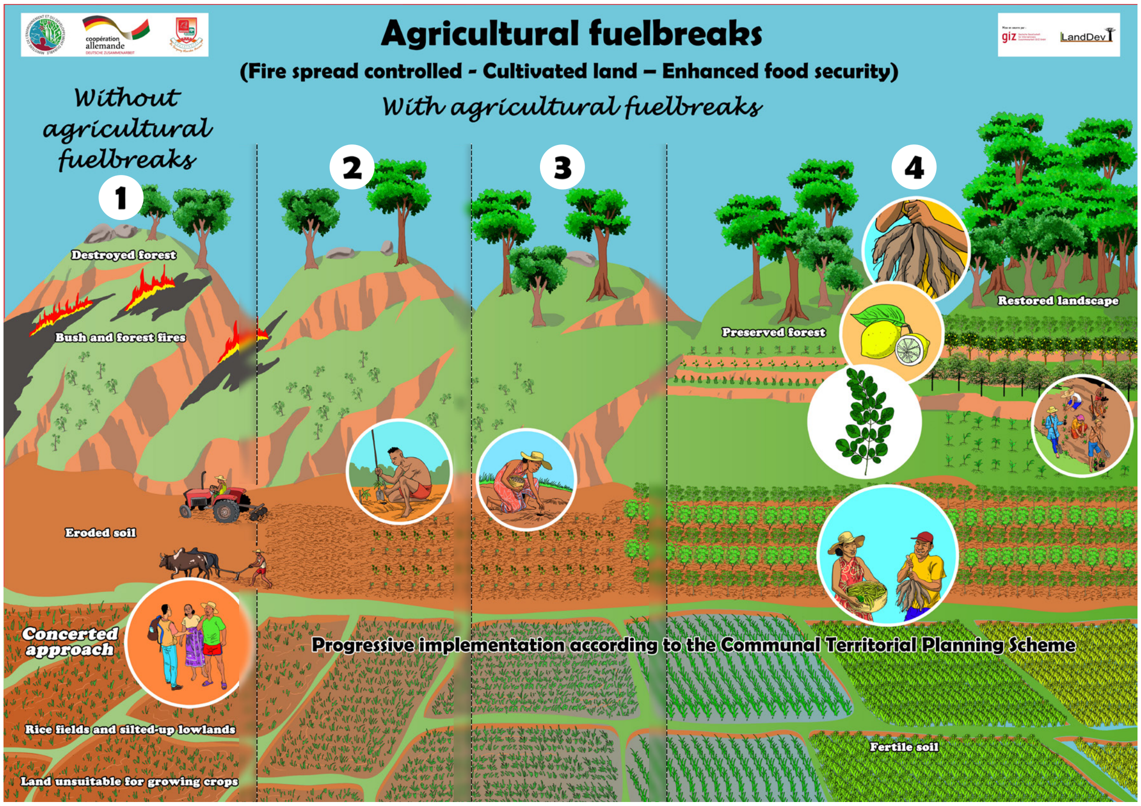


Figure 2: Agricultural fuelbreaks as a component of integrated and multiple-use landscapes. Source: LLandDev.org

Conclusions

Land tenure remains a key challenge in establishing agricultural fuelbreaks. Indeed, land ownership remains the key driver of farmers' interest in sustainable land management. Combining short- and long-term investments is vital, particularly in the process of maintaining and restoring fertility. Farmers are always interested in multiple benefits over a range of time periods (with a strong bias towards the short term).

The process of establishing fuelbreaks is relatively cumbersome. It requires the support of decentralized services (responsible for territorial land-use planning) and centralized services (for technical support, particularly in the agriculture, livestock, forestry and land sectors). This makes scaling up difficult in Madagascar, where sectoral ministries are understaffed as a result of structural adjustment policies in the 1990s. This problem cannot be addressed by projects that have neither the mandate nor the timeframe for this type of support. Two key elements are thus becoming apparent as framework conditions for long-term success: capacity strengthening at the community level, and finding ways to connect directly with farmers for a continuous exchange of information based on a common learning model.

The concept of agricultural fuelbreaks is not new. It draws on experience with and knowledge of sustainable land management in Madagascar developed over the past century. It also fits into mosaic management and landscape approaches that date back several decades.

However, the concept has been, and still is, challenged by contrary aspirations to manage large uniform areas in a way that facilitates operational management but weakens fire response capability, particularly in forests. The current difficulty in controlling large fires illustrates the shortcomings of that approach, and agricultural fuelbreaks appear to offer a sustainable approach to achieving fire-resilient landscapes.

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