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# The status of Mediterranean forests 2025

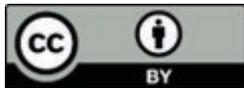
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# Chapter 6 - The role of urban and peri-urban forests in improving sustainability at the urban–rural interface

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## Introduction

The urban population of the Mediterranean was approximately 562 million in 2020, and it is projected to rise to 669 million by 2050 (UNDESA, Population Division, 2018).

As cities grow, so does their demand for resources, such as food, water and energy, putting huge pressure on peri-urban and rural areas where these resources are produced. This urban expansion often results in a one-way flow of ecosystem goods and services as cities progressively drain rural reservoirs without replenishing them, thereby disrupting ecological balances and reducing the benefits that these ecosystems provide.

At a time when balancing rural areas and urban sprawl is critical, understanding the underlying

dynamics of urban–rural exchanges is of utmost importance. These exchanges between urban and rural areas form the foundation for providing essential goods – such as food, water, timber, fibre and energy – known as provisioning ecosystem services, along with many other ecosystem services that provide regulating, supporting and cultural benefits. At the core of this balance is the concept of ecosystem connectivity (Staccione, Candiago and Mysiak, 2022), which entails creating channels for ecosystem services that go beyond municipal boundaries. This approach helps tackle landscape fragmentation and the resulting degradation of ecosystems, while also improving the urban ecosystem itself.

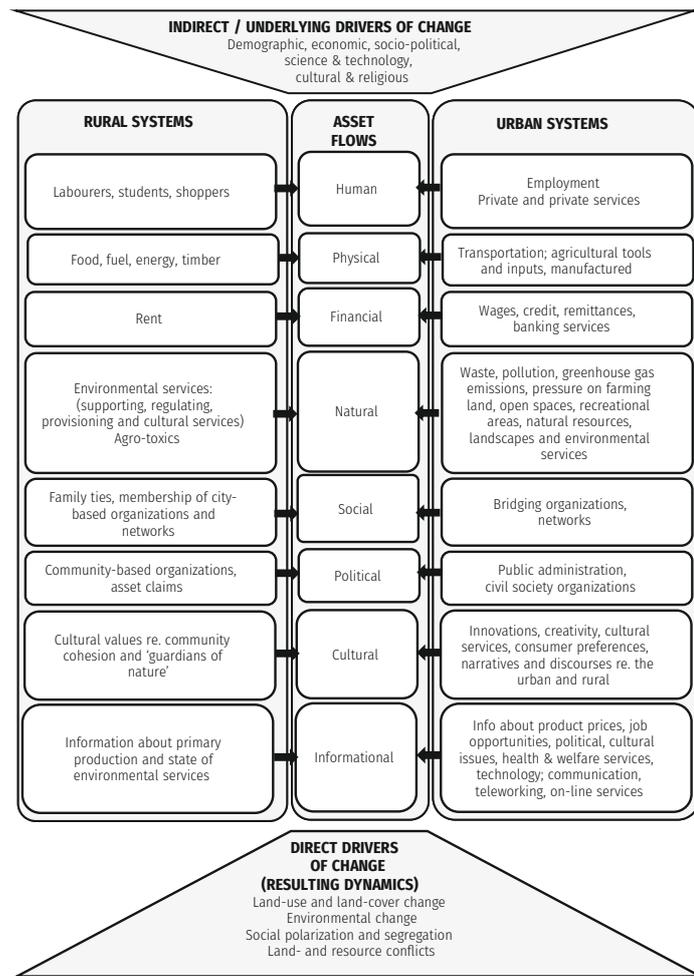
Historically, Mediterranean cities were compact, but the rapid urbanization that began in the twentieth century has since shifted towards more

expansive urban development because of rural-to-urban migration coupled with the displacement of urban residents caused by the gentrification of city centres. This has led to serious social challenges and the fragmentation of natural landscapes, which threatens biodiversity and weakens ecological connectivity. By 2030, the Mediterranean region is projected to become one of the biodiversity hot spots with the highest urban cover, which is set to increase by 160 percent. This increase is second only to that experienced by the Eastern Afromontane region, which is expected to see a 1 900 percent rise in urban cover (Seto, Güneralp and Hutyra, 2012).

Since the mid-twentieth century, rapid urban development has transformed natural and semi-natural habitats and led to a dramatic increase in substrate impermeability. Soil sealing is considered one of the main causes of land degradation in Europe (Ferreira *et al.*, 2022), with particular reference to the urban–rural interface (URI). Critical land cover transformation in peri-urban areas has had detrimental effects on both the urban and rural environments, amplifying the impacts of climate change.

The URI is the transitional zone where urban and rural areas converge. It is characterized by rapid land-use changes and significant demographic shifts. It is more than just a physical boundary; it is a dynamic space where the influences of urban and rural environments intermingle, creating both challenges and opportunities in ecological, social and economic terms. In many peri-urban areas, inadequate living conditions expose residents to climate-related risks, such as floods and droughts

**Figure 6.1.** Asset flows at the urban–rural interface



Note: As cited in Ros-Tonen, Pouw and Bavinck (2015): flows and direct drivers are adapted from Douglass and from Allen; the flows have been restructured as asset flows, considering Castells' concept of "space of flows"; and indirect drivers and environmental services are based on the Millennium Ecosystem Assessment.

Source: Ros-Tonen, M., Pouw, N. & Bavinck, M. 2015. Governing Beyond Cities: The Urban-Rural Interface. In: J. Gupta, K. Pfeffer, H. Verrest & M. Ros-Tonen, eds. *Geographies of Urban Governance: Advanced Theories, Methods and Practices*. pp. 85–105. Cham, Switzerland Springer International Publishing. [https://doi.org/10.1007/978-3-319-21272-2\\_](https://doi.org/10.1007/978-3-319-21272-2_)

(IPCC, 2014). Furthermore, air pollution and heat waves disproportionately affect Mediterranean cities compared to northern Europe, posing significant public health challenges, especially among vulnerable populations (Ballester *et al.*, 2023; Neira *et al.*, 2023; Rodríguez *et al.*, 2007).

Although cities provide rural areas with intangible benefits such as financial flows, technological advancements and cultural innovation, these advantages do not make up for the depletion of natural resources and ecosystem services (Ros-Tonen, Pouw and Bavinck, 2015). The URI thus

becomes a spatial entity in its own right – a zone of unequal exchange, where the flows of ecosystem services are unbalanced. Addressing these imbalances at the URI is crucial, as they directly affect the reciprocity and equitable exchange between rural and urban areas. Achieving this requires integrated urban planning strategies that prioritize land management, resilience building, and equitable access to resources and services.

In this context, peri-urban forests<sup>19</sup> can greatly help re-balance an uneven distribution and flow of ecosystem goods and services along the URIs of the Mediterranean region. As shared assets, these forests can connect urban and rural environments, providing mutual benefits to both populations at the same time. This chapter explores the specificities of the Mediterranean URI; the role that peri-urban forests play in balancing the flows of products and services between rural and urban areas; and the importance of recognizing the URI as a specific spatial type that requires distinct strategies in respect of the planning and management of peri-urban forests.

## Specificities of the urban–rural interface and the role of urban and peri-urban forests

### *Ecological and environmental specificities of the urban–rural interface*

From an ecological perspective, the URI features a diverse range of habitats, including remnants of natural vegetation, agricultural land, urban greenspace, and newly established woodlands in abandoned sites and brownfields (Trentanovi *et al.*, 2021). This diversity supports a variety of species and ecological processes, making these areas crucial for biodiversity conservation and food production. As we will see in the examples below, by regulating ecosystem processes and the flow of goods and services between urban and rural areas, peri-urban forests and trees play

a pivotal role in mitigating the impacts of urban sprawl and land conversion, boosting resilience to disasters and climate change effects, and improving the overall quality of urban and peri-urban environments.

The URI is particularly susceptible to land-use change, driven by the expansion of urban areas, and its ecological integrity is often compromised by habitat fragmentation. The conversion of land from rural to urban uses often leads to significant environmental impacts, including soil degradation, loss of biodiversity, and alterations to the hydrological cycle. Healthy and diverse peri-urban forests can play a key role in mitigating these ecological disruptions. A notable example of this can be found in Ljubljana, Slovenia, where data were collected to estimate the reduction of surface runoff resulting from planting trees in a car park. The results show that pine trees could reduce surface runoff by 7.3 percent per year, while birch trees may provide a 4.8 percent reduction (Zabret and Šraj, 2019). Peri-urban forests can slow down rainwater runoff, recharge groundwater and increase water availability in soils, which is essential for soil health and resilience on peri-urban agricultural land.

Forests and trees serve as green corridors that connect fragmented landscapes and help conserve biodiversity, allowing for the movement of species and maintaining the balance of ecological processes. The 400 hectares of green belt surrounding Ouarzazate, Morocco, have acted as a buffer against desertification. This has helped reduce soil degradation and has protected the city from the strong winds and dust clouds that affect the area (UNEP, 2015). In Ljubljana, Slovenia, a mosaic of numerous forest remnants combined with larger forest complexes, helps maintain ecological connectivity, providing habitats for a variety of bird species and preserving the stability of their populations along the rural–urban continuum (de Groot *et al.*, 2021).

Urban and peri-urban forests also improve local climate resilience by sequestering carbon and regulating urban microclimates. Areas of the URI where vegetation consists of large woody species have the potential to serve as substantial carbon sinks. Research conducted in Rimini, Italy, showed that mature specimens of large species

<sup>19</sup> Networks or systems comprising all woodlands, groups of trees and individual trees located in peri-urban areas, including trees and woodlands in the URI (FAO, 2016).

such as *Platanus x acerifolia* can remove up to 9 kilograms (kg) of carbon dioxide (CO<sub>2</sub>) from the atmosphere per day through photosynthesis, 65 years after being planted, and can sequester up to 220 kg CO<sub>2</sub> per year as new woody biomass, ultimately storing up to 7 tonnes of CO<sub>2</sub> in their overall woody biomass (Fini *et al.*, 2023). Studies using the life cycle assessment approach have highlighted how peri-urban forests are the option with the greatest potential as CO<sub>2</sub> sinks, considering both the above-ground vegetation and the soil (Nicese *et al.*, 2021).

The maintenance of healthy vegetation along the URI can also help minimize the risks associated with wildfire (Bento-Gonçalves and Vieira, 2020; Tacaliti *et al.*, 2023). In Italy, over 50 percent of forest fires occur within 300 metres of an urban area, highlighting the challenges at the wildland–urban interface (Mancini *et al.*, 2018). Furthermore, these areas are susceptible to experiencing recurring fire events at short intervals (Elia *et al.*, 2019). In Türkiye, cities have grown outwards, and for the past 60 years, settlements have gradually encroached on the forests around them. This urban sprawl has heightened the risk of forest fires, which have caused considerable damage to both the urban settlements and the forests. Additionally, the preparedness of forestry management and local governments has often been inadequate, leading to substantial losses of life and property during the fires (Şen, Güngör and Şevik, 2018). The Iberian Peninsula is one of the regions in the Mediterranean basin most susceptible to fires. This has led to the implementation of national plans for protection against fire and committees to fight forest fires in both Spain and Portugal. These strategies set out specific action plans to prevent fires in the URI, given that this area has experienced the highest increase in risk in recent years due to urban expansion and the abandonment of agricultural land. The progressive replacement of highly flammable non-native tree species, such as *Eucalyptus* spp., is one of the actions planned.

Finally, in some Mediterranean cities, woody perennial food-producing species have been used to establish urban food forests. This practice relies on a combination of agriculture, forestry and agroforestry in urban areas, and supplies

cities with nutritious food while also improving urban biodiversity and enhancing social cohesion (Salbitano *et al.*, 2019). A notable example of a food forest is the Forest Vegetable Garden in Parco Nord, Milan, Italy. There, 2 000 fruit trees along with a variety of vegetables and herbs have been planted together in a way that mimics natural ecosystems, providing fruit such as berries that are edible for humans and for the local wildlife. The project aims to grow food while simultaneously enhancing biodiversity. In doing so, the Forest Vegetable Garden helps establish green corridors that connect fragmented habitats around the edges of the city, benefiting both biodiversity and the people living there.

### **Social specificities of the urban–rural interface and the role of urban and peri-urban forests in social integration and community building**

The URI is often characterized by population changes, as urban residents seek a more rural lifestyle and rural inhabitants move closer to urban centres in search of economic opportunities. This creates a hybrid social environment, where rural traditions and urban lifestyles intersect.

However, the URI is shaped not only by demographic shifts between urban and rural populations, but also by global migration patterns. In Mediterranean cities, lower-income populations and migrants often reside in suburbs or on the outskirts of urban centres where housing is more affordable, and employment opportunities are more accessible to them. While this can foster cultural exchange and social integration, it can also create challenges related to social cohesion and community identity, particularly if the needs and values of different groups are not adequately addressed.

A prime example of improving social integration through peri-urban forests can be seen in Catalonia, Spain. The Parc Natural de Collserola, a peri-urban park located west of Barcelona, serves as a cultural venue and natural site for residents from diverse neighbourhoods and backgrounds. By hosting cultural and educational events and providing a place for recreation, the Parc Natural

de Collserola offers a shared space to urban and suburban residents, fostering social interaction and integration. The Taza National Park in Algeria is another example of successful collaboration between urban and rural areas. It offers residents a shared recreational area to enjoy nature and take part in activities that promote environmental awareness (Bouchentouf, 2019; Moulai, 2020).

However, social dynamics can be further complicated by the emergence of informal settlements or slums, which frequently develop in the suburbs of cities, typically occurring in areas where the lack of affordable housing fails to meet the needs of growing populations, particularly among low-income groups, including migrants. The existence of slums within the URI can exacerbate existing social inequalities, making it more difficult for residents to integrate into both urban and rural communities. A particularly relevant example of how peri-urban forestry can address these challenges is the recent dismantling of the Lombroso slum in Rome, which existed on the city's outskirts for 37 years. This marked a significant step towards fostering social inclusion and creating a healthier urban environment. The city implemented a relocation plan for 33 families, totalling 145 individuals, to provide new housing opportunities as well as integration programmes and tailored educational pathways for children. What makes this case especially noteworthy from the perspective of peri-urban forestry is the transformation of the former slum into a new urban forest. The site will be reforested with 145 trees symbolizing the relocated individuals, and the new green area will create a green corridor that connects to the nearby Santa Maria della Pietà park. By transforming a previously marginalized site into public greenspace, this initiative provides an opportunity to rebuild social ties while enabling social reconciliation after years of social fragmentation. Moreover, it balances upholding human rights through the provision of decent housing and social services, and restoring legality, urban decorum and environmental health.

Building on these exemplary initiatives, forests can also play a key role in addressing the broader disparities between urban and rural areas, particularly in terms of access to services and infrastructure. While urban residents typically

have better access to health care, education, transport and other essential services, those living on the outskirts at the URI may face significant barriers. Forests and trees can help bridge these gaps by improving both the aesthetics and the functionality of peri-urban areas. The development of green corridors not only makes these areas more pleasant but also promotes more sustainable mobility options. By incorporating cycling paths into green areas, cities can create accessible, safe and environmentally friendly alternatives for commuting and recreation, which can also help reduce traffic congestion and pollution both at the URI and within urban centres. A successful example of this approach can be found in Marseille, France, with the ambitious rehabilitation programme of the Longchamp park. This initiative aimed to restore this historic park and make it more accessible and appealing to all residents, particularly by reducing environmental disparities between the affluent and less privileged neighbourhoods in the city. The initiative is part of a broader citywide effort to promote sustainable mobility. Marseille is actively developing green paths and cycle lanes to connect its peripheral neighbourhoods, such as the 1.7 kilometre-long green path that links the Roy d'Espagne pine forest to the sea at Pointe Rouge, featuring both pedestrian walkways and cycling paths.

In both Rome and Marseille, peri-urban forestry initiatives highlight how green infrastructure can help bridge social divides and enhance environmental sustainability. These projects not only improve the quality of life for residents living on the URI but also contribute to broader social and environmental goals, demonstrating the essential role of peri-urban forests in building inclusive and resilient communities. Moreover, they show that addressing social disparities at the URI requires targeted investments in infrastructure and services that cater to the diverse needs of both urban and suburban communities, ensuring that the benefits of urbanization are shared more equitably across the interface zone.

### Tree house in the peri-urban forest of Celje, Slovenia.



### **Economic specificities of the urban–rural interface and the role of urban and peri-urban forests in improving livelihoods**

The URI features a diverse economic landscape, where agricultural and non-agricultural activities co-exist. Agriculture remains a significant economic activity in many interface areas in the Mediterranean region, providing livelihoods for rural populations and contributing to the food security of nearby urban centres. At the same time, the proximity to urban markets creates opportunities for diversifying economic activities, including various industries, such as manufacturing, tourism and service-oriented businesses. Economic diversification can strengthen the resilience of interface communities, allowing them to adapt to changing economic conditions and reducing their reliance on any single source of income.

However, land values in the URI are often highly variable, reflecting the competing demands for land in these areas. As urban areas expand, the value of land in the interface zone tends to

increase, due to speculation and the potential for future development. This can lead to economic displacement. The changes in land ownership patterns can have significant social and economic consequences, including the loss of agricultural land, disruption of rural livelihoods, and the transformation of the interface areas into more urbanized environments. In such contexts, urban and peri-urban forests can offer a valuable buffer by supporting economic activities and ecosystem services that contribute to the local economy. Sustainable management of urban and peri-urban forests can generate income through ecotourism, agroforestry, and the sale of forest products, creating jobs for local communities while promoting environmental conservation. The peri-urban forest of Celje, Slovenia, is an excellent example of a sustainably managed forest area on the fringe of a city, designed for ecotourism and providing a stimulating and diverse outdoor environment.

Other initiatives aimed at conserving and restoring peri-urban forests focus on the preservation of agricultural areas. In the peri-urban environment known as La Vega, in Granada, Spain, irrigated agriculture for crops like potatoes, tobacco and corn, is being replaced by the revival of dryland crops, including wheat, barley and legumes, the sustainable use of traditional *choperas* – forest formations of various *Populus* species, and farm parks and alternative food networks. These alternative management practices are allowing peri-urban farmers to sustain their businesses and lifestyles, thereby reinforcing their resilience within an urban environment.

The employment landscape at the URI is characterized by a mix of formal and informal economies. In addition to traditional agricultural work, residents may also find employment in nearby urban centres, start small-scale businesses, or participate in the informal economy. This flexibility can be both an asset and a challenge, as it allows residents to adapt to changing economic conditions but also exposes them to vulnerabilities, such as job insecurity and a lack of social protection. Taking Spain as a reference, the OECD (2024) estimated that URIs have the potential to create approximately 2.5 million green jobs over the next 10 years, which would increase the proportion of

the total population employed in the green job sector from the current 1.75 percent to 10 percent. These jobs are expected to be concentrated in sectors linked to environmental policies and urban afforestation at different scales. One of the most important areas where green jobs will be created is in the management and maintenance of urban and peri-urban forests. These economic activities not only provide direct employment but also boost related industries within the sector. Understanding the employment dynamics in the interface zone is crucial for developing policies that support sustainable livelihoods and reduce economic inequality.

Peri-urban forests can provide alternative sources of local construction materials, contributing to strengthening the wood value chain, including from a circular bioeconomy perspective. This reduces the pressure on natural forests from urban areas and increases the sustainability of both energy sources and wood flows from rural to urban areas.

Urban and peri-urban forests and trees also provide indirect economic benefits both in urban and rural areas. By shading and screening buildings, urban forests and trees help save money on cooling and heating; they contribute to improved public health (WHO Regional Office for Europe, 2016; Wolf *et al.*, 2020), which reduces health care costs (Donovan, 2017; McDonald *et al.*, 2017; Wolf *et al.*, 2015; Wolf and Robbins, 2015). The contribution of greenspace to health was measured by the reduction in costs associated with major cardiovascular and respiratory diseases, including mortality and hospital admissions. This assessment encompassed health care expenses, lost productivity among workers and welfare losses, such as the costs incurred from hospital admissions. Peri-urban forests improve mental health and provide space for physical activities, helping offset the increase in non-communicable diseases linked to a sedentary and inactive lifestyle. There are many examples in the Mediterranean region that highlight efforts to strengthen the role of urban and peri-urban forests as key promoters of urban health. A recent longitudinal study conducted on 600 000 residents of Rome over a 10-year period has highlighted the positive effect of urban forests on mental health. Residents who

live near trees require fewer medical prescriptions for psychotropic drugs (Spano *et al.*, 2023). The “Breathing in the Parks” initiative promoted by the *Silva Mediterranea* Working Group on Urban and Peri-urban Forests and led by scientists from the University of Granada, Spain, illustrates how the health impacts of allergens released by urban forests can be reduced. Measures such as increasing specific and functional biodiversity, controlling the introduction and spread of exotic and invasive species, promoting gender equality, and understanding the allergenic potential of each tree species are essential for designing healthy green spaces (Cariñanos *et al.*, 2019).

Increasing the availability of quality peri-urban forests and parks is also key in promoting the sustainable enjoyment of these spaces, as it would help distribute human-induced pressure across different natural spaces. In France, the people of Marseille often visit the nearby Calanques National Park to go hiking and climbing and enjoy the stunning coastal scenery. In Tunisia, residents of Tunis visit the region’s forests, like the Boukornine Forest close by, for picnics, walks and a chance to enjoy nature.

### **Key aspects of governing the urban–rural interface as a distinct land type**

Urban fringes have historically been viewed as transitional zones between urban and rural areas, but this perspective fails to recognize their unique characteristics and importance within the broader urban–rural continuum.<sup>20</sup> While the URI is a dynamic zone marked by the flow of people, goods and services – including ecosystem services – it also represents a physical space at the urban fringe “that is not rural but not yet urban”, with distinct specificities and challenges (Lerner and Eakin, 2011). This calls for a tailored approach to planning, governance and management, especially to address the unequal flow of goods and services,

<sup>20</sup> The “urban-rural continuum” refers to the gradual transition and interdependence between urban and rural areas, a conceptual gradient across various degrees of urbanization and rural characteristics, rather than a clear-cut boundary between urban and rural areas. This continuum reflects the interconnectedness between urban and rural areas and the diverse functions they serve within regional landscapes and economies.

where urban areas typically extract natural resources from rural and peri-urban areas without providing a proportional return. Addressing this imbalance requires a paradigm shift in the way the URI is perceived, moving away from its conventional treatment as a buffer zone to recognizing it as an area in its own right.

In policy terms, the URI should be managed using a tailored approach that avoids both replicating urban governance models and applying rural management practices, requiring instead planning frameworks that consider its multifunctionality and address the need to balance urbanization with agricultural production, biodiversity conservation, and the provision of ecosystem services (Depietri and Orenstein, 2020; Doernberg and Weith, 2021). This is particularly relevant since urbanization continues to drive the expansion of cities into peri-urban areas, creating dynamics of “peri-urbanization” (López-Goyburu and García-Montero, 2018; Shaw, van Vliet and Verburg, 2020). The planning for the URI should consider it a multifunctional landscape that supports both urban and rural functions without compromising its environmental, social and economic specificities.

Urban forestry, and peri-urban forestry specifically, can play an important role in this process. These forests act as shared assets that improve the flow of ecosystem services between urban and rural areas, while also contributing to the peri-urban economy, such as by creating green jobs. In addition, they can provide green and recreational spaces that foster a stronger sense of place, enhance social cohesion, and improve the well-being of the diverse communities that inhabit the URI. The multifunctionality of peri-urban forests has the potential to trigger the transformation of the URI into an “opportunity space” (Scott *et al.*, 2013), where economic, environmental and social benefits are integrated and mutually reinforced, ultimately strengthening the integrity of the URI as an area in its own right.

To fully realize the potential of peri-urban forests, an important aspect is to recognize the social heterogeneity of URI inhabitants and address the challenges related to the URI’s governance. The first step towards effective governance structures involves the recognition among urban planners, citizens and suburban residents that urban

growth and peri-urban changes are interlinked, often resulting in land-use conflicts. The URI frequently extends across multiple administrative boundaries, with institutional fragmentation preventing the smooth resolution of these conflicts. Multilevel governance fragmentation can assist in overcoming this institutional and governance, and eventually strengthening the URI. This involves distributing authority both horizontally, among municipalities and local actors along the urban–rural continuum, and vertically, across different institutional levels of government, including the local, regional and national levels (Ros-Tonen, Pouw and Bavinck, 2015).

For instance, in many Mediterranean countries, national governments are responsible for broader planning and management of forested areas for environmental protection and resource use (OECD and UCLG, 2019), which includes peri-urban forests. However, a peri-urban forest may be owned by a national authority but managed by local authorities, which are better equipped to deal with issues such as facility maintenance, safety and community engagement. An example is the Montseny Natural Park in Spain,<sup>21</sup> which is located near Barcelona. This park is managed collaboratively by national conservation agencies,<sup>22</sup> the Regional Government of Catalonia, the two autonomous provinces of Barcelona and Girona, and four local municipalities. This multilevel governance system ensures that the park serves both local peri-urban recreational needs and national conservation goals.

Introducing the concept of multilevel governance acknowledges the complex administrative landscape of the URI and emphasizes the importance of involving multiple institutional stakeholders in the planning and management of peri-urban forests.

In conclusion, to manage the Mediterranean URI as a distinct dimension, it is essential to adopt a holistic, cross-sectoral and multilevel governance approach that integrates both urban and rural

<sup>21</sup> <https://costabrava.org/en/what-to-do/nature/natural-parks/montseny-natural-park/#:~:text=The%20management%20plan%20for%20E1%20Montseny%20Natural%20Park%2C,government%20offices%2C%20and%20groups%20associated%20with%20the%20region>

<sup>22</sup> UNESCO and the Spanish Ministry for Ecological Transition and Demographic Challenge (MITECO).

development. By focusing on policies that address the unique characteristics of the URI and by leveraging the potential of peri-urban forests as multifunctional assets, cities in the Mediterranean can achieve more equitable and balanced exchanges between urban and rural areas, while strengthening the ecological and socioeconomic resilience of the peri-urban communities.

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