

Article

Street Tree Redevelopment in Rome's Historical Landscapes: From Strategic Vision to Streetscape Design

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Abstract: Street trees play a fundamental role in shaping pedestrian sidewalks, squares, and small rest areas, enriching the public space, together with paving, street furniture, and lighting. However, the project of street tree lines along urban sidewalks remains an underestimated issue in urban design and strategic planning, even if it could be a pivotal opportunity for a widespread redevelopment of living streets and public spaces. The present study focuses on landscape aspects of the 'street tree project' intrinsically linked with the identity, perception, and morphological issues of urban spaces, from a strategic vision of the city to the human scale of the urban landscape. In this perspective, we discussed the case of Rome, Italy, where the historical heritage has had an extraordinary value, and where street trees are considered a notable contribution to the landscape identity of the whole city. The administrative council of the Municipality of Rome has initiated a comprehensive census of street trees and is currently developing a Street Tree Masterplan. This plan will serve as a guiding framework, outlining strategies for the conservation of arboreal heritage and the revitalization of the urban tree population along city streets. Based on the empirical evidence stemming from this case study, the discussion highlights the relevance of poorly debated issues, in both the academic and practitioner's literature, mainly concerning the choice of urban trees' species. Choosing the 'right tree species in the right place' has implications that are not only ecological and environmental, but also perceptive and architectural, being intimately associated with the urban scene and the identity of places.



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1. Introduction

Planting trees in cities has several objectives [1–3], among which, air pollution mitigation [4,5], the containment of the 'heat island' effect [6,7], the provision of ecosystem benefits [8,9], biodiversity support [10–12], noise pollution mitigation, and the contribution to the efficiency of the drainage system [13,14] are likely the most relevant in a joint sustainable and resilient vision of metropolitan spaces. Trees provide shade and make rest areas where people can sit more comfortably. They also contribute to the quality of urban space and the well-being of citizens [15–17], with a beneficial impact on people's health [18–20]. Functionally speaking, urban forestry provides nature-based solutions and, when it comes to tree planting along road axes, these solutions can be included in the context of green infrastructures [21–23], both participating in the ecological network of a given city [24–26] and promoting the pedestrian dimension of the route. Trees and vegetation play an essential role in the shaping of public spaces, favoring the socialization

and enjoyment of free time outdoors [27–29], whether we consider urban parks or green infrastructure connected to the network of cycle–pedestrian mobility [30–32].

Finally, there is a well-defined aesthetic and ornamental function of trees in urban space [33,34]. Trees and vegetation are essential to creating a quality landscape [35–38], contributing to the design of public space [39] through backdrops, perspective wings, perceptive alignments, and facade masking. Particularly, street trees play a fundamental role in shading pedestrian paths and squares, enriching the public space, together with paving, street furniture, and lighting [40]. In fact, streets of contemporary cities are rapidly evolving, from being simply networks of vehicular traffic to public spaces for people [41], supported by the presence of trees and vegetation [42,43], which make them green infrastructures [44–46], where people can move on foot or by bicycle in a healthier and more vital environment [47,48].

To this end, various initiatives and programs aimed at developing urban forestry interventions [49,50], including the planting of street trees, have been promoted by governments worldwide in recent years.

However, when planning tree lines in a given urban context, a critical question arises: what criteria should guide the selection of the appropriate tree species for a specific location?

Many cities are equipping themselves with specific planning tools for planting and caring for trees in urban environments, including Street Tree Masterplans [51–53] or Urban Green Regulations [54] that, however, often represent practical manuals without an overall vision of the city. In Italy, the Urban and Extra-urban Forestry Plan (approved in 2021) aims to provide a common methodology based on solid scientific references in order to identify and plant ‘the right tree in the right place’, but it still remains a generic recommendation.

In addition to ensuring the compatibility of the tree species with the biogeographical and ecological characteristics of the site, what other factors must be considered when selecting the appropriate tree for different urban landscapes?

There are several issues concerning the design of street trees on a sidewalk, both when it comes to inserting new trees and replacing specimens along a row. In choosing the right tree for a specific urban street, having its own character, the historical, cultural, and identity factors are first and foremost relevant. Also, tree species are rooted in places and contribute to creating the image of the city.

An additional contingent theme, which is of the greatest importance from the practical point of view of the technical feasibility of the interventions [55], is the one concerning the size of the sidewalks, where there must coexist, as they are vital space for the growth of the trees set in the asphalt and a continuous strip for pedestrians’ walking, guaranteeing full accessibility to disabled people [56,57]. On the sidewalk, bars and shops, cycle paths, small rest areas, and spaces equipped with furniture can additionally generate spatial micro-conflicts, while providing diversified opportunities for pedestrians, if they are well organized [58].

From these considerations, it follows that the goal of planting new trees on urban sidewalks should be considered within the broader issue of ‘street-scape design’, having also important perceptive, historical, and architectural implications.

In this perspective, the present contribution aims to discuss the case of Rome, Italy, where the historical heritage has had an extraordinary value, and where street trees are considered a notable contribution to the landscape identity of the whole city [59]. The administrative council of the Municipality of Rome has initiated a comprehensive census of street trees and is currently developing a Street Tree Masterplan [60]. This plan will serve as a guiding framework, outlining strategies for the conservation of arboreal heritage and the revitalization of the urban tree population along city streets. Through a comprehensive literature review and a visual/narrative analysis of diverse urban contexts within Rome,

with a focus on the role of trees, this study documented the critical importance of species diversity in the design of resilient and sustainable ‘streetscapes’ within long-established cities possessing significant historical legacies.

2. Materials and Methods

2.1. Study Area

Rome is a city that presents environmental criticalities, associated with pollution and vehicular traffic along the road network [61]. At the same time, it has an important natural capital consisting of the green parks of ‘historic villas’, protected natural land within the consolidated city boundaries, and vast archeological areas that create an incredibly high ‘green landscape porosity’ within the urban fabric [62–64]. The green heritage of the Italian capital city extends over a surface area of 400 million square meters, with over 300,000 individual trees, distributed both within green areas and along the roads, for a total of nearly 1200 km of tree rows characterizing the city from a historical, environmental and landscape point of view [65]. Where the historical heritage has extraordinary value, street trees also contribute to the landscape identity, as clearly observed in Rome [66,67]. The current image of tree-lined streets is the result of a historical stratification of different dominant species in the urban scene [68,69].

For instance, *Ulmus* were typical of the Rome of Pope Sixtus V in the 16th century, when the ‘olmate’ were placed along the routes traveled by pilgrims, who led to the Basilicas. *Plane trees* reflect the desire of the 19th century Italian King Umberto I to give Rome the international character of other European capital cities, using a tree selected as a hybrid in England (*Platanus × acerifolia*). The *Cupressus sempervirens* of the archeological walks, the domestic pines (*Pinus pinea*), and the holm oaks (*Quercus ilex*) of a central district surrounding the Vatican City such as Prati, Western Rome, have contributed to creating that image of the Roman landscape of the twentieth century. These were promoted, over time, in the well-known design projects of a major architect and landscaper of that time, namely Raffaele De Vico. Trees in Rome are clearly an expression of historical periods and are diversified in the different urban neighborhoods.

Designing street trees in Rome means, from the point of view of urban and landscape design, dealing with the urban form of the eternal city, which is given by the road layouts, the morphology of the different settlements [70], and its architectural, archeological, historical, and naturalistic emergencies. We should consider, together, the porous structure of the urban fabric, into which the historical parks, protected natural belts, and archeological areas are inserted, including the general topography, with the course of the Tiber and Aniene rivers, the historical ‘Ancient Roman’ walls, and other consolidated elements in the urban scene, which create margins, backdrops, alignments, spatial conformations, and perceptive relationships.

The morphological structure of Rome is characterized by the radial progression of consular roads, from the central districts towards the periphery. Over time, the consular roads have become aggregating filaments of the built fabric, which extended beyond the metropolitan region, exerting traffic congestion. On the other hand, these roads cross different landscapes, namely in peri-urban territories where, despite environmental fragmentation, fragments of widespread naturalness coexist with areas where the relict (rural) landscapes are still recognizable. These are territories where local biodiversity is well preserved, composing a complex matrix of widespread natural, historical, and archeological heritage.

2.2. Study Objectives

The structure of the article is reported as follows. After introducing a reference scenario, Section 2 analyses the case of Rome, Italy, where a census of street trees is currently being carried out using Geographic Information Systems supporting the masterplan of street trees, designing future strategies for the expansion of tree cover and for the care of the existing tree heritage.

Rome is a particular city, for the richness of its historical and identity values, for the enriched stock of tree biodiversity [71,72], as well as for the complexity of social functions [73] and economic activities that coexist in the urban scene.

Starting from the case study, we propose a series of reflections on the practical issue of new street-line tree design. In particular, we discussed some possible criteria for choosing street trees' species based on the landscape performance of trees by type of street, grounding the debate both on an architectural and ecological discourse. The case of Rome, with all its historical implications, should exemplify the intrinsic complexity of planning and designing street tree lines in other cities with the same characteristics in terms of cultural heritage.

Finally, we debate the role of native species as making up the current street tree lines; they are often under the attack of pathogens, but they usually appear more natural and are well suited to the present landscape context. We also discuss an alternative use of an alien plant species assumed to be more resistant to climate change.

3. Results

3.1. The Planning Strategy of the Street Tree Masterplan of Rome Municipality

Starting from a systematic census of street trees and an interpretative framework, which classified streets based on the landscape performance of the tree rows, the masterplan proposes specific strategies in terms of the replacement and development of new plantations [60]. From a methodological point of view, a classification of trees by dendrological types and streets based on the required landscape performance was carried out according to a hierarchical scheme with four types of streets: (R01) green infrastructure, (R02) ecological corridors, (R03) 15 min urban axes, and (R04) neighborhood residential streets. Appropriate intervention strategies were formulated for the different types of streets, including the identification of the types of trees and the simulation of possible transformation scenarios. A brief description is provided below.

'Green infrastructure' roads (R01) are 'consular' roads intended as infrastructural axes (radial) of ecological connection between the large internal urban green areas and the open territory (Figure 1). The trees planted on consular roads are essentially *Pinus pinea* and *Platanus × acerifolia*, with a few exceptions. They are trees that have a role as territorial landmarks. The proposed strategy for these types of roads emphasizes the reinforcement of existing linear tree plantations while respecting the role and identity of the existing trees. By increasing tree density along radial roads, the plan aims to facilitate the reconstruction of green wedges that penetrate the urban areas, thereby reconnecting the surrounding countryside metropolitan greening.

R02 roads, characterized by wide sections designed to accommodate high-speed traffic, possess the potential to function as a foundation for an internal, tree-lined ecological network. This network would effectively interconnect a vast urban green mesh. Furthermore, these roads play a strategic role in establishing a linear hub for sustainable mobility and associated infrastructure.



Figure 1. Selected examples of radial ('consular') roads in Rome, classified by the masterplan as 'R01—green infrastructure'; (a) Cristoforo Colombo Street, with *Pinus pinea* that constitutes an identifying landmark; (b) Nomentana street, characterized by a quadruple row of *Platanus × acerifolia*.

The selection of tree species will prioritize high-quality specimens with expansive canopies. Furthermore, a diverse range of species will be incorporated to enhance biodiversity and strengthen ecological corridors within the urban environment.

R03 role streets (urban axes of the 15 min city) are the main axis within various districts, characterized by built-up frontages and ground-floor commercial establishments. They function as pedestrian-oriented streets where trees provide shade for pedestrians and contribute to the overall aesthetic appeal of the urban landscape (Figure 2). For this type of road, smaller species are suggested, even with seasonal blooms, which can contribute to improving the quality of the public space, providing shade on the sidewalk and making the seating areas more comfortable.



Figure 2. Three-dimensional simulations with planting of new trees on R03 type roads (15 min axis) in Rome; (a) Cola di Rienzo Street, (b) Marconi Road, both in Central Rome. (Source: author's elaboration, 2024).

Planning strategies for existing trees and new plantations in Rome are grafted into a coherent framework of interventions on public greenery, respecting local identities and the urban context. In a figurative and symbolic interpretation that has sometimes been given to the urban form of the city, the consular roads are the rays of a star, delimited by the circumference of the ring road, with a longer strip of territory, which extends toward the Tyrrhenian Sea coast. With respect to its urban form, the future vision of the city is that of a "green star" (Figure 3), increasingly green, where street trees reinforce the morphological structure of the city and its identity.



Figure 4. Orthophotos and landscape photos of Mazzini Avenue in Central Rome; images taken from Google Maps and the author's archive.



(a)



(b)



(c)

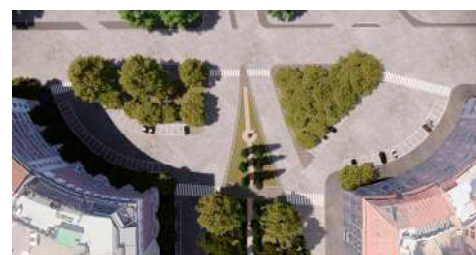


(d)

Figure 5. The Garden Fountain of Mazzini square, designed by Raffaele De Vico. (a) A historical image of the Plaza; (b) image of the Plaza in 2024; (c) the linear park of Mazzini Avenue, with a grove of *Quercus ilex* and the access passages marked by *Cupressus sempervirens* (d).



(a)



(b)

Figure 6. Project simulation for Piazzale Clodio: (a) Aerial view of the current situation, showing flowerbeds used as parking spaces; (b) proposed scenario featuring the removal of pavement from the flowerbeds and their transformation into green spaces.



Figure 7. Proposed scenario for the entrance to the linear park from Piazzale Clodio: (a) Current situation featuring a flowerbed covered with asphalt; (b) proposed design for the new gateway to the linear park, including two rows of *Cupressus sempervirens*.

Another example is Via Ostiense (Figure 8), a consular road, which features two central medians with an alternating arrangement of plane trees and holm oaks, as well as two relatively narrow lateral sidewalks. The project must balance two somewhat conflicting objectives: developing a bike lane on both sides of the lateral sidewalks and restoring the street trees that have been lost over time.

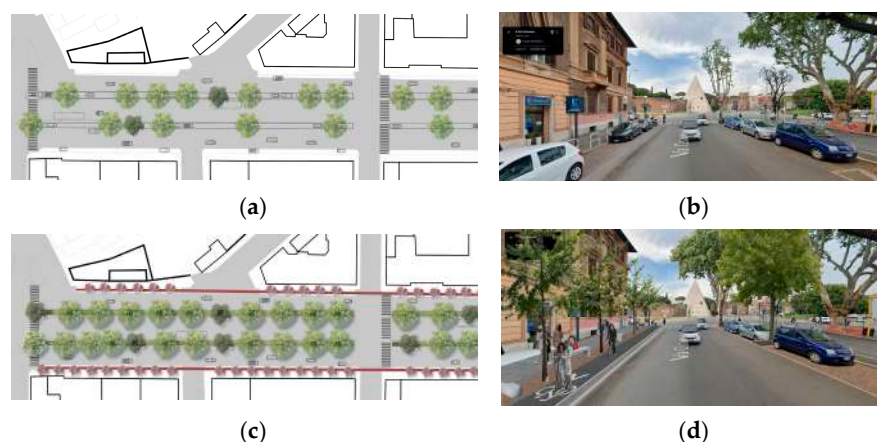


Figure 8. Ostiense Street, Rome: (a,b) Existing conditions with two central rows on the central medians alternating plane trees and oak trees, most of which have been lost; (c,d) project simulation showing new tree plantings in the central medians (*Platanus × acerifolia* and *Quercus ilex*), along with the redevelopment of the lateral sidewalks featuring a new row of *Cercis siliquastrum* and a cycle path on both sides. (source: author's elaboration, 2024).

4. Discussion

This case study on Rome's tree lines reflects the complexity of planting new street trees, which cannot be relegated to the mere management of the existing trees by Municipal Offices. On the one hand, a strategic vision of the entire city is needed, which guides choices on the replacement and new planting of trees along urban streets. In this sense, the interventions of the replacement and planting of new street trees should be defined according to the urban role played by the road and the trees themselves, fitting into a coherent reference framework, taking into account urban forms and the identity of metropolitan landscapes.

At the same time, it should be considered that what is indicated in the strategic framework of the masterplan represents a general guideline, which requires an in-depth analysis in the executive phase and assessments to be carried out on a case-by-case basis.

Trees play an important role from a landscape and perceptive point of view [77,78], placing themselves in relation to the road section, the pedestrian path of the sidewalk, and the urban fronts of the facades.

From a landscape point of view, it is also important to evaluate morphological and perceptive factors, in terms of the relationship between tree rows and the urban scene. The shape of the crown, the bearing of the trees, the strength, the color of the foliage, and the seasonality of any blooms, have an important perceptive value in the urban context, characterized by the morphology of the building fabrics, the figurative characteristics of the urban fronts, edges, limits, and openings towards open spaces.

A peculiar aspect of planting trees along the streets (i.e., replacement within a tree row or creation of a new street tree) is the choice of the species to be used in the different interventions, which should take into account the indications of both general and specific nature [79,80]. The first aspect is the origin of the species [81,82]. The National Strategy for Urban Greenery highlights the importance of selecting native plant species consistent with soil quality and the ecological characteristics of the territory [83–85], in order to ensure the extended functionality of the ecosystem benefits. In cities, and particularly for the creation of street trees, exotic species have been used to a large extent. A study carried out by the Italian Botanical Society (2019) on 15 Italian cities (including Rome), documented how more than 50% of the species used in tree-lined avenues are exotic. This study proposed to define the species to be included in street trees based on the so-called ‘potential’ vegetation (based on the well-known ecological notion of ‘vegetation series’) and to plan the replacement of the trees taking into account the phytosanitary and stability problems of each species.

According to Ferrini [86], it is important to contextualize the type of intervention to be used, since the most effective strategy to improve urban biodiversity is ‘differentiation’ rather than ‘simplification’ [87,88]. A management strategy for the replacement of old and/or dangerous rows or plants, particularly those that contribute to the distinctive character of specific areas within the city, should prioritize a phased renewal approach. This strategy aims to ensure the visual continuity of tree-lined streets over time [89]. In cases where there are no native species suitable for a particular context and where the non-invasiveness of a given species is ascertained, it is possible, sometimes even desirable in relation to the effects of climate change, to plant exotic species.

Regarding species selection, a decision-making process is established that prioritizes the preservation of existing tree species within the socio-economic context. This approach emphasizes the protection of pre-existing species within the tree stand, particularly when replacing missing trees. Conversely, in the case of renewal of the entire row (e.g., because of old age or unsuitability of the pre-existing species) or the creation of a new street tree stand, it is appropriate to deal with the need to favor local (native) species compatibly with the limitations imposed by climate change forecasts. The more consistent use of autochthonous species according to the local flora [90], however, is confronted with the availability of suitable material from a nursery perspective. In relation to climate change, it appears important to encourage the use of local origins (in the case of Rome, using forest propagation material collected at least in the central Tyrrhenian ecological region). However, at present, the nursery system is not always able to ensure this need, with the risk that the demand for autochthonous species is satisfied only with the supply of non-local material (e.g., a field maple produced from seeds collected in Northern France, or a holm oak from Northern Spain, or origins of geographical and climatic contexts completely different from those of Central Italy).

After all, even the ‘choice of the right tree in the right place’ is not at all automatic, moving between contrasting assessments. The criterion of the historical identity of tree species linked to places will have to deal with the need for species diversification, in terms

of resilience and biodiversity. While the criterion of utilizing native species remains crucial, it must increasingly incorporate the long-term need to introduce species that exhibit greater resilience to the impacts of climate change.

A choice of tree species, therefore, which may be valid from an ecological point of view, because it is more adaptable to climate change, may not be a good choice from a landscape and perceptive point of view. Can it be legitimate to replace the plane trees (*Platanus × acerifolia*) along a historic street in Rome, attacked by a pathogen, with *Pyrus calleryana* ‘Chanticleer’, which is proving to be more resistant to attacks? Can we replace the pine trees along the consular roads, which cause problems to the road surface with their roots, which have now taken on an important role in designing the image of the city? One might also ask whether it is nicer to see a row of trees all of the same species and size, or a more articulated rhythm of different trees in an urban context. These are questions that cannot be answered without a long, interdisciplinary discussion of their positive and negative implications.

It is always within the scope of the intervention project that specific assessments should be made by the designer, who must take into account together of different aspects, dealing with the ecological, environmental, architectural, historical, cultural, and identity nature of urban landscapes.

On the scale of the sidewalk project, moreover, the design of the tree rows along the street pavement remains a complex issue [91], which presents conflicting situations and overlapping elements in a limited space, including trees, in the limited space of the sidewalk, where a variety of users coexist. The conflicts that can arise from the unsustainable or inappropriate planting of trees on the sidewalk essentially concern the following: (i) the transverse dimension of the sidewalk; (ii) broken tiles and exposed roots; (iii) interference with underground utilities; and (iv) interference with different activities and functions that occupy public space.

On the other hand, planting trees and maintaining existing trees along urban sidewalks, could be a great opportunity for a widespread and capillary redevelopment of the urban public space [92,93]. The sidewalk is like a continuous line that moves within the urban space, providing the opportunity for pedestrians to reach different points of the city and to access different functions that pertain to the public space. In a compact city, where the urban fronts rest on sidewalks, and the ground floor of the buildings is largely used for commercial activities, trees provide shade and encourage the flow of pedestrians walking, favoring environmental comfort and urban sociality [94]. In the streets of great inter-neighborhood connection, where the road section allows it, trees and vegetation act as a green infrastructure [95,96] or as an ecological corridor for biodiversity, but also as a support structure for slow mobility. The growth site of trees and vegetation can increase the drainage surface of the sidewalk, generating intrinsic benefits on the ability to intercept rainwater flows, a particularly relevant matter from a climate change perspective. The redevelopment of street trees, with the implementation of new plants is, finally, a strengthening element of the quality of the pedestrian sidewalk and the public space in general [97,98].

5. Conclusions

The street tree redevelopment project of Rome, compared to the Street Tree Masterplan of other cities in the world, discounts the complexity and relevance of the city’s history, with a projection towards the future, which should duly take into account its consolidated identity. The Rome Street Tree Masterplan must prioritize the maintenance and care of existing trees, with a strong emphasis on individual plant health. Recognizing that the preservation of this arboreal heritage constitutes the core objective, the plan should

incorporate a comprehensive approach to tree care. The assumptions underlying a specific street tree planning tool are multiple and have been summarized in this study, representing a concrete example for other European cities that could also be adapted to contexts with similar surrounding environments. Planting trees on the sidewalks along the streets therefore represents not only an important tool for the implementation and conservation of the tree heritage at an urban and metropolitan level, but also an opportunity to improve the quality of public space, and the quality of life of citizens.

Intervening on the network of street trees can be an important opportunity for cities that are facing the global challenges of climate change, both to strengthen green infrastructure, counteract the heat island, and ensure a widespread redevelopment of street pavements. When considering the effect on people, the street tree project should take into account a range of contingent and interfering issues related to the road surface. At the same time, it should seize opportunities to work on the redevelopment of public space, in synergy with projects aimed at remodeling the road section, including the introduction of cycle paths, widening of pavements and the provision of street furniture. European cities, by virtue of their existing heritage of trees and green spaces, should become more aware of the strategic value of street tree redevelopment in streetscape design.

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