

Urban Forestry: A Bibliometric Analysis

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ABSTRACT

This study presents a bibliometric analysis of urban forestry research to map its intellectual structure, thematic evolution, and collaboration patterns. A total of 468 Scopus-indexed documents published between 2000 and 2026 were analyzed using VOSviewer through keyword co-occurrence, overlay, and density visualizations, co-authorship analysis at the author, institution, and country levels, and citation analysis. The results show that the field is organized around five interrelated themes: ecological sustainability, management and governance, human-tree interactions, tree planting and canopy management, and greenspace-oriented urbanization. The overlay map indicates a shift from management, policy, and participation topics toward climate change, ecosystem services, biodiversity, carbon sequestration, and remote sensing in recent years. Citation analysis highlights foundational works on the definition, costs, ecosystem benefits, and governance of urban forestry. Co-authorship networks reveal several cohesive research groups connected by a few influential scholars, while institutional collaboration remains limited. At the country level, the United States is the dominant hub, followed by Canada, China, Italy, Germany, the United Kingdom, and Brazil. These findings provide an overview of the development of urban forestry research and indicate directions for future studies.

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1. INTRODUCTION

Rapid urbanization has become one of the defining global transformations of the twenty-first century, placing increasing pressure on urban ecosystems, environmental quality, and the well-being of city residents. In response, trees and forests within and around cities are no longer regarded merely as aesthetic elements but as essential green infrastructure capable of improving environmental quality and urban livability [1]. Urban forestry can be described as the

planning, management, and governance of all tree-dominated vegetation in urban and peri-urban areas, including street trees, parks, woodlands, and private green spaces, in order to deliver ecological, economic, and social benefits to urban communities. Although the concept originated in North America, it has been widely adopted and adapted in Europe and other regions, reflecting differences in land use traditions, institutional arrangements, and management priorities [2].

Urban forests perform a wide range of functions that are central to sustainable urban development. They contribute to climate change mitigation and adaptation, reduce the vulnerability of urban populations, and support local livelihoods, particularly when integrated with urban and peri-urban agriculture [3], [4]. Urban trees also moderate microclimates, intercept air pollutants, and reduce stormwater runoff, although empirical evidence regarding their quantitative effect on ambient air quality is still debated [5]. These multiple functions position urban forestry as a key nature-based strategy for addressing environmental problems associated with urban growth.

Beyond environmental benefits, urban forests are increasingly linked to human health and climate policy. Trees generate public-health benefits that need to be considered in urban forestry decision-making [6], while the selection of tree species with high carbon sequestration potential has become a practical instrument for strengthening urban carbon sinks [7]. At the same time, the effectiveness of urban forestry depends strongly on the involvement of citizens, communities, and institutions. Communication among scientists, policymakers, and citizens in participatory processes [8], network governance involving multiple stakeholders [9], and the activities of community groups that shape uneven canopy cover across neighborhoods [10] illustrate the social and governance dimensions of the field.

The growing importance of urban forestry has stimulated a considerable increase in scientific output over the last two decades. Research has expanded from traditional arboriculture and forest management toward interdisciplinary approaches that combine ecology, urban planning, social science, and data science. Technological developments such as remote sensing for mapping and monitoring urban tree cover [11] and artificial intelligence for tree inventory and decision support [12] have further diversified research methods, while regional syntheses show that urban forestry research is spreading beyond North America and Europe into Latin America and other

developing regions [13]. Consequently, the body of literature on urban forestry has become large and increasingly heterogeneous.

Given this growth, a systematic assessment of the development, structure, and emerging trends of urban forestry research is needed. Bibliometric analysis offers a quantitative approach to examining scientific literature by identifying publication patterns, influential documents and authors, collaboration networks, productive institutions and countries, and thematic evolution within a research domain [14]. Unlike conventional narrative reviews, bibliometric mapping provides a macro-level view of the intellectual structure of a field and allows researchers to trace how research priorities change over time.

Although many studies have examined specific aspects of urban forestry, such as ecosystem services, tree selection, maintenance costs, or governance, the literature remains dispersed across disciplines, regions, and methodological traditions. Previous reviews generally focus on particular themes or geographical contexts, so an integrated picture of the intellectual structure, collaboration dynamics, and thematic shifts of the field is still limited. Therefore, this study conducts a bibliometric analysis of urban forestry research to map its keyword structure, most cited documents, co-authorship patterns, institutional linkages, and international collaboration networks.

2. METHODS

This study adopted a bibliometric analysis approach to examine the scientific development of urban forestry research. Data were retrieved from the Scopus database, which provides broad coverage of peer-reviewed literature in the environmental, social, and planning sciences and is widely used in bibliometric studies. The search was conducted in September 2026 using the keyword “urban forestry.” The final dataset comprised 468 documents published between 2000 and 2026, consisting of 386 journal articles, 44 book chapters, 32 conference papers, 4 books, and 2 short surveys, which

together had received 8,439 citations. Bibliographic information, including titles, abstracts, keywords, authors, affiliations, publication years, source titles, and citation counts, was exported in RIS format, and duplicate or incomplete records were screened before analysis.

Bibliometric mapping was performed using VOSviewer, a software program developed for constructing and visualizing bibliometric networks [15]. Keyword co-occurrence analysis was applied to identify the main research themes and clusters, overlay visualization was used to trace the

temporal evolution of topics based on the average publication year, and density visualization was used to detect research hotspots. In addition, co-authorship analysis was conducted at the author, institution, and country levels to reveal collaboration structures, while citation analysis was used to identify the most influential documents in the field.

3. RESULTS AND DISCUSSION

3.1 Keyword Co-Occurrence Network Visualization

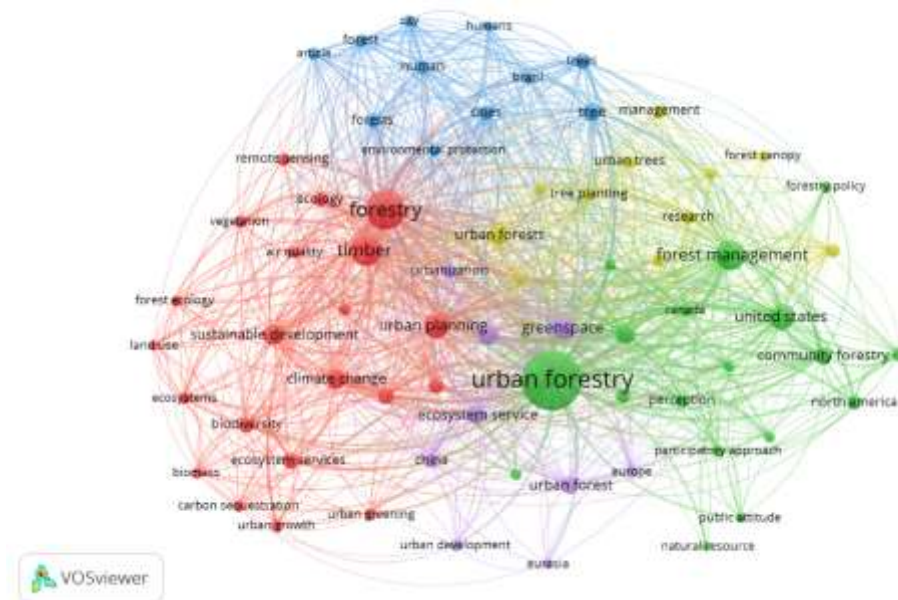


Figure 1. Network Visualization

Source: Data Analysis, 2026

Figure 1 illustrates the intellectual structure of urban forestry research. The term “urban forestry” appears as the largest and most central node, followed by “forestry,” “timber,” “forest management,” “urban planning,” and “greenspace.” This configuration shows that the literature is anchored on urban forestry as an integrative concept linking forestry science with urban planning and green space studies. The dense links among nodes indicate a highly interconnected field in which ecological, managerial, and social themes are closely intertwined.

The red cluster is the largest and represents the ecological and environmental sustainability dimension of urban forestry. It includes forestry, timber, ecology, vegetation, air quality, remote sensing, forest ecology, land use, sustainable development, urban planning, climate change, biodiversity, ecosystems, ecosystem services, biomass, carbon sequestration, urban greening, and urban growth. This cluster reflects research that evaluates the environmental functions of urban forests, particularly their roles in climate change mitigation, carbon storage, biodiversity conservation, and air quality

regulation, as well as the use of remote sensing to assess vegetation and land use change.

The green cluster, centered on urban forestry itself, captures the management, policy, and social dimensions of the field. Keywords such as forest management, community forestry, forestry policy, participatory approach, public attitude, perception, and natural resource, together with geographic terms such as United States, Canada, and North America, indicate a strong research tradition on how urban forests are managed and governed, how residents perceive them, and how communities participate in decision-making, especially in the North American context.

The blue cluster in the upper part of the map contains trees, tree, cities, city, human, humans, forest, forests, environmental protection, and Brazil, reflecting studies on the interaction between people and trees in urban environments and

on environmental protection. The yellow cluster, consisting of urban trees, urban forests, tree planting, forest canopy, management, and research, represents the operational side of urban tree management, including planting programs, canopy cover assessment, and maintenance practices.

The purple cluster includes greenspace, urbanization, ecosystem service, urban forest, urban development, China, Europe, and Eurasia. This cluster connects the provision of urban forests with urbanization processes and green space planning, particularly in rapidly growing Chinese cities and in European urban contexts. Overall, the network shows that urban forestry research is organized into five interrelated dimensions: ecological sustainability (red), management and governance (green), human-tree interactions (blue), tree planting and canopy management (yellow), and greenspace and urbanization (purple).

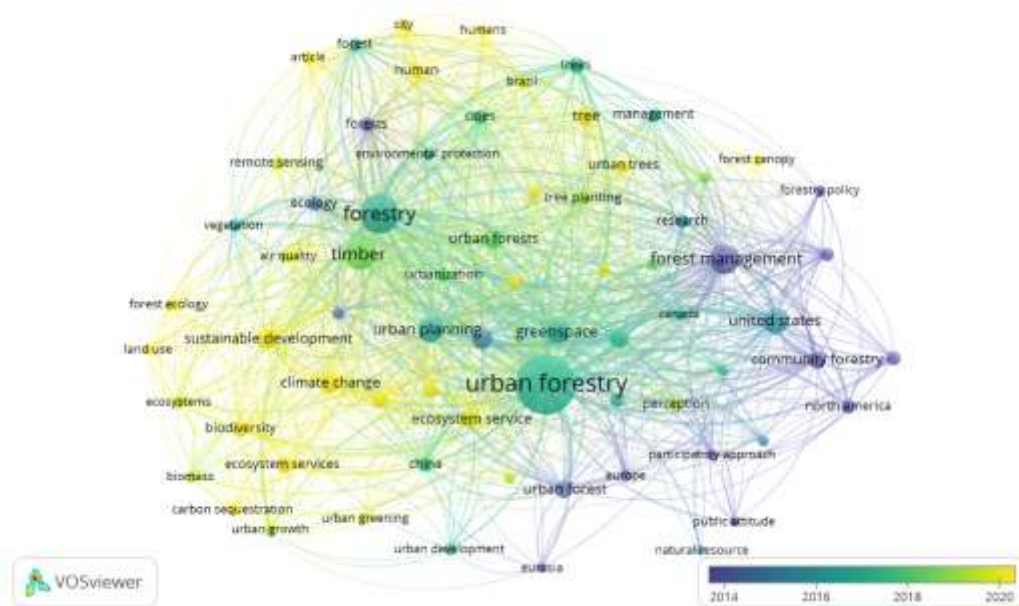


Figure 2. Overlay Visualization

Source: Data Analysis, 2026

Figure 2 presents the temporal evolution of urban forestry research, with node colors representing the average publication year from around 2014 (purple) to 2020 (yellow). The central node “urban

forestry” and closely related terms such as “forestry,” “urban planning,” “greenspace,” “united states,” and “cities” appear in teal to green, indicating that they have remained core topics throughout the analyzed period.

Earlier research, shown in purple and dark blue, is dominated by forest management, forestry policy, community forestry, participatory approach, public attitude, North America, Europe, Eurasia, and urban forest. This suggests that the initial development of the field emphasized management systems, policy frameworks, and public participation, largely within North American and European settings. In contrast, recent topics shown in yellow include sustainable development, climate change, ecosystem services, biodiversity, carbon

sequestration, remote sensing, air quality, land use, urban greening, tree planting, forest canopy, and urban trees.

This shift indicates that recent studies increasingly position urban forests as nature-based solutions for climate adaptation, environmental quality, and sustainable urban development, supported by spatial and remote sensing technologies. The appearance of Brazil among recent terms and China in the intermediate period also reflects the growing contribution of emerging economies to urban forestry research.

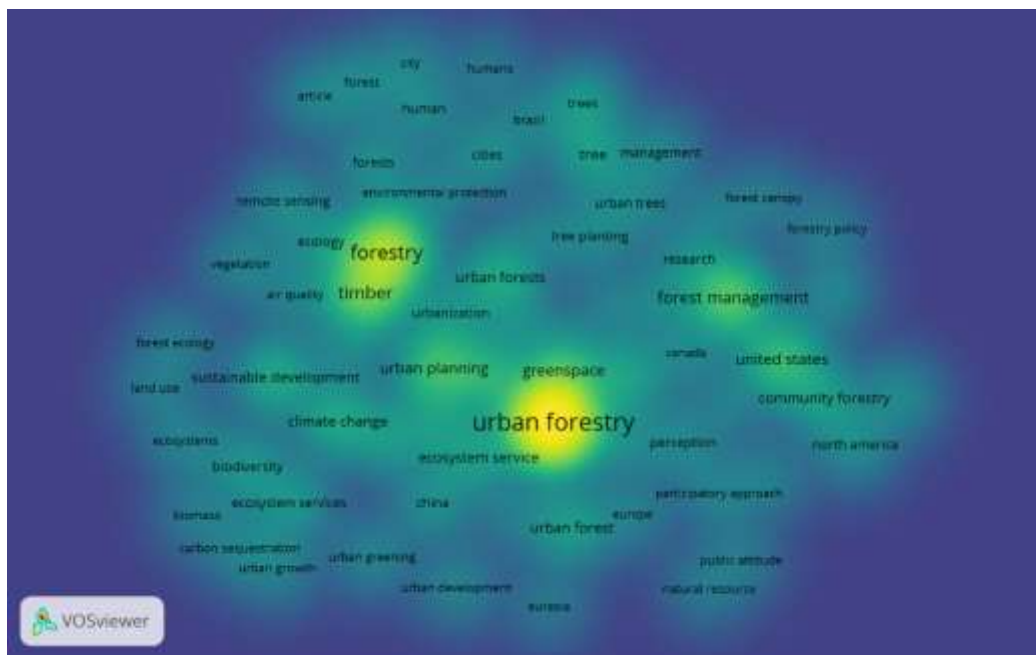


Figure 3. Density Visualization

Source: Data Analysis, 2026

Figure 3 shows that research intensity is concentrated in three main hotspots. The brightest area is centered on “urban forestry,” confirming its role as the dominant research focus. The second hotspot is formed around “forestry” and “timber,” reflecting the strong contribution of general forestry literature, while the third hotspot surrounds “forest management,” indicating a well-established stream of management-oriented research. Moderately dense areas appear around urban planning, greenspace, United States, community forestry, trees, and climate

change, which represent active and relatively mature topics.

In contrast, peripheral terms such as land use, biomass, carbon sequestration, urban growth, urban development, Eurasia, public attitude, natural resource, and forest canopy are located in cooler zones. These topics are less intensively studied and therefore represent opportunities for further research, particularly regarding carbon sequestration, canopy dynamics, and the integration of urban forestry into land use and urban development planning.

3.2 Citation Analysis

Table 1. Top Cited Documents

Citations	Authors and Year	Title
430	[2]	Defining urban forestry - A comparative perspective of North America and Europe
286	[16]	Beyond ‘trees are good’: Disservices, management costs, and tradeoffs in urban forestry
253	[17]	Urban forestry and cool roofs: Assessment of heat mitigation strategies in Phoenix residential neighborhoods
233	[18]	A decade of urban forestry in Europe
212	[19]	Introducing urban food forestry: A multifunctional approach to increase food security and provide ecosystem services
205	[20]	Smarter ecosystems for smarter cities? A review of trends, technologies, and turning points for smart urban forestry
192	[21]	Innovative urban forestry governance in Melbourne?: Investigating “green placemaking” as a nature-based solution
186	[22]	The costs of maintaining and not maintaining the urban forest: A review of the urban forestry and arboriculture literature
178	[23]	Selection of trees for urban forestry in the Nordic countries
171	[5]	Does urban forestry have a quantitative effect on ambient air quality in an urban environment?

Source: Scopus, 2026

3.3 Co-Authorship Analysis

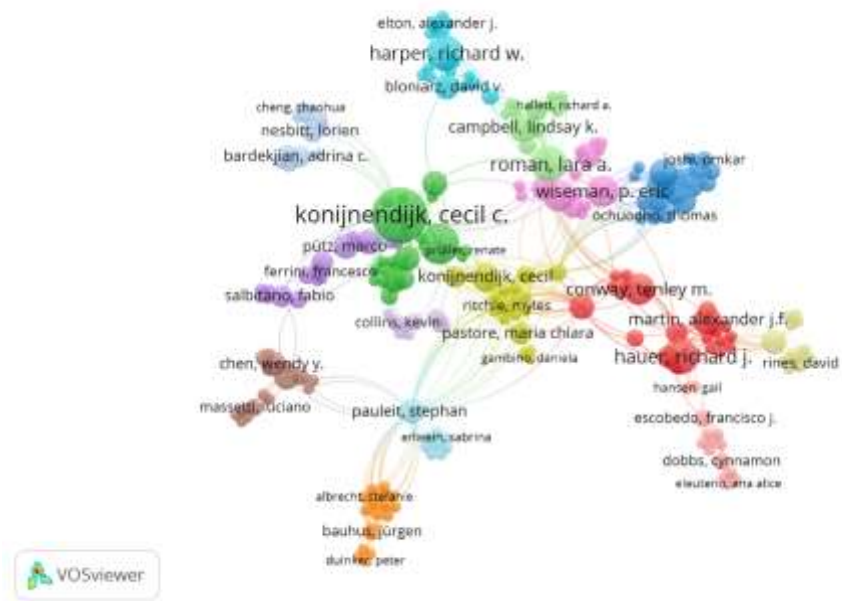


Figure 4. Author Visualization
Source: Data Analysis, 2026

Figure 4 reveals a co-authorship structure composed of several distinct yet partially connected clusters. The largest node belongs to Konijnendijk, Cecil C., who forms the central green cluster together with Prüller, Renate and other collaborators and connects to several neighboring groups, confirming his

position as a key figure in the field. A related cluster under the name variant Konijnendijk, Cecil links with Ritchie, Myles, Pastore, Maria Chiara, and Gambino, Daniela, indicating that inconsistent author names in the database split part of his collaboration network. On the right side, a strongly connected North

American network is formed by Roman, Lara A., Wiseman, P. Eric, Conway, Tenley M., Hauer, Richard J., and Martin, Alexander J.F., extending to Joshi, Omkar and Ochuodho, Thomas as well as to Escobedo, Francisco J. and Dobbs, Cynnamon. The upper part of the map is occupied by Harper, Richard W., Bloniarz, David V., and Elton, Alexander J., who are connected to Campbell, Lindsay K. and Hallett, Richard A. On the left, European groups led by Pütz, Marco, Ferrini, Francesco,

and Salbitano, Fabio, as well as the group of Chen, Wendy Y. and Massetti, Luciano, are linked to the central cluster, while Pauleit, Stephan acts as a bridging author connecting the group of Albrecht, Stefanie, Bauhus, Jürgen, and Duinker, Peter with the core network. This structure suggests that collaboration in urban forestry is organized around a few influential scholars who connect otherwise separate regional research communities.



Figure 5. Institution Visualization

Source: Data Analysis, 2026

Figure 5 shows a small, linear institutional collaboration network, indicating that formal institutional linkages in urban forestry research remain limited within the dataset. On the left side, Clemson University is connected to several forestry and environmental departments, with a department of forestry and environment acting as the main intermediary node. This group is linked through only a few long-distance ties to a second group on the right, consisting of the yellow nodes and a blue

cluster of departments of forest resources. The chain-like structure, with only a small number of institutions meeting the threshold, suggests that collaboration mainly occurs among forestry departments of North American universities and that institutional networks are less developed than author- and country-level networks. The pattern also reflects fragmented affiliation data, as units of the same university are often recorded under different names.

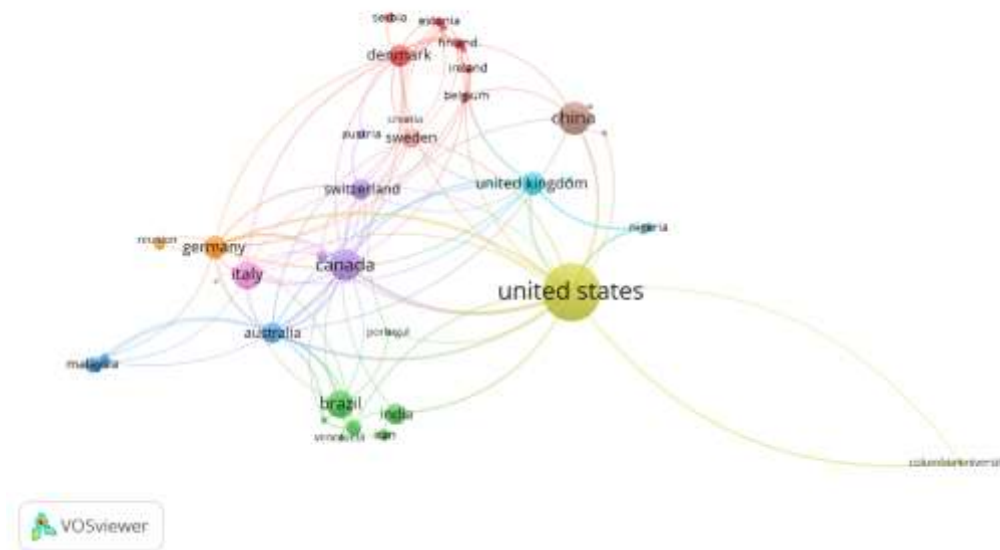


Figure 6. Country Visualization

Source: Data Analysis, 2026

Figure 6 shows that the United States is the dominant country in urban forestry research, as indicated by its largest node and extensive links to almost all other countries. Canada, China, Italy, Germany, the United Kingdom, Brazil, and Australia form the second tier of contributing countries. Several regional clusters can be identified: a Northern and Eastern European cluster led by Denmark with Finland, Estonia, Ireland, Belgium, and Serbia, closely connected to Sweden and Croatia; a cluster linking Canada with Switzerland and Austria; a cluster of emerging economies consisting of Brazil, India, Iran, Venezuela, and Portugal; and an Asia-Pacific connection between Australia and Malaysia. The United Kingdom connects with Nigeria, Germany is associated with Reunion, and China appears as an important hub with strong ties to the United States. The node “columbia university” reflects inconsistent affiliation records rather than an actual country. Overall, international collaboration in urban forestry is centered on the United States and Europe, while participation from Africa, Southeast Asia, and Latin America remains relatively limited.

4. CONCLUSION

This bibliometric study of urban forestry research reveals a mature, interdisciplinary, and expanding field that integrates forestry science, ecology, urban planning, and social science. The keyword analysis shows that the field is structured around five interrelated themes, namely ecological sustainability, management and governance, human–tree interactions, tree planting and canopy management, and greenspace-oriented urbanization. The temporal analysis indicates a clear shift from management, policy, and community participation topics toward climate change, ecosystem services, biodiversity, carbon sequestration, and remote sensing, positioning urban forests as nature-based solutions for sustainable cities. Citation analysis highlights the foundational role of studies on the definition, costs, ecosystem benefits, and governance of urban forestry. Co-authorship analysis demonstrates that collaboration is organized around several influential scholars, while institutional collaboration remains limited and fragmented. At the country level, the United States acts as the central hub, supported by

Canada, European countries, China, and Brazil, whereas contributions from Africa and Southeast Asia remain limited. Future research should strengthen cross-regional collaboration, particularly with developing

countries, and further explore carbon sequestration, canopy dynamics, and technology-based monitoring to support evidence-based urban forest planning.

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