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Urban forestry and public safety: a bibliometric study using consolidated Meta-analytical Theory

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Abstract

Objective: To understand the contribution of urban forestry to the promotion of public security through a systematic integrative review of studies involving the relationship between urban forestry and crime.
Methodology: The documents were extracted from the Web of Science database and analyzed using consolidated meta-analytical theory (CMAT).
Relevance: Brazil is a country with high urbanization rates, where large cities have visible social inequality and high environmental degradation. Urban forestry provides ecosystem services that can mitigate various problems in the urban environment. However, there are few studies on the social aspects of urban vegetation. Moreover, there are no studies on the contribution of forestry to the promotion of public safety in Brazil.
Results: A total of 198 studies were found: 66% were published in the last five years, and their main language was English. The affiliations of the most prominent authors and research funding agencies are in the United States of America, which is also the country with the highest number of publications, 46.9%. The most cited article shows that trees with tall crowns and low vegetation contribute to a reduction in crime. The main research fronts denote an interest in understanding the social aspects of urban forestry.
Theoretical/methodological contributions: This study fills a gap by presenting a theoretical overview of studies related to urban forestry and crime using CMAT.
Social contributions: This study is intended to spark novel discussions in Brazil on the role of urban forestry in the promotion of public security.

Keywords: Environment. Urban green areas. Public policies. Crime.

Arborização urbana e segurança pública: um estudo bibliométrico por meio da Teoria do Enfoque Meta Analítico consolidado

Resumo

Objetivo: Entender a contribuição da Arborização Urbana na promoção da segurança pública, por meio de uma revisão sistemática integradora dos estudos, que envolvem a relação entre Arborização Urbana e Criminalidade.
Metodologia: Os documentos foram extraídos da base de dados Web of Science e analisados por meio da Teoria do Enfoque Meta Analítico Consolidado (TEMAC).
Relevância: O Brasil é um país com altos índices de urbanização, e as grandes cidades possuem visíveis desigualdades sociais e elevada degradação ambiental. A Arborização Urbana fornece serviços ecossistêmicos que podem mitigar diversos problemas do meio urbano. Entretanto encontram-se

poucas pesquisas referentes aos aspectos sociais da vegetação urbana. Sobre a contribuição da Arborização, para a promoção da segurança pública, inexistem trabalhos no Brasil.
Resultados: Encontraram-se 198 trabalhos, 66% das publicações foram dos últimos cinco anos, e o idioma principal o inglês. As filiações dos autores de maior destaque e as agências financiadoras de pesquisa são dos Estados Unidos da América, sendo, também, o país com maior número de publicações, 46,9%. O artigo mais citado mostrou que árvores de copas altas e baixa vegetação, contribuem para a diminuição da criminalidade. Os principais fronts de pesquisa denotam interesse em entender os aspectos sociais da Arborização Urbana.
Contribuições teórico/metodológicas: O trabalho preenche uma lacuna, ao apresentar um panorama teórico das pesquisas relacionadas à Arborização Urbana e Criminalidade, utilizando a TEMAC.
Contribuições sociais: O estudo, pretende ser um incentivo, para o início da discussão no Brasil sobre o papel da Arborização Urbana, na promoção da segurança pública.

Palavras-chave: Meio ambiente. Áreas verdes urbanas. Políticas públicas. Crime.

Forestación urbana y seguridad pública: un estudio bibliométrico utilizando la Teoría del Enfoque Meta Analítico consolidado

Resumen
Objetivo: Entender la contribución de la Forestación Urbana en la promoción de la Seguridad Pública, mediante una revisión sistemática, integrando estudios que involucren la relación entre la forestación urbana y la delincuencia.
Metodología: Los documentos se extrajeron de la plataforma Web of Science y se analizaron utilizando la Teoría del Enfoque Meta Analítico Consolidado (TEMAC).
Relevancia: Brasil es un país con alta urbanización y las grandes ciudades tienen desigualdades sociales visibles y alta degradación ambiental. La forestación urbana proporciona servicios ecosistémicos que pueden mitigar varios problemas en el entorno urbano. Hay poca investigación sobre los aspectos sociales de la vegetación urbana. Sobre la contribución de la forestación a la promoción de la seguridad pública, no hay obras en Brasil.
Resultados: Se encontraron 198 trabajos, siendo que 66% fueron de los últimos cinco años y el idioma principal fue el inglés. Las afiliaciones de los autores y agencias de financiación más destacadas son de los Estados Unidos de América, que tiene el 46,9% de las publicaciones. El artículo más citado mostró que los árboles con copas altas y vegetación baja contribuyen a la reducción de la delincuencia. Los principales frentes de investigación denotan interés por comprender los aspectos sociales de la forestación urbana.
Contribuciones teóricas/metodológicas: El trabajo llena un vacío al presentar un panorama teórico de la investigación sobre la forestación urbana y el crimen, utilizando TEMAC.
Contribuciones sociales/para la gestión: El estudio pretende fomentar el debate en Brasil sobre el papel de la forestación urbana en la promoción de la seguridad pública.

Palabras clave: Medio ambiente. áreas verdes urbanas. Políticas públicas. Crimen.

Introduction

The growth of the urban population in Brazil occurred quickly and without planning. The nation's scenario as a rural country in 1920 was modified by the intensification of industrialization in its urban centers, by the increase in sanitary quality improvements in its cities and the need for labor (Portela & Vesentini, 2004). Another important factor was agricultural mechanization; small farmers, who were rendered unable to compete in the market moved to cities in search of better job opportunities (Wanderley, 2014).

In 1960, there was a reversal in terms of the places of residence in the country; more than 50% of the population was now living in urban areas (IBGE, 2021). This scenario has

been consolidated; in the 2010 census, Brazil's urban population totaled 160,925,804 people, approximately 84%, while only 29,829,995 people, 16% of the population, lived in rural areas (IBGE, 2010). The Southeast region had become the most urbanized with a 93% urban population, followed by the Central-West with 90% and the South with 86% (IBGE, 2015).

This population increase has resulted in large urban centers with a heterogeneous supply of goods and services, visible social inequalities, exclusionary public environments and high levels of environmental degradation. The removal of vegetation and soil waterproofing have caused numerous adversities, challenges for the managers of large cities (Carvalho, 2020).

An important tool for mitigating these various problems is quality urban forestry in a city. Urban forestry formed by green areas (squares, parks, botanical gardens and other green infrastructures) and street forestry (trees on sidewalks and central beds) provides several ecosystem services, such as noise reduction (Oliveira et al., 2018), heat island and extreme temperature alleviation (Erlwein & Pauleit, 2021), improved thermal comfort (Martini, Biondi & Batista, 2019), surface runoff reduction (Locatelli et al., 2017), pollution reduction (Lei et al., 2021) and increased spaces for leisure and recreation (Salgado et al., 2020).

However, the exponential removal of vegetation and the lack of planning for the insertion of urban forestry in cities have prevented their populations from enjoying a right guaranteed in the Constitution: "Everyone has the right to an ecologically balanced environment, a good for the common use of the people and essential to the healthy quality of life, imposing on the government and the community the duty to defend and preserve it for present and future generations" (Constitution of the Federative Republic of Brazil of 1988, 1988, Art. 225).

The realization of rights, or citizenship, whether civil, political or social, is performed by public policies. Such policies are the actions of the state to resolve problems of a collective nature that directly or indirectly affect the entire population in a given country. Thus, goods and services are distributed according to the demands of society and are implemented and effected by the state (Souza, 2006; Gianezini et al., 2017; Estevão & Ferreira, 2018).

One of the essential services demanded by society concerns security. The Public Security Policies established in Brazil in the 1960s focused on the defense of the state and the political and social order (Silvares, 2019). However, security extends beyond policing actions; it involves social, environmental and economic aspects, whereby actions integrated into various processes are necessary to keep a population safe (Milkiewicz, Philippi & Damacena, 2020).

Urban forestry can contribute to public security policy, impacting the quality of life of a population. Initial research sought to understand how vegetation impacts the emotional disorders that are considered psychological precursors of violence, e.g., mental fatigue—

responsible for increased irritability—lack of focus or mood outbursts. Studies have shown that urban green areas, such as squares, parks, gardens and urban vegetable gardens, associated with quality street trees foster leisure spaces, which, in turn, stimulate outdoor activities, increasing interactions (Faber Taylor & Kuo, 2009; Van den Berg et al., 2015).

The fear of crime, measured by a population's sense of security, relates to the social cohesion and collectivity existing in a given location. Studies show that more cohesive neighborhoods, where neighbors know the people who walk on the streets, imply feelings of safer environments among their residents. Flows of people and well-maintained green spaces tend to inhibit criminal activity, as they increase street surveillance. A lack of collective action in a neighborhood favors the seclusion of people in their homes, making it more difficult for their neighborhood to distinguish regulars from passers-by, affecting how individuals perceive the safety of their neighborhood (Mahrous, Moustafa & El-Ela, 2018).

Some researchers have sought to understand the relationship between crime rates and wooded areas. Older theories suggested that the removal of urban vegetation is a way to combat crime. This method was used in 1825 by English King Edward I when he forced landowners near highways to remove trees to reduce theft in the region (Kuo & Sullivan, 2001). However, the results of have studies have shown just the opposite, i.e., forestry contributes to a reduction in crime rates, increasing the feeling of security. In an evaluation of crime statistics in Portland, after planting more trees, a reduction in violent crimes was observed, suggesting that the inclusion of new trees on streets in impoverished neighborhoods may be one solution for reducing their index of violence (Burley, 2018). The crimes of robbery, arson, burglary (Kuo & Sullivan, 2001), and theft (Carriazo & Tovar, 2016) as well as property crime (Ye, Che & Li, 2018) and homicide (Escobedo et al., 2018) also occur at lower rates in more wooded areas.

In Brazil, most studies on urban forestry have focused on vegetation with an ecological lens to identify and quantify the diversity of this vegetation. Studies related to social aspects, such as environmental perception, social justice, health, well-being and safety, are still limited (Barona et al., 2020).

Regarding whether urban forestry is an element that contributes to public safety and crime reduction, most relevant studies have been conducted in North America and Europe. Brazilian territory is highly urbanized, and large urban centers have high crime rates. There is thus a need for studies on this subject in the Brazilian reality because quality urban forestry allows improvements in a population's quality of life across social, environmental and economic aspects. The objective of this study is therefore to understand the contribution of urban forestry to the promotion of public security through a systematic integrative review, based on consolidated meta-analytical theory (CMAT), of the literature concerned with the relationship between urban forestry and crime.

Methodology

This exploratory study involved a quantitative approach based on CMAT, an integrative systematic review method (Mariano & Rocha, 2017). CMAT incorporates qualitative, integrative and systematic review. The method consists of three stages: Stage 1. Research preparation; Stage 2. Presentation and interpretation of the data; Stage 3. Detailing, integrative modelling and validating with evidence.

Stage 1

The *Web of Science* database was selected for locating relevant research. This database is a highly relevant citation bank, containing information of a multidisciplinary nature (Liu, 2019). The platform comprises publications from 21,000 peer-reviewed academic journals and 205,000 conference proceedings and more than 104,000 editorially selected books (Clarivate Analytics, 2021).

The selected search terms were variations of the central theme, urban forestry, and the Boolean operator AND was used to combine this with the theme crime. Thus, the terms used were *green space* AND *crime*; *vegetation* AND *urban* AND *crime*; *street tree* AND *crime*; *urban forestry* AND *crime*; *urban forest* AND *crime*. The criteria we adopted were as follows: in the field filter, the search term “All fields” was chosen because it allows a user to easily find search terms in any field; for the period of publication, no filter was selected to query the entire timespan of the database—76 years, from 1945 to August 2021; and, finally, there were no limitations for document types, languages or research areas. Data extraction into .txt format was performed on the platform itself.

Stage 2

This stage was based on a survey of the 11 items determined by CMAT, based on the following principles/laws that govern bibliometrics: Brandford's Law, which measures the relevance of a journal in a given area of knowledge; the Law of Literature Obsolescence, which estimates the decline of records in a given area of knowledge; the Law of Elitism and Law of 80/20, which identify the elite in a given topic; and Lokta's Law, which explains authors’ degree of relevance (Mariano & Rocha, 2017).

The following 11 items are based on the results of queries on the *Web of Science*: 1. Analysis of the most relevant journals; 2. Analysis of journals that published the most research on the subject; 3. Evolution of the theme, year by year; 4. Authors who published the most research vs. authors who were the most cited in research; 5. Most cited documents; 6. Countries that published the most research; 7. Conferences that contributed the most research; 8. Institutions that published the most research; 9. Agencies that funded the most

research; 10. Areas that published the most research; and 11. Frequency of keywords. Analysis of the last item entailed the use of *TagCrowd,* a free text analysis tool that indicates the frequency of terms and generates word clouds (TagCrowd, 2021).

Step 3

The objective of detailing was to integrate the main contributions of the literature by bibliographic coupling, which represents the main contributions (research fronts), and cocitation, which represents the main lines of research within the theme. For these analyses, *VOSviewer* version 1.6.15, a software tool for the construction and visualization of bibliometric networks, was used. The creations of the networks, the views of the layouts and the adjusted clusters of networks were constructed; later, the views were saved as a PNG image.

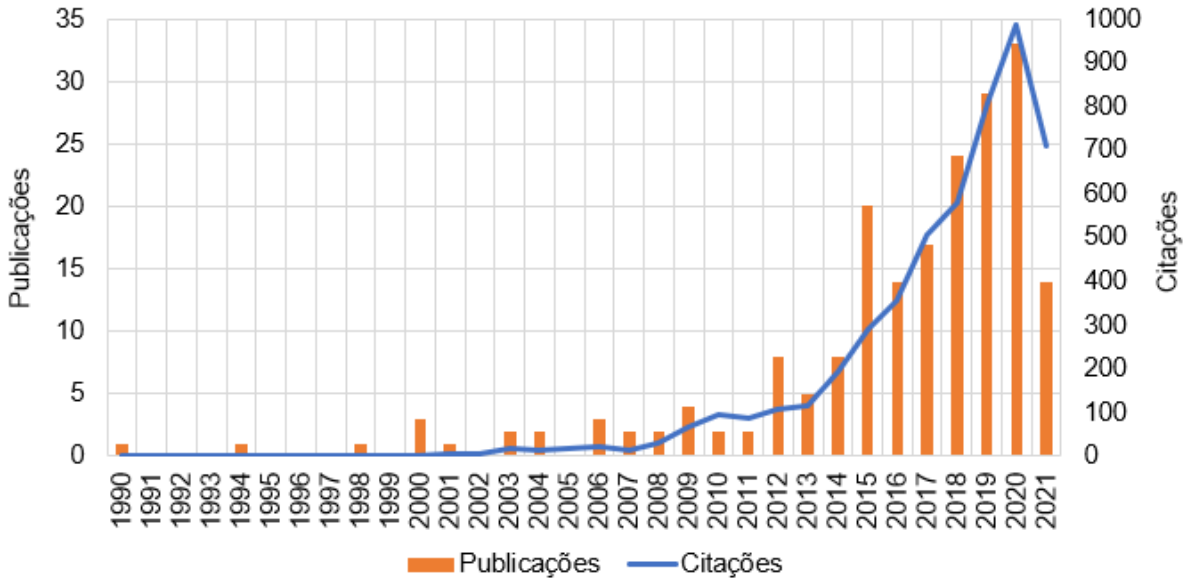
Results and discussion

Presentation and interrelationship of data

On the *Web of Science,* 198 results with all the terms were found, 185 of which were articles. The oldest document was from 1990, and although the period selected for the study spanned 76 years, academic discussion on the subject is recent. In 2012, there was an increase in publications, totaling eight documents. However, after 2016, this growth was continuous—from 14 to 33 publications in 2020, and in 2021, 16 publications as of August. Notably, 66% of the found articles were published in the last five years (Figure 1).

Figure 1

Number of publications and citations related to urban forestry and crime as of 2021 found on the Web of Science



Source: *Web of Science* (2021), adapted by the author.

The increase in publications in recent years is mainly due to global guidelines that advocate the need for cities to be more forested and sustainable (Food And Agriculture Organization of The United Nations & Arbor Day Foundation, 2021; Mit Senseable Lab & World Economic Forum, 2021; United Nations, 2021), as well as to the increase in technologies that allow the use of spatial analysis software and enable easily obtaining images—information necessary for understanding the relationship between urban vegetation and crime (Cracknell, 2019).

The total accumulated citations, over 31 years, was 5,019; 92.3% of this total lacks self-citation. The most cited article, 596 times, was written by Frances E. Kuo and William C. Sullivan in 2001. The work is entitled *"Environment and crime in the inner city - Does vegetation reduce crime?*" and was conducted in a housing project in Chicago, United States of America (USA). The authors evaluated crime reports provided by the police, aerial photos and interviews with residents. Their analysis of 98 buildings via the regression method resulted in negative correlations for tree and grass density, i.e., trees with high crowns and low shrubs do not facilitate crime and, in some situations, could even inhibit crime in the central districts of the focal city (Kuo & Sullivan, 2001).

Previous studies have shown that vegetation is associated with an increased fear of crime and a sense of insecurity (Nasar & Fisher, 1993; Michael, Hull & Zahm, 2001). Following the work of Kuo and Sullivan (2001), other researchers delved into the subject to better

understand the relationships among the various types of urban vegetation and crimes through different methodologies, e.g., the influence of the structures and social aspects in urban spaces, such as lighting, urban vegetation management, and socioeconomic structures.

The second most cited article, 326 times, was written by Kuo and Sullivan and Rebekah Levine Coley and Liesette Brunson. This research, *"Fertile Ground for Community: Inner-City Neighborhood Common Spaces*", explores the formation of certain neighborhood social ties that imply social cohesion and the sense of security among residents and the factors that interfere with their formation. Their results show that places where there are more green spaces attract people to outdoor activities, enabling casual social encounters between neighbors while promoting the development and strengthening of social ties in their neighborhood (Kuo et al., 1988).

Studies that involve urban vegetation and social aspects, such as crime, have a multidisciplinary character because several aspects can affect this relationship—lack of public lighting, quality of public green areas and urban forestry, location of these spaces, etc. Studies on this topic have involved interactions of researchers from different areas of knowledge, such as health, computing, engineering, architecture, landscaping, criminology, sociology, and agricultural science, to study its various aspects (Zuniga-Teran & Gerlak, 2019).

The five authors who have published the most research on the subject have each published four articles. Muriel Droomers and Karien Stronks are professors at the Department of Public Health, University of Amsterdam, Netherlands, and their research investigates green spaces, health, fear of crime, social cohesion and environmental stressors (Agyemang et al., 2007a, 2007b; Jongeneel-Grimen et al., 2014; Hunter et al., 2019 b; Generaal et al., 2019). Aleksandra Lis is a professor at the Institute of Ethnology and Cultural Anthropology at Adam Mickiewicz University, Poland. Her studies focus on the relationship between urban vegetation and the feeling of security and fear of crime (Lis, Pardela & Iwankowski, 2019; Lis et al., 2019; Lis, Zalewska & Iwankowski 2019; Lis & Iwankowski, 2021). J. Morgan Grove is a leader in the *USDA Forest Service*, *Northern Research Station*, USA, and has discussed crime, social justice and urban vegetation (Troy & Grove 2008; Troy, Grove & O'Neil-Dunne, 2012; Schwarz et al., 2015; Troy, Nunery & Grove, 2016). Social scientist Michelle C. Kondo works at *Communities and Landscapes of the Urban Northeast*, USA. Kondo's studies address topics such as crime and the environment, the relationship between tree cover and firearms, urban health and safety (Kondo, South & Branas, 2015; Locke et al., 2017; Kondo et al., 2017; Kondo et al., 2017; Kondo et al., 2017; Kondo et al., 2017). al., 2018).

The research areas that have been most relevant in terms of number of publications are the ecology of environmental sciences (100 records), urban studies (60) and occupational environmental public health (43). Of the conferences, the *International Conference on Urban*

Forestry and Forest Preservation, the *International Conference on Sustainable Planning and Development* and the *International Conference on Urban Horticulture* are the most relevant.

The journals with the highest impact factor (JCR) were determined by taking into account all the relevant categories in the 198 studies. These journals are *New England Journal of Medicin* (JCR 91,245) and *Lancet* (JCR 79,321) in the medicine category, and *Morbidity and Mortality Weekly Report: Surveillance Summaries* (JCR 58,769) in the public, environmental and occupational health category, since none of the works found were published in these journals. While some studies were published in these journals, those with the highest JCR have not yet paid due attention to the topic because, in addition to it being a little explored subject, it is outside their main scope.

The journals that published the most research were *Urban Forestry Urban Greening* (JCR 4,537) with 27 publications; *Landscape And Urban Planning* (JCR 6,142) with 21; and the *International Journal of Environmental Research and Public Health* (JCR 3,390) with 14. Despite their varying impact factor, the journals with a higher JCR have published the most research and are thus references on the subject; they are highly desired by authors for publication. Notably, urban forestry and its health benefits is a recent subject, requiring more relevant research to better understand this relationship.

The main language in the identified publications is English (196 studies). In addition to their language being used in most research for the dissemination of science, the USA and Canada lead the rankings for most publications—57% of the studies (Table 1).

Table 1

Top countries with publications on urban forestry and crime found on the Web of Science, as of 2021

Ranking	Countries	Publications	%
1º	USA	93	46.9
2º	Canada	20	10.1
3º	Australia	18	9
4º	England	16	8
5º	China	14	7

Source: *Web of Science* (2021), adapted by the author.

The three main funding agencies have been from the USA: the *United States Department Of Health Human Services* with 14 funded studies, the *National Institutes of Health* (Nih USA) with 13, and the *National Science Foundation* (NSF) with 12. Among the top 50 funding agencies, there are no Brazilian initiatives, indicating the need for investment in salient research in Brazil.

Regarding the affiliations of authors who wrote the most identified studies, the *United States Department of Agriculture* (USDA) and the *United States Forest Service* are affiliated with 17 publications each, and both are from the USA.

To visualize the lines of research that deal with the central theme of urban forestry and crime, the keywords in the 198 focal documents were selected and then inserted into the *TagCrowd* tool. This online software created a word cloud in which the font size of each displayed word is proportional to its number of citations. The map shows the 50 words with the highest frequencies (Figure 2). The terms used to perform the search were excluded from the keywords for a better diagnosis and visualization of the focal topics.

Figure 2

Word cloud of the frequency of keywords used in identified publications on the Web of Science, as of 2021, on the subject urban forestry and crime

Source: Research Data (2021).

The words "*environment*" (101), "*health*" (76), "*fear*" (56), "*neighborhood*" (52), "*parks*" (48), "*safety*" (45) and "*perceptions*" (42) are the most representative. These words are associated with the initial studies on how a population associates vegetation with the fear of crime. The relevant authors have found that more vegetated areas stimulate physical activity and leisure, resulting in greater interactions within a neighborhood. The perceptions of residents on their sense of security, the most applied method to measure the fear of crime,

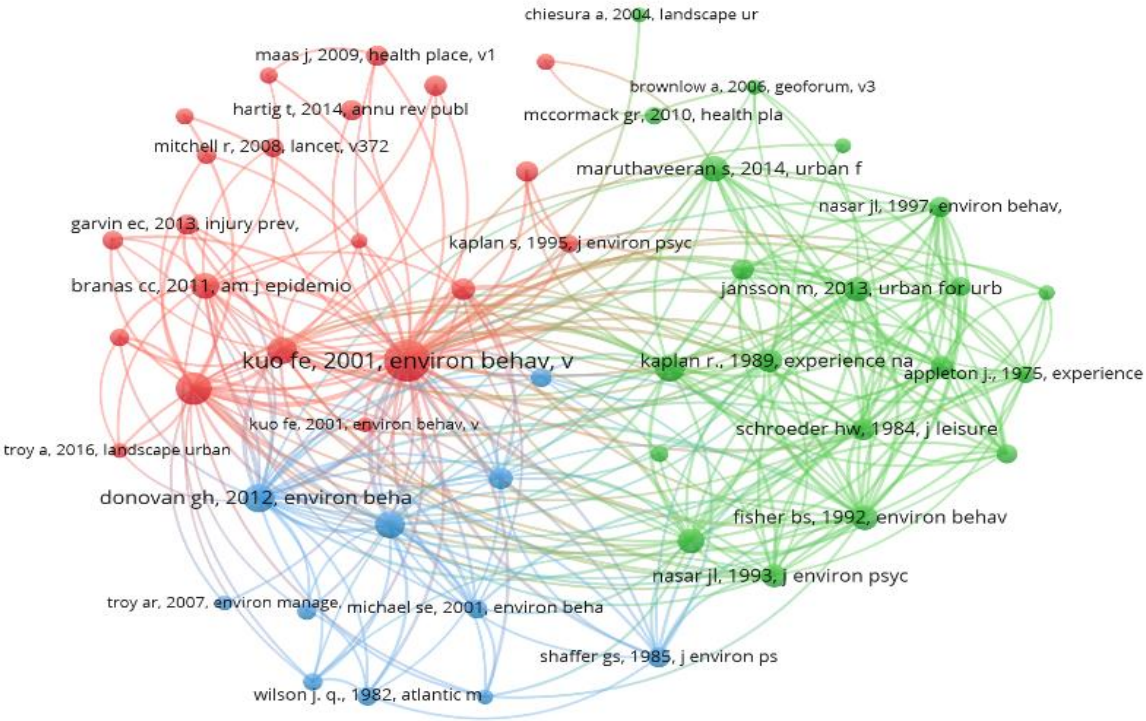
was the object of study for several authors. More recent studies have addressed forestry and its contributions to improvements in health, physical and mental “physical-activity” (29), “physical” (27), and “stress” (19). The presence of keywords in discussions more focused on the social sphere—“social” (39), “justice” (21) and “accessibility” (20)—is also notable. This analysis thus shows that the literature has been concerned with the needs of urban populations, increasingly seeking to improve their quality of life. In addition, there is an interest in the use of urban forestry as a tool for promoting health and social justice, in addition to its ecosystem benefits.

Detailing, integrative modelling and validation with evidence

VOSviewer was used to identify topics that had already been studied in regard to the search terms. This tool allows the construction of a cocitation map to verify the articles in the bibliographic references of the 198 identified studies that have been regularly cocited. With the map, it is possible to establish the approximations and similarities of the most cited studies and their main contributions or theoretical approaches. The grouping of these references consisted of 52 items divided into three clusters (Figure 3).

Figure 3

Cocitation map of the theme urban forestry and crime in studies on the Web of Science as of 2021



Source: Research Data (2021).

Cluster number 1, colored red, contains 21 studies and has the highest concentration of citations on the map. The seminal study of Kuo and Sullivan (2001) is highlighted because it is the most cited study in regard to the relationship between forestry and crime. The other two articles that appear with larger spheres are works that express the ideas defended by Kuo and Sullivan. The first article evaluates the relationship between tree canopies and crime rates, finding a negative correlation, i.e., less crime occurs in more wooded areas (Troy, Grove & O'Neil-Dunne, 2012). The second concludes that when vacant lots are recomposed with well-kept vegetation, they can reduce crime and promote some aspects of health (Branas, et al., 2011).

The second, green cluster contains 20 studies. The most relevant research addresses preferences for vegetation type and the feeling of security. The cluster's authors have found that trees and grasses that receive constant maintenance increase the feeling of security among residents (Kuo, Bacaicoa & Sullivan, 1998). Two other articles that stand out discuss the fear of crime and its relationship with urban green spaces and external characteristics (Nasar & Fisher, 1993; Maruthaveeran & van den Bosch, 2014). Jack L. Nasar, in the field of psychology, specifically, environmental psychology, has three studies in this cluster: "*A Model Relating Visual Attributes in the Residential Environment to Fear of Crime"* (Nasar, 1981), "*Proximate physical cues to fear of crime"* (Nasar & Fisher, 1993) and "*Landscapes of Fear and Stress"* (Nasar & Jones, 1997*).* The initial research on the subject focused on whether urban vegetation is associated with the fear of crime and a sense of security.

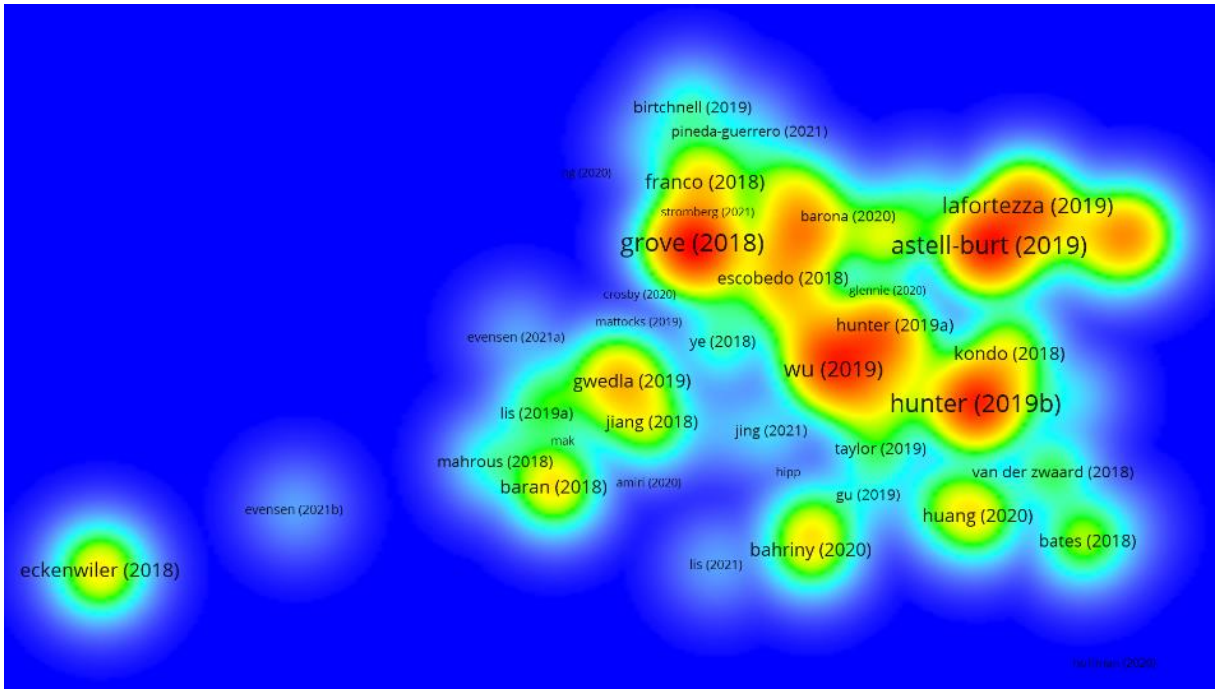
The third *cluster*, in blue, contains 11 studies, a much smaller number than the first two. The book *"The Death and Life of Great American Cities*" appears to have received the highest number of citations. The subject it addresses is urban planning in the 20th century, offering a critical view of modernist urban policies, which the author blames for decline in urban neighborhoods in the USA, instead proposing a new vision of organic urban life (Jacobs, 1961). Another highlight is an article that evaluates street forestry and trees in lots. It shows that trees on public roads are associated with lower crime rates. However, the results on trees in house lots are mixed; smaller trees that obstruct vision are associated with increased crime, while larger trees are associated with reduced crime (Donovan & Butry, 2010). Also included in this cluster are *"Environmental Factors Influencing Auto Burglary: A Case Study*", published in 2001 (Michael, Hull & Zahm, 2001), and a study by Frances E. Kuo published in 2003, *"The Role Of Arboriculture In A Healthy*" (Kuo, 2003). These authors are always cited together because their ideas are opposed. While the first study suggests that the removal of vegetation from a park can control the crimes that occur there, the second finds that trees with high crowns, shrubs and grasses actually reduce crime rates.

Bibliographic coupling was also performed in *VOSviewer* with a heatmap that shows the main research fronts (Figure 4). Specifically, articles published between 2018 and 2021,

i.e., 100 documents, were selected. Notably, the use of long periods cannot adequately identify the focuses in recent discussions (Glänzel & Thijs, 2012; Zupic & Čater, 2015).). This analysis thus compared authors who cite the same literature; that is, it revealed what approaches are currently gaining strength. That is, it demonstrates how the authors discuss related topics.

Figure 4

Bibliographic coupling density map of the theme urban forestry and crime in studies on the Web of Science, as of 2021



Source: Research Data (2021).

On the map, the concentrations of red spots are stronger for Grove et al. (2018), Wu et al. (2019), Astell-Burt & Feng (2019) and Hunter *et al.* (2019 a). All these articles focus on some of the social aspects of urban forestry, e.g., vegetation as an instrument of social inequality, the association between urban vegetation and mental health, the environment and physical activity, and satisfaction with the urban green domain.

These results show that the research on urban forestry shifts with global demands. Mental health problems, such as depression and anxiety, are becoming increasingly common. The increase in technology use, consumption of processed foods and ease of displacement have contributed to the increase in obesity and related health problems (Sales, Costa & Gai, 2021).

The theme of crime and public security is of paramount importance in Brazil. Hopefully, researchers from various areas of knowledge can effectively respond to the demands of this

population via studies that analyze the relationship between urban forestry and public security at the national level.

Conclusion

This study has investigated how urban forestry can contribute to public security by exploring the literature on the relationship between urban forestry and crime. Specifically, articles published in journals indexed in the *WoS* database were analyzed through an integrative systematic review based on CMAT. Examining the 198 identified publications, covering a period of 31 years (from 1990 to 2021), has allowed us to show that the number of studies that correlate urban forestry with crime and/or public safety is still low. However, in the last decade, there has been an increase in the number of publications—since 2016, this increase has been continuous.

The USA leads the ranking of focal publications due to its incentives for research on this topic. Among the top 50 funding agencies with the largest identified publications, the top three are from the USA; Brazilian initiatives are absent.

Our results also show that the seminal study of Kuo and Sullivan (2001) is still relevant in the general literature because its results have both inspired and justified the development of other relevant studies. Based on the frequency of keywords, the main interest in the initial studies was the perception of a population on the feeling of security; more recent studies have addressed forestry and its contributions to improving the quality of life, physical and mental health and social justice.

The main research fronts we have identified denote an interest in the social aspects of urban forestry, such as the use of vegetation as an instrument of social inequality, the association of urban vegetation with mental health, the relationship of environment and physical activity, and the satisfaction with urban greenery; collectively, these demonstrate that authors are committed to addressing current research gaps.

Notably, there is an ongoing need to research this subject in Brazil; we found no studies on the relationship between Brazilian urban forestry and crime or public security.

Finally, by using CMAT, it was possible to map the literature by identifying the most relevant studies in a given area. For a future agenda, we recommend applying the expanded CMAT to evaluate other databases.

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